



US14/US83/SD34 Missouri River Bridge Report of Findings



Missouri River Bridge US14/US83/SD34
State Project (SP) 410540

November 23, 2016
Initial Issue (I-1)

REVISIONS:

Project: South Dakota Department of Transportation
 US14/US83/SD34 Missouri River Bridge Replacement Study
 State Project (SP) 410540

Document: Report of Findings

Revision	Date of Issue	Description
D-1	May 3, 2016	Draft Issue
D-2	July 7, 2016	Draft Issue
D-3	September 12, 2016	Draft Issue
I-1	November 23, 2016	Initial Issue

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The preparation of this report has been financed in part through grant(s) from the Federal Highway Administration and Federal Transit Administration, U.S. Department of Transportation, under the State Planning and Research Program, Section 505 of Title 23, U.S. Code. The contents of this report do not necessarily reflect the official views or policy of the U.S. Department of Transportation.

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Missouri River Bridge– South Dakota Department of Transportation
Report of Findings

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EXECUTIVE SUMMARY

The US14/US83/SD34 Bridge over the Missouri River between Pierre and Fort Pierre, South Dakota is a non-redundant haunched steel plate girder bridge, built in 1962. The replacement of the US14/US83/SD34 Bridge is identified in the South Dakota Department of Transportation's (SDDOT's) long-range development plan, with the preliminary replacement study scheduled to be completed in conjunction with the Environmental Assessment document for the project in 2016. The final design and construction of the bridge is programmed for 2017 to 2024.

In the City of Pierre, the existing roadway geometry, recent development activities, waterfront trail system and local access were key factors in developing alternatives. The existing, core roadway system is laid out in a grid-like network. However, much of the grid network is skewed to follow the direction of the Missouri River. The skewed and un-skewed systems generally intersect along Elizabeth Street (and also outside the study area along Broadway Avenue and East Capitol Avenue). While this posed a challenge it also provided a tremendous opportunity to develop solutions which addressed access to neighborhoods, businesses, parks, trails and the waterfront.

In Fort Pierre, the roadway system is less extensive and somewhat less developed, but still exists in a grid-like pattern generally parallel to the River. Some of the significant challenges include the 90-degree curve of Highway 83, and the intersection of Highway 14/34. Access to the local road network, local businesses and the waterfront and trails were equally important.

After a detailed study of many alignments and their related influence on providing all movements between US83 and US14/SD34, and access to the area of interest, one alignment was selected as being superior. The selected alignment N1.1:

- Maintains full access to adjacent commercial properties
- Allows for maintenance of traffic on existing bridge during construction of new bridge
- Maintains access for all movements between US83 and US14/SD34; and
- Minimizes right-of-way acquisition near the bridge approaches

The bridge type selection process used a three-tiered approach in which a multitude of alternatives were developed and gradually dropped from consideration once it was determined that they were not as viable as those being carried forward. Eight bridge types with twenty cross-section alternatives were developed for the Tier 1 Conceptual Options. Of these designs, three bridge types were carried forward to the Tier 2 Evaluation with one section to be further refined. These included a parallel flange steel plate girder, a haunched flange steel plate girder, and a spliced prestressed concrete girder. The Tier 2 Evaluations included structural analysis and structural feasibility assessments of the remaining alternatives as well as detailed cost investigations, including both initial cost and life cycle costs derived from routine maintenance and inspection functions for the expected life span of each bridge alternative. The alternatives were evaluated with a non-weighted and weighted scoring matrix that accounted for various factors including interface of bridge and roadway, cost, visual aesthetics, inspection and maintenance effort and environmental impacts.

Based upon the results of the Bridge Workshop in the Tier 2 Evaluation, it was decided to carry ahead both the haunched flange steel plate girder design and the spliced prestressed concrete girder design. This was a unanimous decision by SAT participants at the Tier 2 Evaluation Bridge Workshop.

This decision was based on the bridge workshop criteria that included long term and routine maintenance, inspection effort, first cost, life cycle cost, design and construction issues. One of the major design issues discussed was the inclusion of bridge deck joints over pier locations. A concrete superstructure would likely require three deck joints to limit the length of post-tensioning, adding significant cost. A steel superstructure would require only joints at the ends of the deck at abutment locations. The estimated initial construction costs and the life cycle costs were found to be slightly higher for the concrete girder bridge alternative. The cost difference was further increased when parabolic haunched steel girders are utilized for all spans of the bridge.

In the Tier 3 evaluation of the concrete girder option, prestressed concrete girders were selected for lower costs and ease of inspection. Refinements were further made to the concrete girder option to consider the aesthetic aspects of the main spans of the structure. Considering the public input and favor towards haunched girders, the concrete girder option was refined as a part of the Tier 3 evaluation to include parabolic haunched girders over the main spans with parallel girders on the approaches to maximize the economics of the concrete option and keep it comparable to the steel option costs.

SECTION 1 PROJECT INFORMATION

1.1 Introduction

The existing the John C. Waldron Memorial Bridge (Structure No. 33-100-118) carries US Highways 14 and 83, as well as SD Highway 34 over the Missouri River between Fort Pierre and Pierre, SD. For consistency of terminology and to match local lexicon, this bridge will be referred to as the US14 Missouri River Bridge through this report.

Figure 1.1 View of Existing Bridge



The US14 Missouri River Bridge is a 10-span and 4-lane structure. It was opened in 1962 and has a total length of 1659 feet. The two main navigational spans are each 235'-0" long, with approach spans ranging from 109'-0" to 175'-6". The structure is divided into three units with lengths of 418 feet, 418 feet, and 820.5 feet – measured from west to east. The bridge's superstructure is comprised of a pair of haunched steel plate girder two-girder systems, while the substructure consists of multi-column piers on driven steel piles. Excerpts from the original plans showing the main bridge plan and elevation and cross-section are included in Appendix C.

There have been a few modifications to the bridge over the years, to improve function and durability. Some modifications include the addition of a sidewalk along the south edge, addition of a center median concrete barrier, reconfiguration of cross-frame diaphragms, and patching of the piers – especially the most easterly pier (Pier No. 10).

The bridge lies in the center of a prescribed study area. The study area boundary, defined in the scope of this study is illustrated in the figure below:

Figure 1.2 Study Area

The study area (**Fig. 1.2**) shows the S-curve approach to the bridge on the Fort Pierre side of the river, the city street grid, the Missouri River and portions of the nearby parks. Also sharing this approach corridor are residential housing and a variety of local business including banks and restaurants. A marina is planned for the future along the west bank of the river. East of the US14 Missouri River Bridge, US14/US83/SD34 continues into downtown Pierre. The existing steel bridge is being considered for replacement for two reasons. The bridge is reaching the end of its life and therefore is showing signs of deterioration and the two-girder structural system is non-redundant, and is deemed a fracture-critical structure. Additionally, the roadway approaches include undesirable curvature, the roadway section on the bridge does not include adequate shoulders and the pedestrian/bicycle facilities do not meet current standards for non-motorized mixed use trail design.

This report is intended to expand upon the decisions that were made as part of the practical range of bridge alternatives developed in the Environmental Assessment. These alternatives were developed according to the following project objectives:

- Meets local, state and federal design standards and relevant regulations.
- Provides capacity and enhances safety for projected traffic volumes and for those alternatives that include a bridge replacement option, provide strategies for future facility expansion.
- Maintains access to local destinations.
- Identifies the potential for impact to the documented social, economic and natural environments on or adjacent to the project site.
- Is consistent with state and local long-range transportation plans.

- Maintains traffic flow in the project area and minimizes delays to facility users during construction.
- Identifies a range of project options.

In addition to developing viable alternatives for the above project objectives, this report also addressed issues related to the following:

- Bridge No. 33100118 (NBI 58, 59, and 60) deck, super and sub conditions
- Bridge No. 33100118 (NBI 68) deck geometry - cross-section (shoulder capacity)
- Approach roadway geometrics
- Local business and waterfront access
- Sensitivity to the surrounding natural environment
- Encroachment on rest area land base
- Potential impact on historic and visual aesthetics

The primary purpose of this report is to present information regarding the development of alternatives, project opportunities and constraints, cost information – on both an initial and life cycle basis - and a basic summary of the selected type which is felt to best meet the project objectives and related project issues. **Table 1.1** list contacts for the Study Advisory Team (SAT) and Citizens Advisory Committee (CAC).

Table 1.1: Project Contacts

Study Advisory Team (SAT)	
Name	Entity
Mark Clausen	FHWA
Sonia Downs	SDDOT – Project Development
John Forman	SDDOT – Pierre Region
Todd Thompson	SDDOT – Bridge Maintenance Engineer
Steve Johnson	SDDOT – Chief Bridge Engineer
Steve Gramm	SDDOT – Project Manager
Mark Hoines	FHWA – Planning
Rick Hahn	City of Fort Pierre – Public Works
Tom Lehmkuhl	SDDOT – Administration
Mark Leiferman	SDDOT – Project Development
Leon Schochenmaier	City of Pierre – Administrator
Dean VanDeWiele	SDDOT – Pierre Area

Table 1.1: Project Contacts, Continued

Citizens Advisory Committee (CAC)	
Name	Entity
Dave Bonde	Fort Pierre Development Corporation
Laurie Gill / Mike Harmon	City of Pierre
Gloria Hanson	City of Fort Pierre
Dave Panzer	Pierre Police Chief
Tom Lee	Capital City Bicycle Club
Anne Lewis	Discovery Center / Pedestrian Issues
Ray Lewis	Great Lakes of SD Tourism Association
Scott Rounds	Pierre/Ft Pierre Exchange Club
Laura Carbonneau	Pierre Chamber of Commerce
Paul Lepisto	Izaak Walton League & SD Walleyes Unlimited
Family of Lt. Commander Waldron	Current Bridge Namesake Family
Rick Murray	Ramkota

1.2 Purpose and Need

The following is a summary of the Purpose and Need document related to the replacement of the US14 Missouri River Bridge crossing. A more detailed summary is included in the Environmental Assessment/Environmental Assessment Worksheet document (Ref. 1).

Bridge Structural and Maintenance Problems

- Built in 1962, the bridge's maintenance needs are increasing and becoming less cost-effective.
- Rehabilitation needs are compounded and complicated by the fact that the bridge lacks structural redundancy.
- Ultimately, replacement is needed to ensure long-term serviceability.

Bridge Shoulder Width

- Existing bridge reaction zones (shoulders) measure approximately two feet on the outside and two feet on the inside (center median barrier), which prevent their use by emergency vehicles and stalled vehicles.
- Disruption to the flow of traffic results when maintenance activities are performed from the bridge deck.

Roadway Geometry and Safety

- US14/US83/SD34 has an existing "S-Curve" jog on the western side of the bridge:

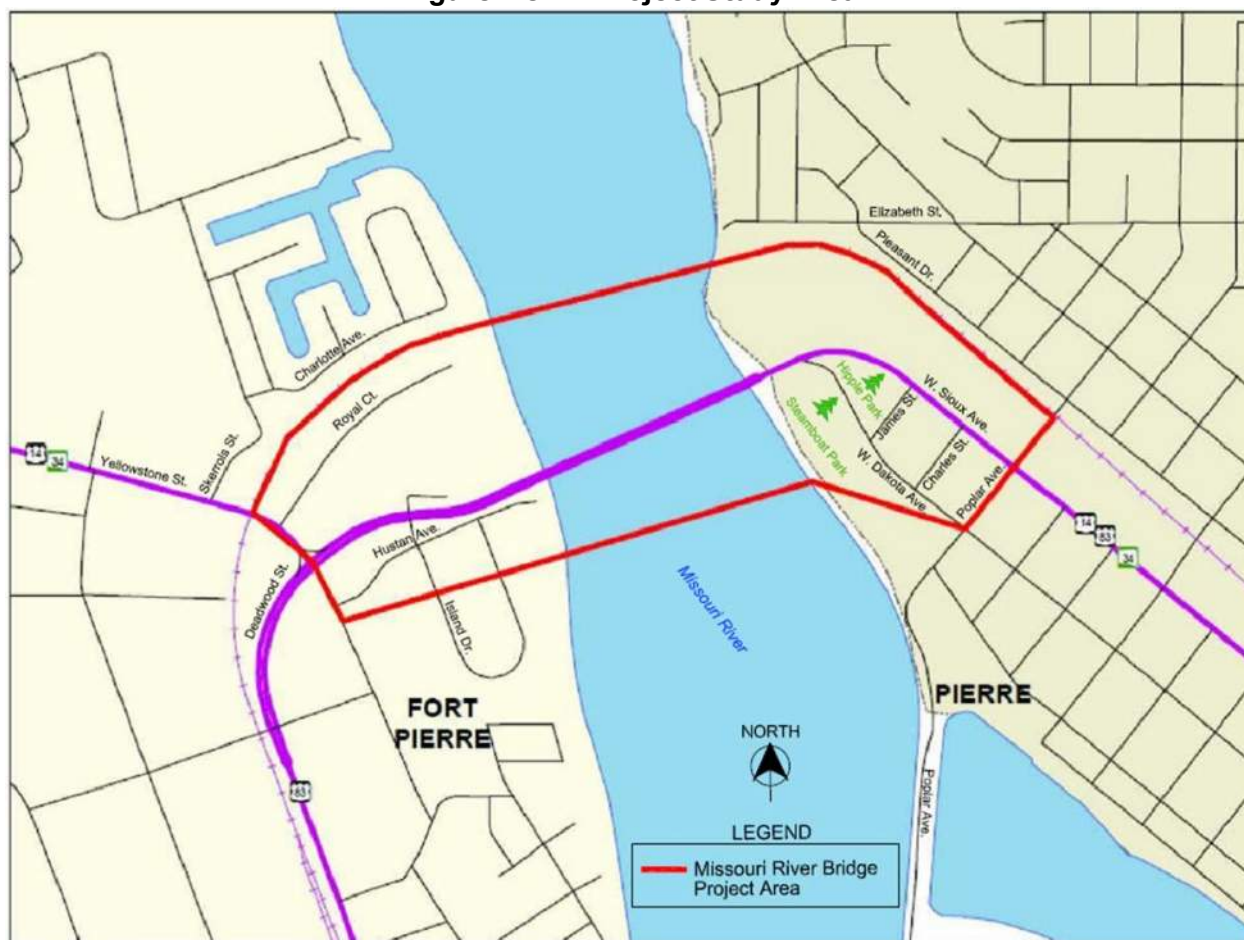
- These jogs create sight distance issues, reduce speeds and may lead to increased driver confusion in the area of the intersection.
- The jog can be effectively eliminated with a new bridge alignment located to the north of the existing location.
- There is a relatively sharp curve on the eastern approach to the existing bridge off Sioux Avenue and onto Dakota Street:
 - By locating the new bridge to the north of the existing location, these curves could be realigned resulting in less of an impact.

The existing 5 ft sidewalk reduces functionality and safety for pedestrians and bicyclists.

1.3 Study Area

The study area, as prescribed by the SDDOT in the RFP, includes the area surrounding the existing US14 Missouri River Bridge bounded in red in **Figure 1.3**, including the intersection of Deadwood Street and Yellowstone Street in Fort Pierre and the intersection of Sioux Avenue and Poplar Street in Pierre. The existing railroad bridge, tracks and at-grade railroad crossings comprise the northern boundary of the study area.

Figure 1.3: Project Study Area



1.4 Description of Bridge Alternatives Process

The development, advancement and selection of the preferred bridge alternative(s) was achieved using a three-tiered process. Each of these tiers was carried out in conjunction with a series of Community Advisory Committee (CAC) and Study Advisory Team (SAT) meetings and workshops. The purpose of the meetings and workshops was to present information to foster an informed decision making process. Each alternative was assessed on its ability to meet the study's Purpose & Need. A brief summary of the development of the criteria and the three tiers in the process is included below.

Criteria and Constraints

Prior to starting the three-tiered process, the study plan's methods and assumptions were established. The Methods and Assumptions document (Appendix A) lays out the methods and assumptions to be used, as well as establishing the performance criteria. These criteria consisted of essential "needs" of the replacement bridge as well as desirable "wants", which guided the development of new bridge types, sizes, locations and features. The replacement bridge performance criteria consisted of:

- Design life
- Navigation clearance requirements
- Anticipated design loads
- Preferred construction materials
- Span arrangement configuration
- Traffic capacities
- Pier protection needs
- Interface with the roadway alignment,
- Desired traffic capacity
- Bridge visual characteristics

Tier 1 – Bridge Concept Development (Tier 1 Evaluation)

During Tier 1, eight (8) potential bridge types were developed. The conceptual bridge types included:

- Steel Box Girder – parallel flange and haunched
- Steel Plate Girder – parallel flange and haunched
- Concrete Box Girder – parallel flange and haunched
- Prestressed Concrete Girder – parallel flange and haunched
- Steel Truss
- Tied Arch – concrete and steel
- Extradosed Cable Stayed
- Cable Stayed

Following meetings with the United States Coast Guard which resulted in the requirement to maintain a 30-foot vertical by 210-foot horizontal clearance, Tier 1 concepts targeted an approximate 230 to 295 feet main channel span. Construction costs, based on square foot estimates from other similar projects, were estimated. The pros and cons of the Tier 1 concepts were summarized. Concepts showing the most promise in meeting the overall

project goals were carried forward to a "Tier 2" evaluation.

Tier 2 – Bridge Concept Refinement (Tier 2 Evaluation)

The concepts identified in Tier 1 were further developed to include the following:

- Construction cost (based on estimated quantities and unit prices from historical averages)
- Life cycle cost estimate
- Construction schedule estimate
- Construction method description
- Discussion/comparison of advantages/disadvantages and risks associated with the alternatives
- Plan, elevation and typical section drawings of each
- Visual rendering of each
- Level of Maintenance and Inspection Effort

Tier 2 includes a structural analysis to assure the structural feasibility of each option and sufficient detail to develop major quantities. This step included quantity-based cost estimates, updated schedules and refined evaluation of other factors. The architectural development was initiated in this step with preparation of visual renderings. A single, preferred alternative was identified in Tier 2 and this was carried forward to Tier 3 for further development and refinement.

Tier 3 – Development of Preferred Bridge Option (Tier 3 Evaluation)

The Tier 3 evaluation was the final step of the type and location study. In this evaluation, bridge details, the span arrangement, and roadway/wall interface were finalized. The architectural details were finalized and the bridge type refined in this step.

1.5 Methods and Assumptions

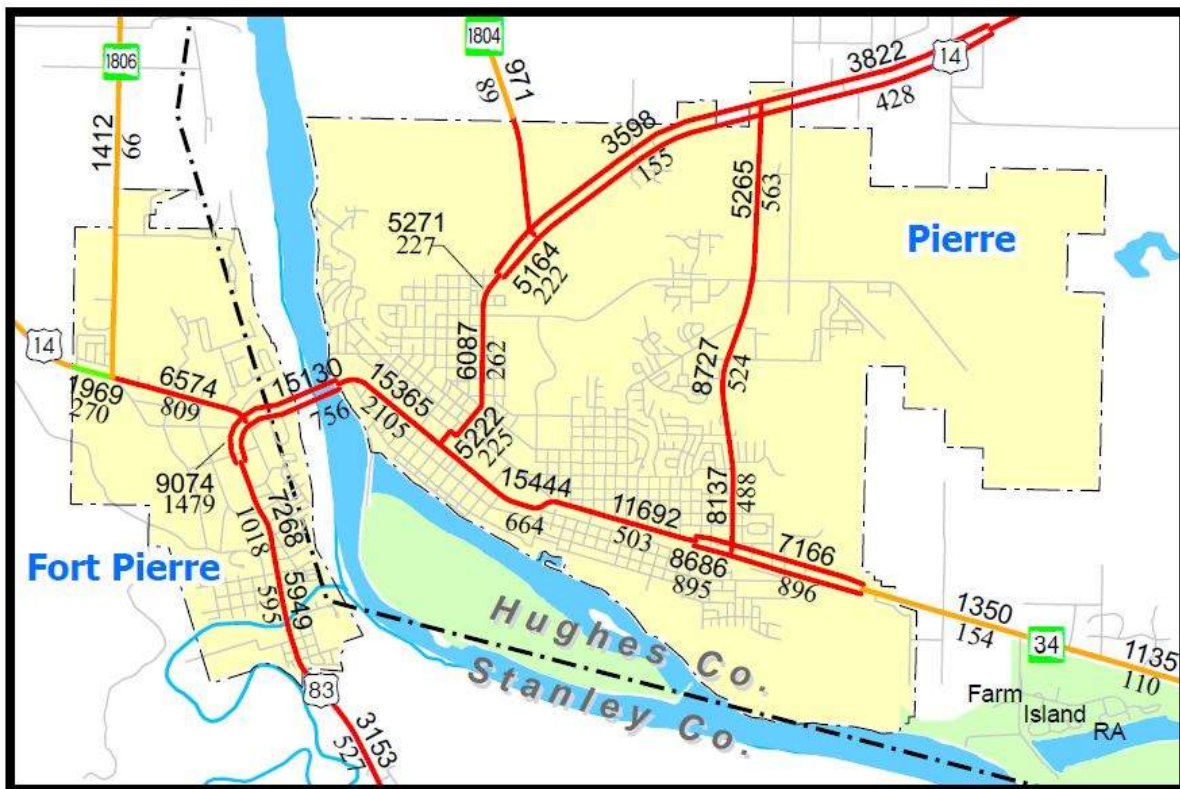
The URS Team worked with the Study Advisory Team (SAT) to establish the design criteria and Methods and Assumptions for the replacement alternatives. Methods and Assumptions prescribe the systematic approach with which each alternative addresses solutions to meet the project purpose and need. The document created a platform through which project planning and decisions could be more informed. Analysis and assessments for traffic operations, environmental impacts, bridge replacements, life-cycle costs were all performed based on the accepted criteria. An approved document of the Methods and Assumptions has been included in Appendix A.

SECTION 2 ROADWAY ASSESSMENT

The URS Team conducted a thorough analysis of the existing traffic operations within the study area. The analysis was based on the 2010 Highway Capacity Manual (HCM2010) methodology. The work included the collection of traffic data within the study area and from the SDDOT, an analysis of the existing traffic operations based on HCM2010, and a speed distribution study of the bridge corridor that determined the 50th and 85th percentile traffic speeds.

With the collected data, baseline assessment, and existing traffic operations, the URS Team was able to determine a traffic demand forecast through the corridor. Analysis was performed for the existing conditions (2013), expected year of bridge opening (2025), the 20-year build conditions (2045), and for the horizon year of the bridge life (2125). Forecasting efforts were focused on the development of a land use to traffic volume relationship and further evaluated with Synchro/SimTraffic 8.0.

Figure 2.1: Traffic Distribution Study

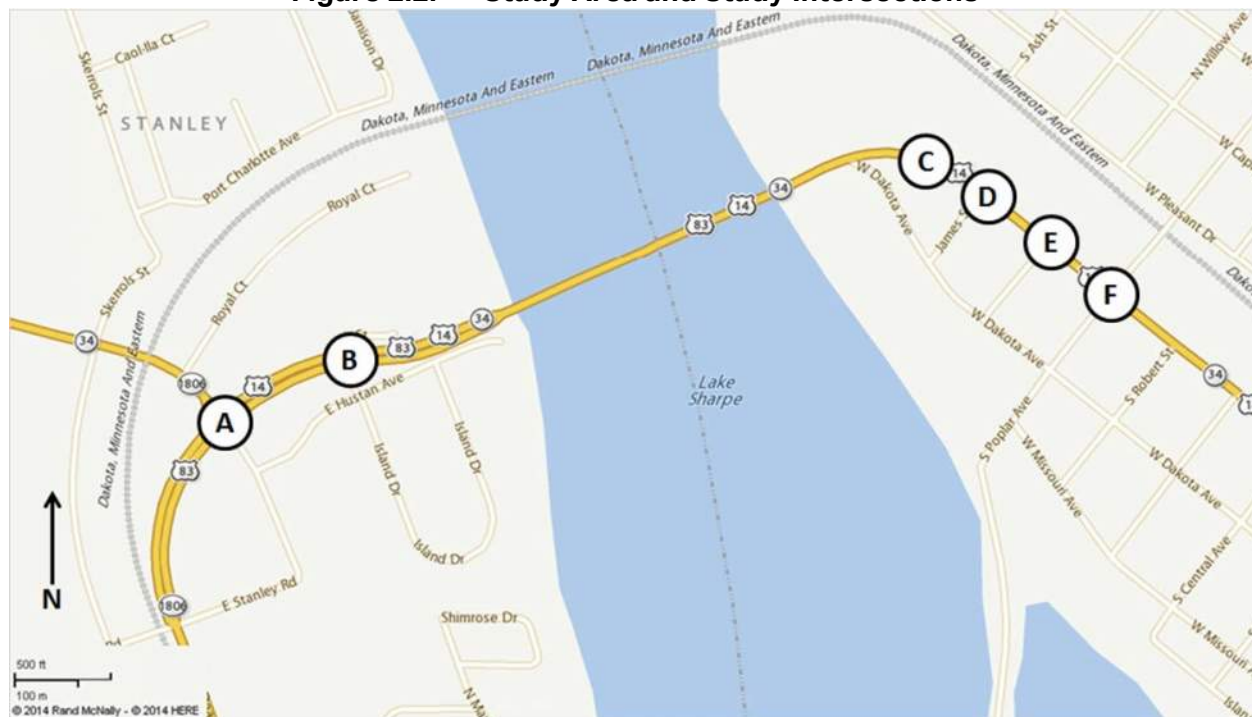


2.1 Existing Traffic Conditions

This study looked at the capacity of the corridor as well as the capacity, delay and queue lengths at six study intersections along the Deadwood/Sioux corridor from its intersection with Yellowstone Avenue in Fort Pierre to its intersection with Poplar Avenue in Pierre. The study intersections, shown in **Figure 2.2** include:

- A. Deadwood Street (US 83) and Yellowstone Avenue (US14/SD34)
- B. Deadwood Street (US14/US83/SD34) and Island Drive
- C. Sioux Avenue (US14/US83/SD34) and Hotel Access
- D. Sioux Avenue (US14/US83/SD34) and James Street
- E. Sioux Avenue (US14/US83/SD34) and Charles Street
- F. Sioux Avenue (US14/US83/SD34) and Poplar Avenue

Figure 2.2: Study Area and Study Intersections



2.1.1 Existing Conditions

The existing bridge over the Missouri River connects the cities of Fort Pierre, in Stanley County, and Pierre, in Hughes County. The bridge carries US Highway 14, US Highway 83 and SD Highway 34. The roadway is named Deadwood Street in Fort Pierre and Sioux Avenue in Pierre (this document will use the roadway names). For the purpose of this study, the Deadwood/Sioux corridor will be considered east-west, and all the intersection roadways will be considered north-south.

The corridor west of the bridge is a four-lane divided roadway with exclusive left-turn lanes at intersections and a 35 mph speed limit. There are no pedestrian facilities on either side of the road. The bridge is a four-lane divided roadway with a speed limit of 35 mph. There is a narrow sidewalk on the south side of the bridge, separated from the roadway with concrete barrier.

Immediately east of the bridge there is an eastbound off-ramp to Dakota Avenue. East of the bridge the corridor is a five-lane divided roadway. There are several commercial accesses per block on each side of the road between James Street and Poplar Avenue. The speed limit in this section is 35 mph.

The six study intersections (shown in **Figure 2.2**) are described as follows:

- A - Deadwood Street (US 83) and Yellowstone Avenue (US14) – This is a four-legged, traffic signal controlled intersection. Eastbound Deadwood is served by one exclusive left-turn lane, one through lane and one shared through/right-turn lane. Westbound Deadwood is served by one exclusive left-turn lane, two through lanes and one exclusive right turn lane. The westbound right turn lane is channelized, and has a free movement to a dedicated lane northbound. Northbound Yellowstone is served by exclusive left-turn, through and right-turn lanes. Southbound Yellowstone is served by one shared left-turn/through lane and one exclusive channelized right turn lane that is controlled by a yield sign. The eastbound left-turn signal is permissive/protected.
- B – Deadwood Street (US 83/14) and Island Drive – This is a four-legged, minor approach stop controlled intersection. Both Deadwood approaches are served by exclusive left-turn lanes, one through lane and a shared through/right-turn lane. The minor approaches are served by wide unmarked single lanes, however, right turning vehicles were observed passing by queued left turning vehicles.
- Eastbound Dakota Off-ramp – On the east side of the bridge, eastbound vehicles can access Dakota Avenue by way off an off-ramp from the right lane.
- C – Sioux Avenue (US 83/14) and Hotel Access – This is a three-legged intersection with stop control for the hotel access. Eastbound Sioux is served by an exclusive left-turn lane and two through lanes. Westbound Sioux is served by one through lane and a shared through/right-turn lane. The hotel access provides a large unmarked lane which was observed operating as both a single lane at some times, and one left-turn lane and one right-turn lane at other times.
- D – Sioux Avenue (US 83/14) and James Street – This is a three-legged intersection with stop control for James Street. Sioux Avenue, east of the hotel access, is a five lane roadway with many accesses, providing two through lanes (one from which right turns are taken, and a two-way left-turn lane (TWLTL). James Street is a wide two lane local roadway.
- E – Sioux Avenue (US 83/14) and Charles Street – This is a three-legged intersection with stop control for Charles Street similar to the James Street intersection. However, this intersection is affected by the McDonald's drive-thru exit which can create a fourth (north) approach. The McDonald's exit is signed as "right turn only", but left turns from this exit are commonly made. For the purpose of the study, the McDonald's drive-thru exit was not considered.

- F – Sioux Avenue (US 83/14) and Poplar Avenue (US 83/14) – This is a four-legged, traffic signal controlled intersection. The eastbound and westbound approaches are each served by one exclusive left turn lane (part of the continuous TWLTL), one through lane and one shared through/right-turn lane. The northbound and southbound approaches are each served by one exclusive left-turn lane and one shared through/right-turn lane. The eastbound left-turn signal is permissive/protected.

In order to establish base conditions for the corridor, turning movement counts were collected at each of the six study intersections in November 2013. Counts were collected during the a.m., midday, and p.m. peak periods. The peak hour turning movement volumes are shown in **Figure 2.3**

Figure 2.3: Existing (2013) Peak Hour Turning Movement Counts

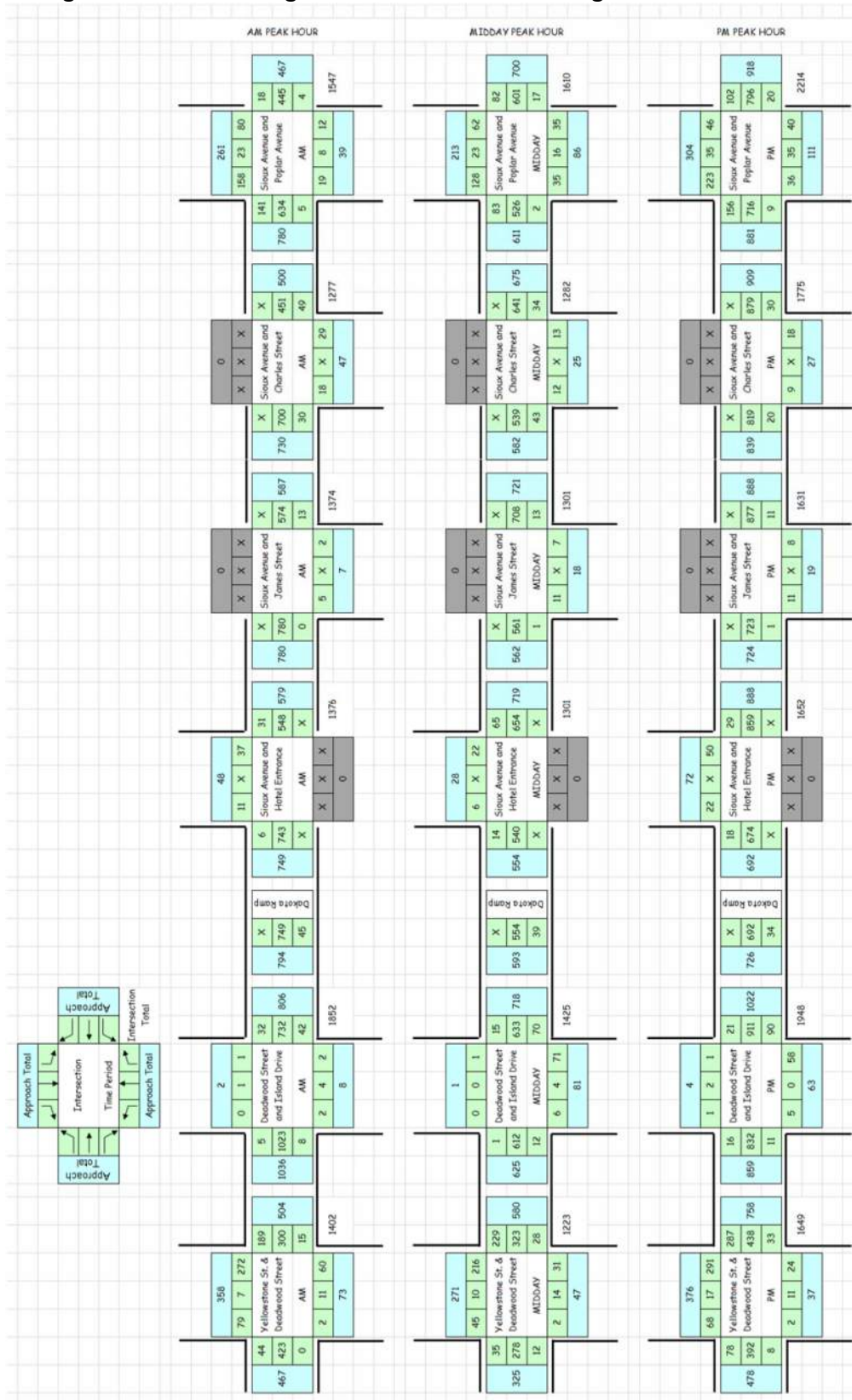
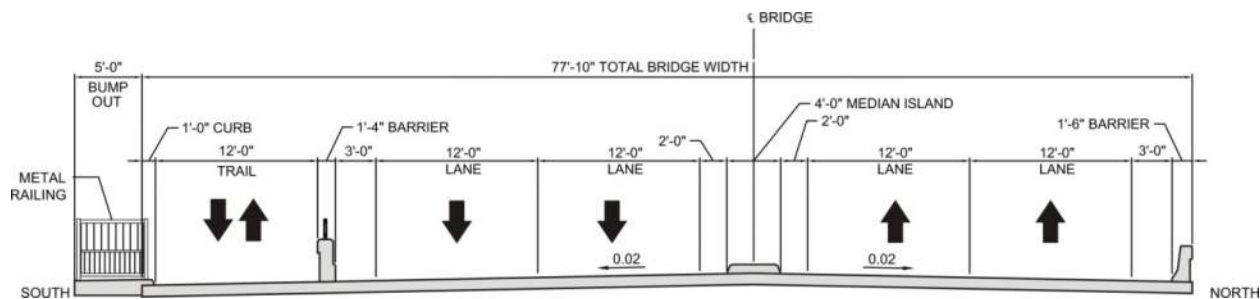


Figure 2.4: Roadway Cross Section

2.1.2 Horizontal and Vertical Alignment

The proposed horizontal roadway alignment includes increasing radii on both the east and west approaches to accommodate the new bridge location north and parallel of the existing bridge. The modifications to the approach alignments will provide better sightlines and operational characteristics for vehicles as compared to the existing condition.

The vertical profile for the roadway will be modified slightly with the proposed bridge to accommodate a bridge high point more central than the existing high point as well as the revised beam depths. The revised vertical profile alignment is not anticipated to significantly change from existing elevations along the study area.

2.2 Traffic Forecast Assessment

The forecasting element of this study provides two necessary sets of data. The historical average daily traffic (ADT) volumes were one of the datasets used to develop traffic forecasts for the years 2025, 2045 and 2125. The 2025 and 2045 forecasts were used for intersection analysis, while all the forecast year traffic volumes were used to determine the minimum number of lanes for the proposed bridge to operate in an acceptable manner.

Scenarios

As identified earlier, there are a total of four traffic scenarios that make up this study:

- Existing (2013) – Actual turning movement volumes and daily counts collected in the field.
- Bridge Opening (2025) – Forecasted turning movements and ADT for the year of the projected opening of a new bridge.
- Horizon Year (2045) - Forecasted turning movements and ADT for the year that is 20 years after the projected opening of a new bridge.
- Bridge Life (2125) – Forecasted ADT for the final year of the bridge based on an expected lifetime of 100 years.

There were several data sets used to develop the forecasts for the three future year scenarios. These include:

- Historical bridge ADTs from years 1967, 1970, and 1980-2013
- Stanley County and Hughes County historical populations (1960-2010)
- Cities of Fort Pierre and Pierre historical populations (1960 – 2010)

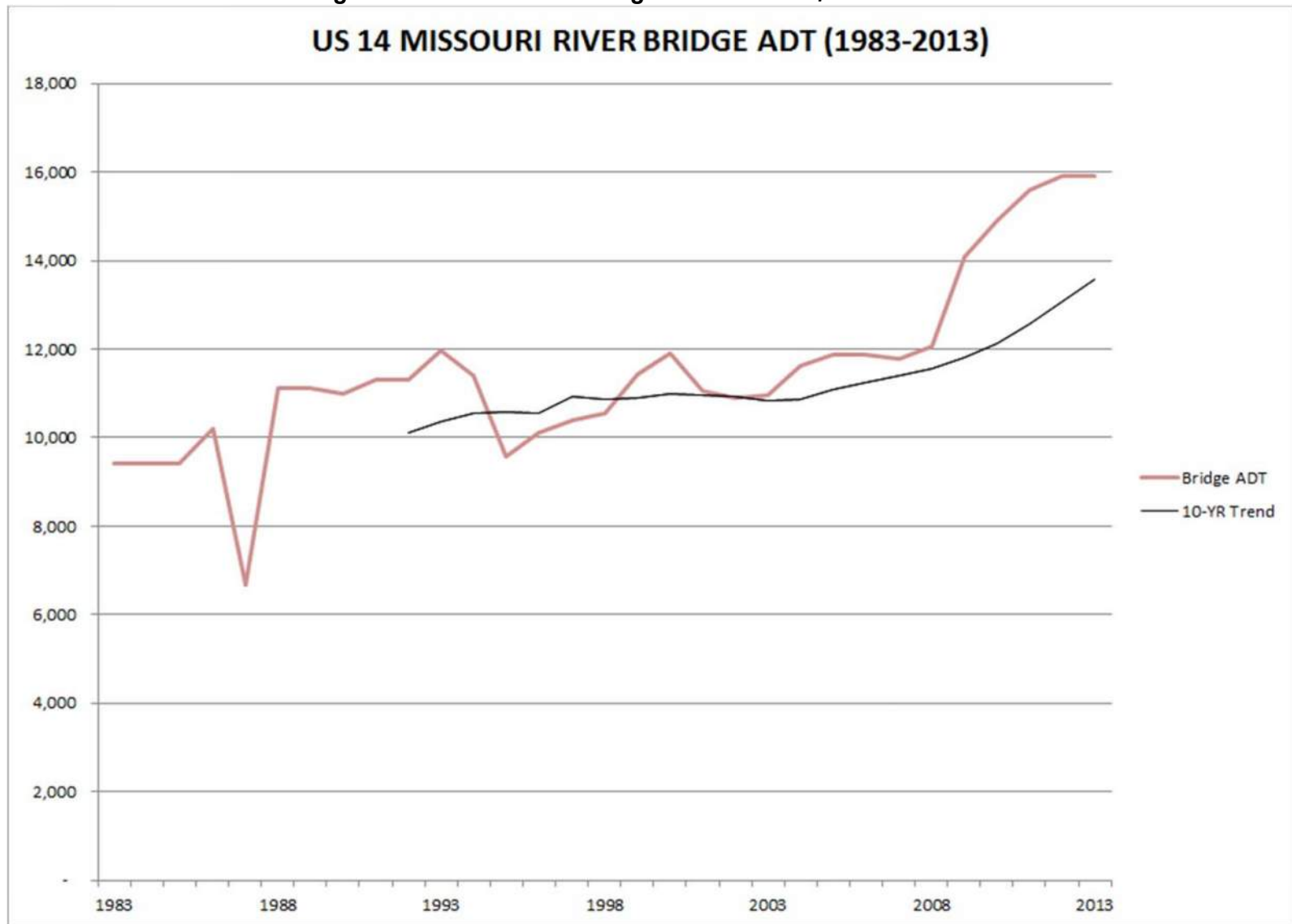
- Stanley County and Hughes County population projections (Central South Dakota Enhancement District Comprehensive Economic Development Strategy, December 2012)

The first step in the forecasting process looked at the historical Bridge traffic volumes to see what the growth trends have been over the past fifty years, with more attention to the most recent thirty years. The ADTs, shown in Figure 4, reveal a fairly steady, although slow, increase, with more significant increases from 2009-2011.

Since the year 2000, yearly changes in Bridge ADT have ranged from -7.1% to 16.7%. Eight of those 13 years have seen ADT change between -1.4% and 2.5%. The last four years have shown decreasing growth rates – 5.7% (2010), 4.2% (2011), 2.1% (2012), and 0.0% (2013).

Also shown in **Figure 2.5**, is the moving average of the previous ten years of data.

Figure 2.5: Historical Bridge ADT Volumes, 1983-2013



2.3 Intersection Operations Assessment and Level of Service

The following discussion and points summarize the information previously presented in the forecasting and traffic study (02/24/2014 Traffic Memo):

- All movements of the six study intersections operate at LOS C or better under existing a.m. and p.m. peak hour traffic conditions (as collected in November 2013), with the exception of:
 - Left turns from northbound and southbound Island Drive experience significant delay, however, these volumes are extremely low.
 - Left turns leaving the Ramkota Hotel access during the p.m. peak hour. These vehicles experience an average of 48 seconds of delay (LOS E), but 95th percentile queues are less than 50 feet, as the counted peak hour volume was 50 vehicles.
- In the 2025 and 2045 scenarios, all minor-stop controlled approaches operate at LOS D or worse. This is not due to high minor approach volumes, but high major approach volumes, which leave few gaps for turning vehicles.
- The historical ADT growth pattern closely mimics the historical growth of the City and County populations. These trends and future population estimates were used to forecast 2025 and 2045 ADTs for the Bridge. The growth factors used were:
 - 2013 to 2025 (12 years) – 16%
 - 2025 to 2045 (20 years) – 27%
- Forecasting continual compounding growth to the 100 year life of the bridge is likely inaccurate due to the limits of population growth in the area. In addition, the capacity of the roadways on either side of the bridge limit the traffic volumes on the Bridge (the Bridge ADT cannot be higher than the volumes of the roadways on either side of the Bridge).
- Deadwood Street, on the west side of the Bridge, can be widened to six lanes (to match a future Bridge cross section) with relative ease. Sioux Avenue, on the east side of the Bridge, poses many obstacles to providing higher capacity than its current five-lane cross section, including a lack of room for widening (structures near the roadway edge), and many mid-block accesses. There are several alternatives to address the need for increased capacity if/when the Bridge provides six lanes:
 - Sioux Avenue and Dakota Avenue one-way pairs
 - Widening Sioux Avenue to six-lanes past Pierre Street
 - Access management strategies
- The traffic forecasts estimate that a five-lane cross section (Sioux Avenue east of the Bridge) will be over capacity near the horizon year of 2045. Although the traffic projections suggest six lanes will be needed beyond 2045 on the bridge, capacity constraints on the Sioux Avenue approach will likely cap the traffic growth at a point below the threshold where additional lanes will be needed on the bridge.

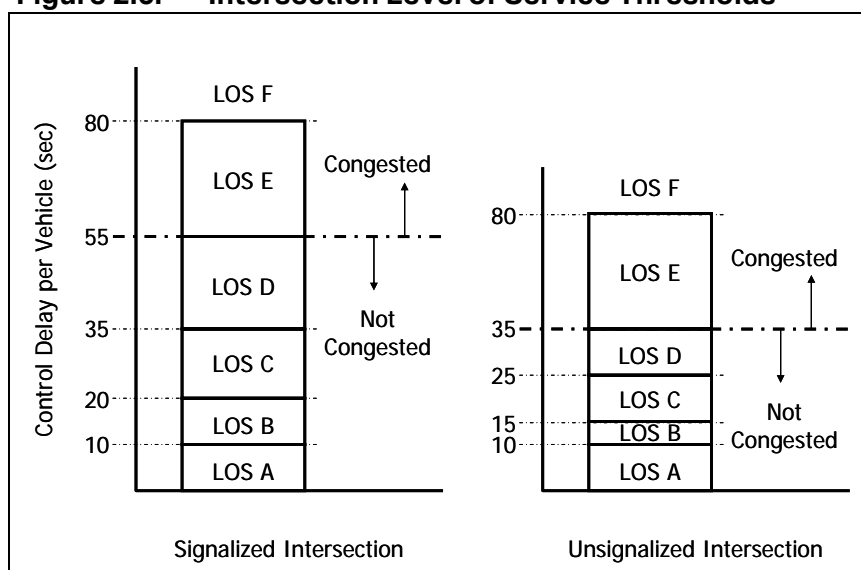
The ability of an intersection to process traffic is affected by the number and type of vehicles, desired turning movements, intersection geometrics, and traffic control devices. For intersection level of service (LOS) the quality of traffic operations is defined as the delay to vehicles caused by the intersection's traffic control, or in the case of minor-approach stop control, yielding to vehicles with higher priority. Intersection LOS typically focuses on operations during the periods of the day with the highest traffic volumes – for the purpose of

this study, the a.m. and p.m. peak hours.

The intersection operational analysis process includes determining the LOS for the key intersections under the existing and forecasted peak hour traffic conditions. In this area LOS C is generally considered an acceptable minimum operating condition during weekday peak hours. For minor-approach stop controlled intersections, the stop controlled approaches can often have high delay with comparatively short queue lengths, as one or two vehicles can wait for a considerable time without additional vehicles arriving at that same approach.

Figure 2.6 presents the intersection LOS thresholds, in terms of seconds of vehicle delay, as defined in the 2010 HCM.

Figure 2.6: Intersection Level of Service Thresholds



(SOURCE: Highway Capacity Manual, 2010)

2.4 Traffic Safety Assessment

2.4.1 Accident History

Figures 2.7 and 2.8 present the history of accident frequency and type, respectively, for the study area.

2.4.2 Pedestrian and Bicycle Safety

The proposed bridge improvements include a 12 foot wide mixed use trail with bump-out overlook areas along the south side of the bridge to replace the existing 5 foot wide pedestrian sidewalk. Trail connections to existing trails near each abutment are included with the proposed improvements as well. The roadway cross section includes wider shoulders to accommodate on-road cyclists. The proposed trail and wider shoulders will significantly enhance safety and attractiveness of non-motorized traffic at the river crossing.

Figure 2.7: Accident History

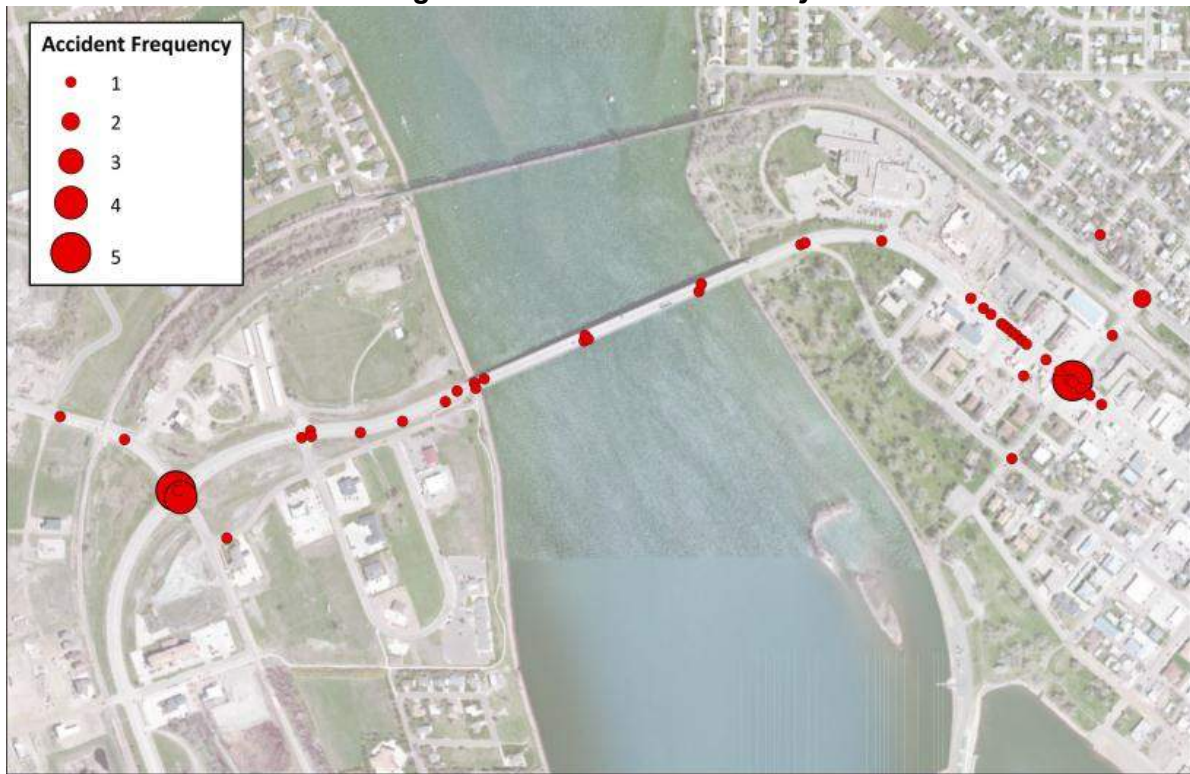
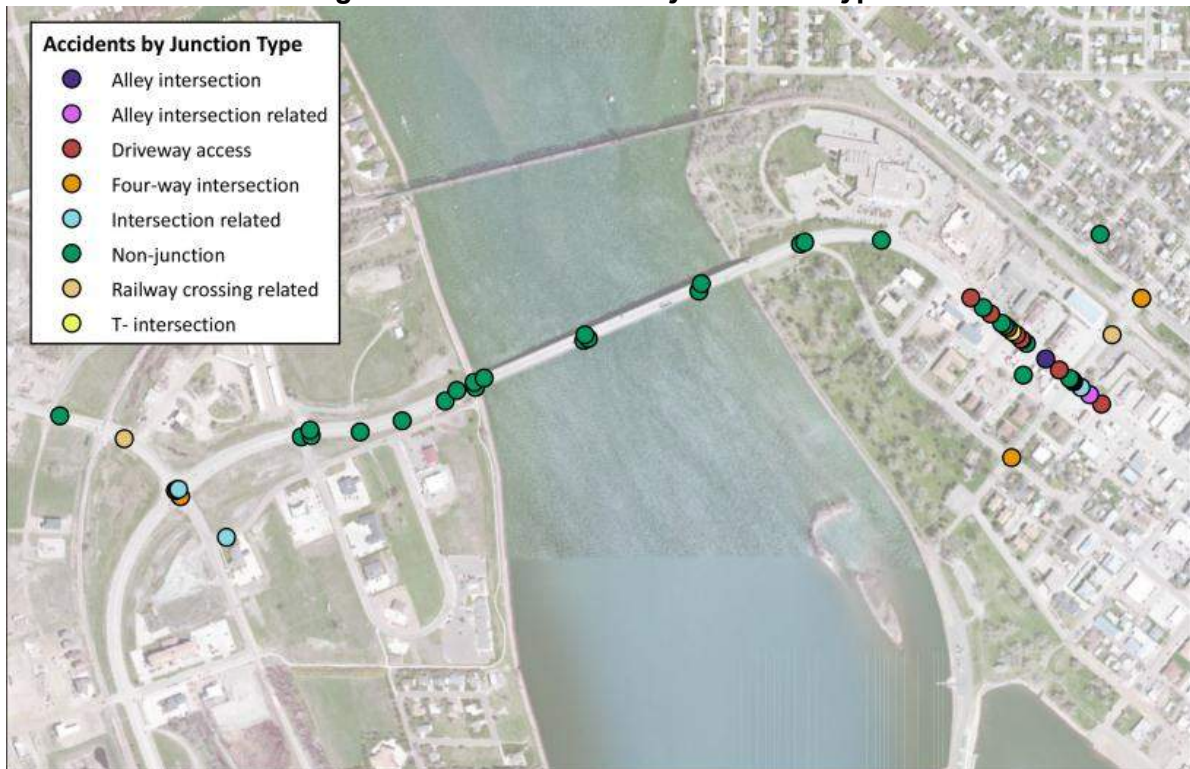


Figure 2.8: Accidents by Junction Type



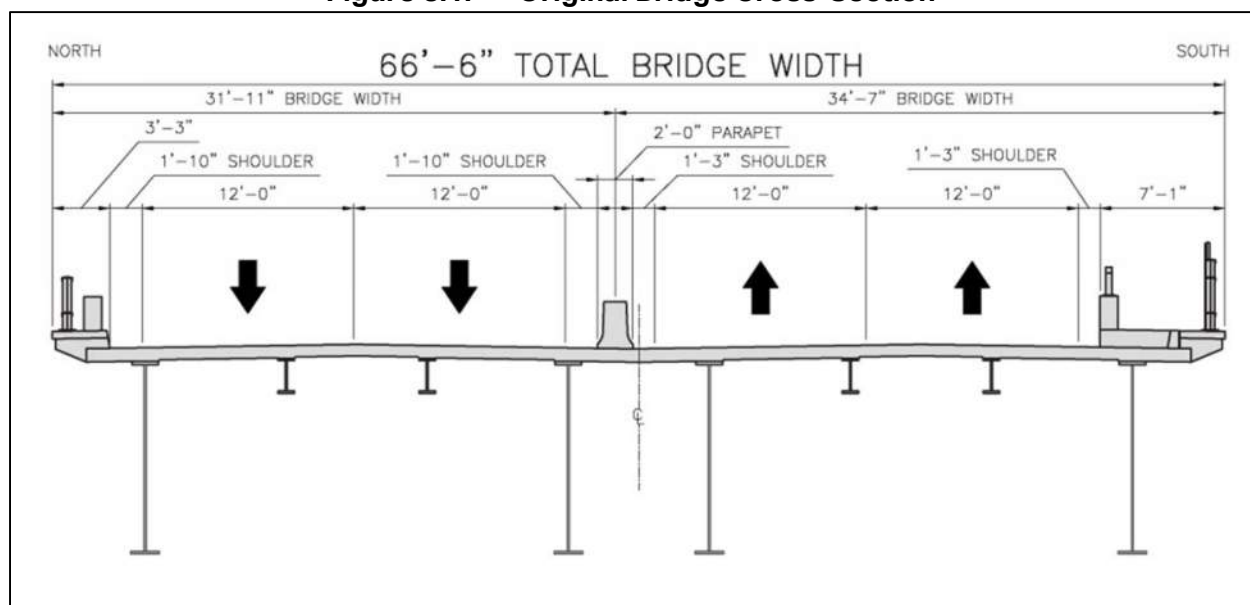
SECTION 3 BRIDGE ASSESSMENT

3.1 Existing Bridge Information

Built in 1962, the US14/US83/SD34 Missouri River Bridge connects the cities of Pierre and Fort Pierre, South Dakota. The ten-span bridge has four variable depth continuous steel girders supporting a concrete deck with stringers and floor beams. The deck is 66.5 ft wide and includes 2 - 12 foot wide traffic lanes in each direction, 15" reaction zones adjacent to barrier and a 5 ft wide sidewalk on the south side. The bridge superstructure bears on multi-column concrete piers. Rocker bearings with anchor bolts allow for expansion and contraction of superstructure.

Alterations have been made to the original bridge structure to address general wear and fatigue. These include removing unsound concrete, installing galvanic anode protection devices in concrete repair/patching areas, removing portions of the lateral wind bracing, patching and installing fabric wrap on the concrete pier columns, a complete rebuilding of pier 10, and some retrofitting of the steel girders. Additionally, concrete barriers have been added to the median and to the outer traffic lanes along the entire length of the bridge.

Figure 3.1: Original Bridge Cross-Section

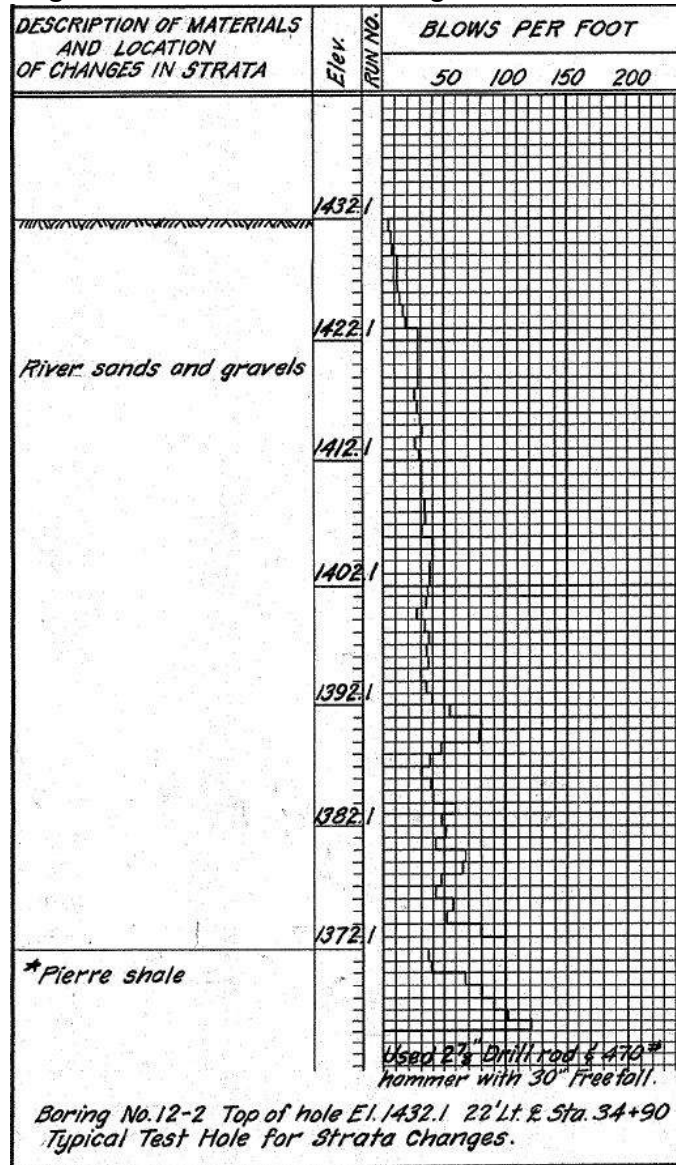


3.1.1 Existing Subsurface Data

The compounded contributions of gradual river channel evolution and an extreme flood event in 2011 have degraded the river bed at pier locations. Despite degradation of up to 18 feet in the river channel, the bridge substructures remain in satisfactory condition. Refer to the Underwater Bridge Inspection Report (Appendix G) for a more detailed description of subsurface structural conditions.

The typical soil supporting the pier footing piles is composed of loose river sand and gravel overlying the relatively stiff Pierre Shale formation. Based on the original construction drawings and geotechnical discussion between the URS Team and SDDOT geotechnical engineers, it was determined that the pile skin friction capacity was estimated to be 2800 psf for preliminary design of drilled shaft foundations.

Figure 3.2: Test Hole Boring Data 1960 Plans



3.1.2 Existing Bridge Component Characteristics

The US14/US83/SD34 Missouri River Bridge underwent a major rehabilitation in 2009 to address concrete deterioration problems in the substructure, and corrosion and fatigue prone items in the steel superstructure. The rehabilitation work was intended to extend the life of the bridge for up to 15 to 20 years. After that point, it was determined that repairs will no longer be cost-effective and the bridge will have reached the end of its useful life. The alternatives considered in this study will address the replacement of this aging structure.

Structural and fatigue analyses of the existing structure were not considered in the scope of this study.

An initial survey of the bridge in 2004 by Mark Hufstetler (SDDOT) recommended the bridge as potentially eligible for nomination to the NRHP. However, the 2009 alterations (cross-bracing removal, pier retrofit) combined with the failure of archival research to yield further information associating the site with a significant person or event in history led to a recommendation of not eligible listing in the NRHP under Criterion A, B, or C. The historical assessment of this bridge is cited in Reference 1.

3.2 Bridge Design Criteria

During the initial stage of the project, URS worked with the SDDOT to develop project-specific performance parameters for use in the development of bridge alternatives. Sections 3.2.1 to 3.2.5 list the critical aspects of the design criteria.

SDDOT expressed the following goals in the RFP:

- The design life was stated as 100 years for replacement. The deck design goal is also 100 years. Periodic maintenance items necessary to achieve a 100 year design life will be identified and included in life cycle analyses.
- Typical cross sections should be dictated by traffic volumes and requirements.
- A bridge and approach design solution that is Context Sensitive – meaning it takes into account a holistic approach that delicately considers the needs and characteristics of the surrounding area and users.
- Span lengths for the river bridge are driven by structure type & height, superstructure depth and economics as well as US Coast Guard (USCG) requirements. Maximum and minimum lengths are not specifically limited. The USCG will be contacted directly with requests for clearance requirements. Proposed bridge options may reduce the existing navigational clearances – provided they are acceptable to the USCG and SDDOT.
- Aesthetic considerations will be a result of stakeholder input as evaluated by the SDDOT/Consultant Team. All aesthetic concepts or proposals shall be provided for SDDOT review/acceptance prior to their publishing or public access.
- Aviation and Railroad restrictions or requirements may be specific to the location and will be the investigative responsibility of the Consultant Team with assistance of SDDOT as necessary.
- If two superstructures are implemented for the river bridge, a minimum distance of 8 feet shall be provided between adjacent copings. If a single superstructure is implemented, means of superstructure maintenance and inspection shall be provided and included in feasibility studies.

3.2.1 Design Criteria – Documentation

The following documents were used in the development of the US14/US83/SD34 Missouri River Bridge Replacement Study.

- 2012 AASHTO LRFD Bridge Design Specifications

- 2010 AASHTO Highway Capacity Manual
- AASHTO Highway Safety Manual
- 2014 SDDOT Structures Construction Manual
- 2012 SDDOT Average Unit Bid Prices
- 2012 SDDOT Annual SD Construction Cost Index (CCI)
- 2004 SDDOT Standard Specifications for Roads & Bridges, with Supplemental Specifications
- SDDOT Road Design Manual
- SDDOT Drainage Manual
- SDDOT Water Quality Program Design Manual
- SDDOT Road Design's CADD Procedures Manual
- SDDOT Standard Plates Index
- SDDOT Highway Surveying Manuals

3.2.2 Geometric Development

Bridge and approach alignment, cross section, and profile reflect the projected traffic needs, watercraft navigational clearances, and the availability of river front access to pedestrians and bicyclists.

3.2.2.1. Bridge Alignment and Cross Sections

Placement of bridge alternatives was influenced by the impacts each would have on the surrounding properties and community at large. Alignments were developed to minimize impacts to the adjacent properties and the community. Factors considered include but are not limited to right of way acquisition, intersection design, sightlines and traffic safety, riverfront accessibility, pedestrian and bicyclist river crossing access, park use, channel alignment, gas line, and watercraft navigational clearances. Staging of new bridge construction to provide for minimal disruption of existing river crossing for local and regional traffic was a significant factor in the determination of the proposed alignment of the roadway.

3.2.2.2. Navigation Clearances

The existing US14/US83/SD34 Missouri River Bridge was designed with two navigational lanes underneath span 8 and span 9 on the eastern side of the bridge. The navigational lanes were naturally located where the riverbed contours provided the deepest channel for safer navigation. Each lane was designed with a horizontal clearance of 210 feet and a vertical clearance of 28.7 feet. The vertical clearance was calculated using a Bridge Reference Plane (BRP) elevation of 1425.8 feet.

3.2.2.3. Aviation and Railroad Clearances

The proposed bridge alignment is not influenced by railroad or aviation clearance requirements.

3.2.2.4. Design Loads and Forces

See Appendix I – Design Criteria for a summary of design loads and forces used in this Report of Findings.

SECTION 4 ENVIRONMENTAL ASSESSMENT

The US14/US83/SD34 Bridge is a primary travel corridor and Missouri River crossing that connects the cities of Pierre and Fort Pierre as well as providing a regional crossing of the Missouri River for three major highways in South Dakota.

Potential impacts of the bridge project on the natural and human environment are addressed in the Environmental Assessment (EA) prepared for the project for compliance with National Environmental Policy Act (NEPA) requirements. The NEPA document identifies alternatives for the project, assesses the environmental, economic and social impacts of the alternatives and explores the methods to avoid or mitigate environmental harm.

A variety of alternatives (approximately 20 variations) were assessed and compared, with public and agency comments considered, resulting in one preferred alternative being selected for the project. The EA compares the impacts of the preferred alternative with a No Build, or do nothing, alternative. The preferred alternative that was chosen, N1.1, is located 50 feet to the north of the existing bridge, with a 10 foot gap between it and the existing structure.

The preferred alternative meets the Purpose and Need for the Project as defined in the EA:

Purpose of the Project:

- The purpose of this project is to maintain the intercity, intrastate, and interstate highway bridge crossing between Pierre and Fort Pierre, consistent with local, state, and regional transportation and development plans, while improving public safety and mobility.

Project Needs:

- The need for this bridge study is demonstrated through a combination of factors, including the following:
 - Structural Deficiencies
 - Geometric Deficiencies
 - System Linkage and Route Importance

The impacts of the preferred alternative for project include the following:

Construction impacts include temporary noise, vibration and air quality impacts, and also traffic impacts including lane shifting, reduction of lanes and short-term detours. Approximately 0.892 acres of parkland was used for the project, while 1.056 acres of excess highway ROW on the south would be added Steamboat Park, resulting in a net gain of .16 acres to the parks. Open space adjacent to the parkland would be added with the removal of the ramp to and pavement from Dakota Avenue. No wetlands are expected to be impacted by the project. However, if required by USACE, mitigation measures will be undertaken. In that case a wetland mitigation plan would be prepared for the Section 404/401 permit application, and the mitigation plan will be developed and coordination with the resource agencies. For wetlands found not under the jurisdiction of the USACE, FHWA regulations (23 CFR 777.9) will apply and mitigation for permanent impact to wetlands will be required. Mitigation will occur

through on-site mitigation, off-site mitigation, or a mitigation bank. The floodplain as currently mapped would not be impacted by the proposed bridge. However as part of the final design process the SDDOT may be required to complete, depending on the 10-year cycle of FEMA maps, a flood plan analysis and the issuance of a "no rise" certification.

Existing bridge demolition may impact bat and bird roosting. SDDOT will follow the most current Programmatic Agreement between FHWA and the USFWS to determine the preservation practices to be used during the construction of the bridge. Fish may be impacted by debris caused by demolition and construction in the water.

The project is not expected to have adverse impacts regarding the following criteria:
The project is not anticipated to have adverse impacts on environmental justice populations (minority or low-income populations), residential or business relocations, air quality (post construction), noise, floodplain or floodway values, wetlands, historic or archeological resources, land use, water resources, water use and water-related land use.

The preferred alternative will not alter the visual landscape as one bridge will be replaced by another bridge both of similar scale and similar location. Bridge aesthetic treatments developed with public and stakeholder input are intended to complement the structural form of the bridge, provide opportunities to celebrate local history and culture, and to enhance the bridge appearance from multiple perspectives.

A number of Federal and State listed Endangered and Threatened species are present in the project area however, no adverse impacts are anticipated for these species based on the proposed location and scope of the project. Further coordination with the South Dakota Department of Environment and Natural Resources (SDDENR) and U.S Fish and Wildlife Service (USFWS) will occur during final design to determine whether species have been added to, or removed from the list of threatened and endangered species, whether they are likely present in the vicinity of the construction limits of the preferred alternative, and whether they will be impacted by construction activities.

In addition to coordination with SDDENR and USFWS regarding threatened and endangered species, the following permits are required prior to construction of the bridge:

Table 3.1: Permit Summary

Permit Name/Type	Permit Description	Issuing Agency	Permit Requirements
Clean Water Act- Section 404 (Wetlands and Other Waters)	Regulates discharge of dredged or fill material into Waters of the United States	USACE	A permit application would be submitted to USACE prior to commencement of construction activities for the Project. If required, a mitigation plan would be prepared through coordination with the resource agencies for the 404 permit and the 401 certification. The Least Environmentally Damaging Practicable Alternative (LEDPA) documentation will be submitted with the 404 permit application.
401 Water Quality Certification	Regulates Water Quality	SDDENR	Permit requirements include ensuring that projects that involve dredging, or proposed

Permit Name/Type	Permit Description	Issuing Agency	Permit Requirements
			discharges of dredged or fill material, protect public health and water resources.
USCG Section 9 Permit	Bridge Permit	USCG	Permit required for bridge replacements in navigable waters.
USACE Section 10 of the Rivers and Harbors Act of 1899	Structures/work Permit	USACE	Section 10 permit required from the USACE for structures and/or work in or affecting navigable waters of the U.S.
Air Quality Permit	Emissions for Construction Equipment	SDDENR	Equipment with point source emission may be required to have an air quality permit. Equipment should be evaluated to determine whether a permit is required by contacting the SDDENR Air Quality Program.
Clean Water Act-NPDES General Permit for Storm water Discharges Associated with Construction Activities	Regulates discharges of pollutants from non-point sources and construction sites greater than 1 acre	SDDENR	BMPs would be implemented to minimize impacts to the Missouri River.

Following a public and agency review period for the EA, the Federal Highway Administration will review comments received regarding the EA and determine whether significant impacts would be incurred from the project. If they determine there are no significant impacts, FHWA issued a Finding of No Significant Impacts (FONSI) document on 10/31/2016 which is the final approval for the project to move into the design phase.

SECTION 5 ALTERNATIVES ANALYSIS

5.1 Introduction

The development of the preferred bridge type, location, and cross section for the replacement of the US14/US83/SD34 Missouri River Bridge required thorough consideration of the issues listed below. The merits of each were used to refine conceptual options toward a desirable solution. The considerations included:

- Maintaining a crossing over the Missouri River
- Navigational requirements on this portion of the Missouri River
- Construction sequencing restrictions with single or dual bridges
- Optimum structural system in balance with aesthetic needs
- Future lane expansions and multiple uses
- Effect on historical significance
- Interface with the roadway alignment
- Riverfront access and pedestrian accommodations
- Limit Environmental Impacts

A three-tiered approach for the selection and costing of the various proposed concepts was used. The three-tiered refinement and selection process provides a comparison of anticipated total bridge costs and also accounts for schedule, specialty construction, and other engineering items that may be necessary to construct a major river-crossing bridge. At the outset a series of decision matrices developed, both weighted and un-weighted, to evaluate each concept with numerical values based on the corresponding impacts on the study area. Tier 1 provides a general platform for all possible replacement options to be considered. Each alternative was evaluated with the matrix rating system and alternatives that did not meet the baseline design criteria were eliminated from future study.

The complexity of the structure type, bridge cross section, location, market conditions and construction factors (land versus water access) influence the overall cost of the bridge. Based on the decision matrix evaluations, favorable conceptual alternatives were selected to be considered in a second tier. Tier 2 included a more refined estimate for bridge quantities, and was developed based on actual historic unit prices. SDDOT unit prices from 2011-2013 as well as the predecessor Yankton Bridge Tabs were researched and adjusted for inflation. Steel and concrete fabricators and SDDOT also assisted in determining appropriate unit prices.

The third tier of bridge cost evaluation used for the preliminary engineering report is a refinement of the second tier cost evaluations. This refinement applied only to the preferred alternatives after most of the attributes of the design were set. The Tier 3 evaluation recalculated quantities since the alignment, bridge width, and span arrangement were known with more certainty. Also, the preferred concept fully incorporates the aesthetic features chosen for the project and reviews the proposed construction methodology.

5.2 Tier 1 - Initial Analysis of Concepts

The first tier of the alternatives analysis included the presentation and elementary assessment of the universe of bridge options. Each of the major bridge characteristics (bridge/roadway cross section, bridge type and bridge location) were developed and evaluated separately.

5.2.1 Bridge Cross-Sections

The cross section defines the bridge alternatives' transportation function and capacity, such as number of lanes, number and size of paths/trails, and presence of medians. For Tier 1, 18 initial bridge cross-section alternatives were developed and assessed. These cross-sections ranged from the modest 2-lane bridge with a single trail to a wide 6-lane bridge with 2 large trails. **Table 5.1** contains the Tier 1 cross section scoring criteria. A complete listing of alternatives and their representative weighted and non-weighted scores are shown in Appendix B – Table A1.

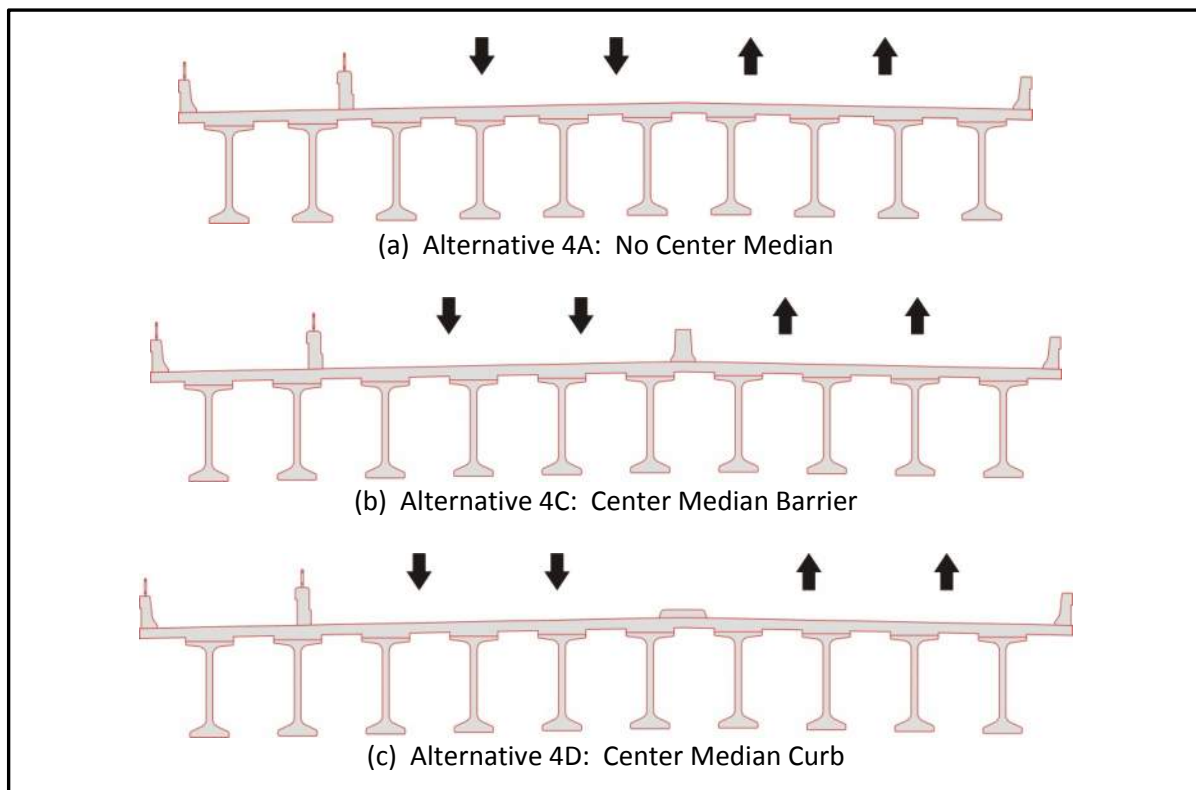
Table 5.1: Bridge Cross Sections

Category	Sub-Category	Individual Pts.	Category Pts.
Context Sensitive Solutions / Environment	Social Impacts	5	15
	Section 4f/6f (Parkland) Impacts	3	
	Cultural/Historical Impacts	2	
	Economic Impacts	2	
	Noise Impacts	3	
Cost Effectiveness	Initial Cost	15	20
	Lifecycle Costs	5	
Maintenance and Inspection	Snow Removal	5	15
	Lane Closure Ability	5	
	Accessibility of Inspection	5	
Traffic Impacts	Level of Service (2025)	10	50
	Level of Service (2045)	25	
	Level of Service (2125)	5	
	Pedestrian Accessibility	5	
	Bicycle Accommodation	5	
Total		100	100

After meeting with the Community Advisory Committee (CAC), the Study Advisory Team (SAT) and the public, three new basic cross-section alternatives (in addition to the no-build alternative for comparison) were chosen for further refinement and analysis. Alternatives 4A, 4C and 4D shown in **Figure 5.1** below were selected as the preliminary preferred alternatives. Each of these alternatives consists of 4 lanes and one large trail/path to be located along the south side of the bridge. The main difference between the three options is no median (4A), or the presence of a center median (4C) or center median curb (4D). These alternatives were decidedly superior to others based on the criteria listed below:

- Accommodates forecasted traffic demands until 2052 (Level of Service D or better)
- Facilitates and consolidates pedestrian and bicycle use
- Smaller footprint and environmental impacts
- Requires lower initial and lifecycle costs
- Easily maintained and inspected
- Allows for close of lanes

Figure 5.1: Bridge Cross-Sections



The two-lane bridge alternatives were dismissed due to their inability to accommodate traffic volumes into the future – resulting in social and business impacts.

The alternatives with six lanes of traffic were eliminated from consideration based on the qualities listed below:

- Several alternatives were limited by the current roadway width from Sioux Ave to Harrison Ave as discussed in the traffic assessment.
- Several alternatives with wide roadway sections lead to more intrusive right-of-way acquisitions
- Initial and lifecycle costs of wider bridge sections
- Increased effort to maintain and inspect larger bridge section

The decision on number of trails/paths was based on input from the Community Advisory Committee. The committee decided that a single large trail was better than two smaller trails. It was perceived that keeping all pedestrian and bicycle users on the same path would lead to

a safer experience. In addition, a wider trail could be utilized by SDDOT maintenance vehicles for routine inspection and maintenance activities; whereas, two narrower trails on each side of the bridge would not provide access for maintenance vehicles.

Bridge sections used in succeeding tiers to assess and select bridge types are most suited and most adaptable to traffic and pedestrian forecasts. Conceptual drawings of each alternate included in Appendix B table A1 give a brief description of each type, offer a short discussion of issues and considerations, and give a disposition statement.

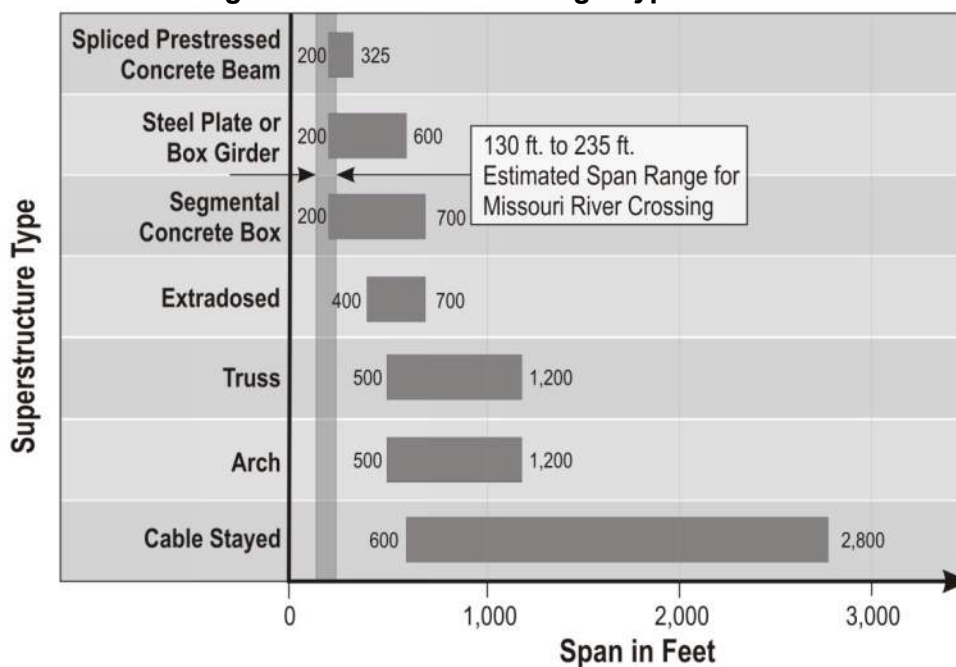
5.2.2 Bridge Types

The bridge type defines the bridge alternatives' structural system and appearance. **Figure 5.2** shows the range of spans suitable for different bridge types. While limited bridge types would span the entire river channel width, several bridge types, including: 1) segmental box; 2) steel plate or box girder; and, 3), spliced prestressed concrete beam, are capable of providing the 210 ft. minimum allowable navigational span required by the US Coast Guard.

For Tier 1, 9 initial bridge type alternatives, in addition to the no-build alternative, were developed and assessed. A brief description of each bridge type alternative with sketches is included in Appendix B – Table A2. During this phase, each of the bridge type alternatives was assessed according to the following criteria presented below in **Table 5.2**:

Table 5.2: Bridge Type Scoring Criteria

Category	Sub-Category	Individual Pts.	Category Pts.
Aesthetics	Fits the Site / Compatible with RR Bridge	10	15
	Continuity of Form & Function	5	
Context Sensitive Solutions / Environment	Social Impacts	5	20
	Section 4f/6f (Parkland) Impacts	3	
	Navigational/Waterway Impacts	2	
	Cultural/Historical Impacts	5	
	Economic Impacts	2	
Cost Effectiveness	Fish & Wildlife Impacts	3	30
	Initial Cost	15	
	Lifecycle Costs	10	
Maintenance and Inspection	Risk of Cost Growth	5	20
	Scheduled Maintenance	5	
	Durability of Critical Items	3	
	Deck Replacement	5	
	Accessibility for Inspection	3	
Structural Redundancy	Inspection Effort	4	15
	Multiple Load Paths	6	
	Continuity	6	
	Blast Resistance & Security	3	
	Total	100	100

Figure 5.2: Feasible Bridge Types

After meeting with the Community Advisory Committee (CAC), the Study Advisory Team (SAT) and the public, three bridge type alternatives (in addition to the no-build option for comparison) were chosen for further refinement and analysis. Alternatives 2, 2A and 3 were selected as the preliminary preferred alternatives. Each of these alternatives considers a girder-type bridge. The main difference between the three alternatives is the girder material (steel or concrete). Each of the alternatives has slightly different girder shapes and design and construction complexities. These alternatives were decidedly superior to others based on the criteria listed below:

- Redundant structures with multiple load paths
- Most efficient bridge types for required spans
- Easily maintained and inspected
- Expandable bridge type if widening is required
- Lowest Cost
- Sleek Aesthetics
- Limited Environmental Impacts – such as visual impacts to surroundings

The rest of the alternatives were eliminated from further study based on the considerations listed below:

- Less efficient structures for required spans
- Structural redundancy concerns
- Construction Cost Growth Risk
- Initial and lifecycle costs of bridge
- Increased effort to maintain and inspect bridge

The preliminary preferred bridge type alternatives were used in succeeding tiers to refine and assess the bridge type(s) best suited for this site.

5.2.3 Bridge Location

Locations and alignments for 20 different alternatives were developed and assessed during the Tier 1 assessment. The alternatives included the following locations: along the existing bridge alignment, north of the existing bridge and south of the existing bridge – each to varying degrees. A brief description and aerial graphic of each location alternative are included in Appendix B – Table A3.

During this phase, each of the bridge location alternatives was assessed according to the following criteria:

- Context Sensitive Solutions / Environmental
 - Parcels Impacted
 - Social Impacts
- Section 4f/6f (Parkland) Impacts
- Noise/Light/Drainage Impacts
- Cultural/Historical Impacts
- Economic Impacts
- Wildlife Impacts
- Visual Impacts
- Cost Effectiveness
 - MDU Gas Line Impact
 - City Water Well Impact
 - Parcel Impacts
 - Intersection Impacts
 - Frontage Road & Road Access Impacts
 - Approach Impacts
 - Construction & Demolition Complexity/Duration Costs
 - Future Expansion Availability
- Traffic & Navigation Impacts
 - Geometrics / Site Lines
 - Construction and/or Demolition Complexity/Duration
 - Level of Service (2025)
 - Level of Service (2045)
 - Level of Service (2125)
 - Pedestrian Impact
 - Bicycle Impact
 - River Navigation Impact

After the Community Advisory Committee (CAC), the Study Advisory Team (SAT) and public involvement meetings, five bridge location alternatives (in addition to the no build alternative) were chosen for further refinement and analysis. Alternatives E2, N1, N2, N4 and N7 were selected as the alternatives to be carried forward for further consideration. These alternatives position the replacement bridge either over the existing bridge (fully or partially overlapping) or to the north of the existing bridge. The main difference between the alternatives is amount of traffic impacts during construction, mostly due to a long detour if the bridge would have to be closed during construction. These alternatives were decidedly superior to others based on

the criteria listed below:

- Low Right of Way impacts to adjacent properties
- Low impacts to Parkland
- Limited impacts to approach roadways and access point
- Minimal traffic disruption during construction
- Status-quo or improvement of S-curve on western approach to bridge
- Low Cost
- Low utility impacts
- Low navigation impacts

5.3 Tier II – Alternatives Refinement

Meetings were held to facilitate a discussion about the preferred alternatives from Tier 1. The following summarizes a series of discussion topics that were part of the Missouri River Bridge workshop of June 6, 2014. During Tier II, the project team developed a refined a series of preferred options from Tier I and then selected one or two of these to advance to Tier III. Tier II options (by topic) are presented below with follow-up discussion pertaining to the selection process.

5.3.1 Tier II – Bridge Route Location

Three alignments illustrated in **Figure 5.3** below were advanced during Tier II. These were reviewed based on their ability to:

- Accommodate future traffic demands
- Accommodate pedestrians and bicycles
- Accommodate community developments including short- and long-term economic impacts to community and users
- Meet ADA requirements
- Lessened effect on Section 4(f), 6(f) Properties and other resources
- Lessen fish and wildlife impacts and meet GF & P requirements.
- Lessened noise, light and drainage impacts
- Avoid, minimize, or mitigate Right-of-Way acquisition

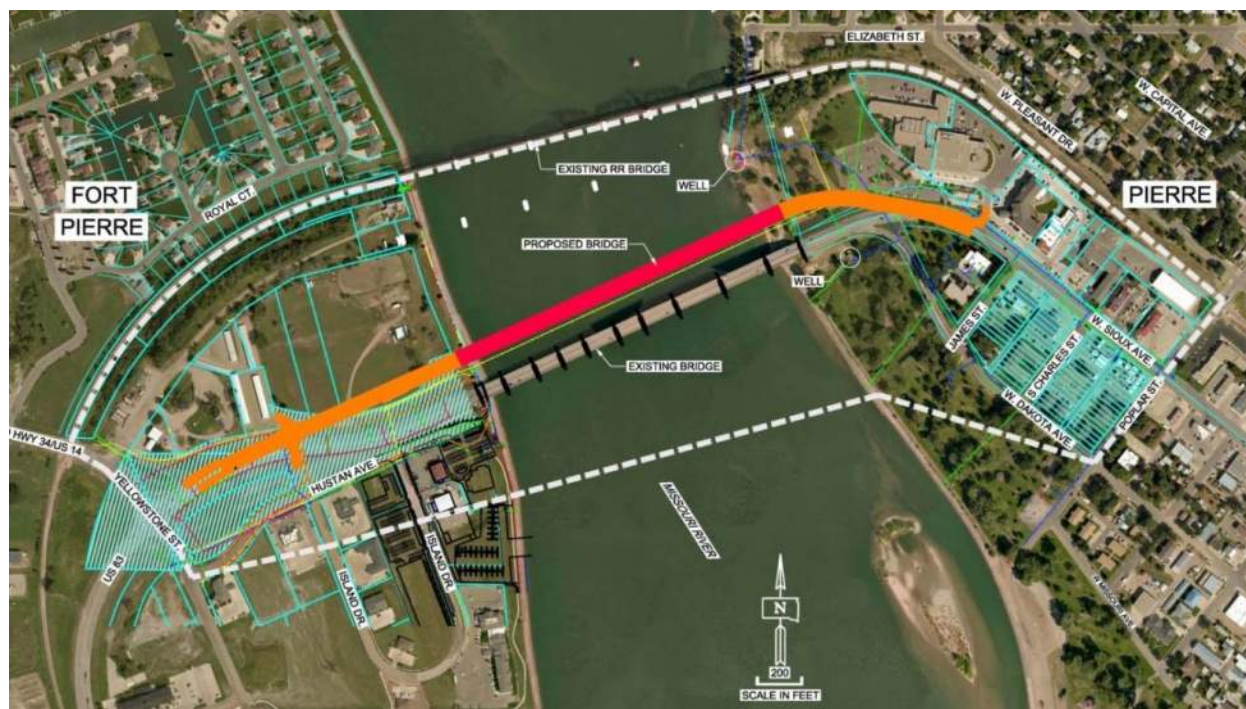
Figure 5.3: Alignment Location Alternatives



(a) Alignment E1 – No-Build Bridge Remains "As-Is"



(b) Alignment N1.1 – Proposed Alignment to North of Existing (10 ft. Gap)



(c) Alignment N2.1 – Proposed Alignment to North of Existing (100 ft. Gap)

Discussion related to the selection of the preferred route location is outlined below:

- Location N1.1 (10 ft gap to the North) and N2.1 (100 ft gap to the North) are the remaining location options following the public survey and meetings with stakeholders.
- N2.1 has more local property impacts compared to N1.1.
- The main benefit of N2.1 is that the new bridge would be built farther from the existing structure and may ease demolition efforts a little. Another benefit for N2.1 was that it was more conducive to the Dakota Ave intersection concept. However, the stakeholders expressed concern over this intersection and it was dropped from contention. With Bridge Alternative N1.1, the Dakota Ave intersection option could be used in the future, if it is decided to be beneficial and has more public support.

As an outcome of the Tier II selection process, N1.1 is the preferred location and N2.1 will be eliminated from consideration for the final design. N2.1 was eliminated due to the higher level of impacts to: private properties in Fort Pierre, Yellowstone intersection in Fort Pierre, Ramkota parking lot in Pierre, disc golf course in Pierre, and longer approach reconstruction in Pierre and Fort Pierre.

5.3.2 Bridge West Approach

One alignment was advanced for the west approach during the Tier II refinement process. The alignment accommodates the bridge shift to the north and reduces the existing curvature on the approach roadway as a result. The west approach is illustrated in **Figure 5.4** below:

Figure 5.4: West Approach Alignment



5.3.3 Bridge East Approach – Dakota Avenue Ramp

Three alignments / layouts for Dakota Avenue were advanced during Tier II. These were reviewed based on their ability to:

- Accommodate future traffic demands
- Accommodate pedestrians and bicycles
- Accommodate community developments including short- and long-term economic impacts to community and users
- Meet ADA requirements
- Lessen effect on Section 4(f), 6(f) Properties and other resources
- Lessen fish and wildlife impacts and meet GF & P requirements.
- Lessen noise, light and drainage impacts
- Avoid, minimize, or mitigate Right-of-Way acquisition

The alignment options (E1, D1 and D2) for the east bridge approach are illustrated in **Figures 5.5, 5.6, and 5.7.**

Figure 5.5: Option E1 – Bridge and Ramp Remains



Figure 5.6: Option D1 – Retain Reconstructed Slip Ramp



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 DAKOTA AVENUE SLIP RAMP

JUNE 19, 2014



Figure 5.7: Option D2 – Remove Slip Ramp and Add Expand Cul-De-Sac

The fundamental question related to this topic is whether to retain the Dakota Avenue slip ramp or remove the ramp and instead construct a cul-de-sac or reconstruct the parking lot with an access trail. Discussion related to the selection of the preferred Dakota Avenue alignment / layout option is outlined below:

- The benefit of building the ramp is that it would help relieve traffic on Sioux Avenue east of the bridge in the coming years, preventing a downgrade in the level of service.
- One downside of the ramp is that it would prevent connecting the two surrounding parks and retain traffic levels through the parks.
- One suggestion was to not build the ramp but retain the ROW in case it was needed in the future. There is concern that if the classification of the ROW is changed from green space to parkland that it would be impossible to build the ramp in the future.

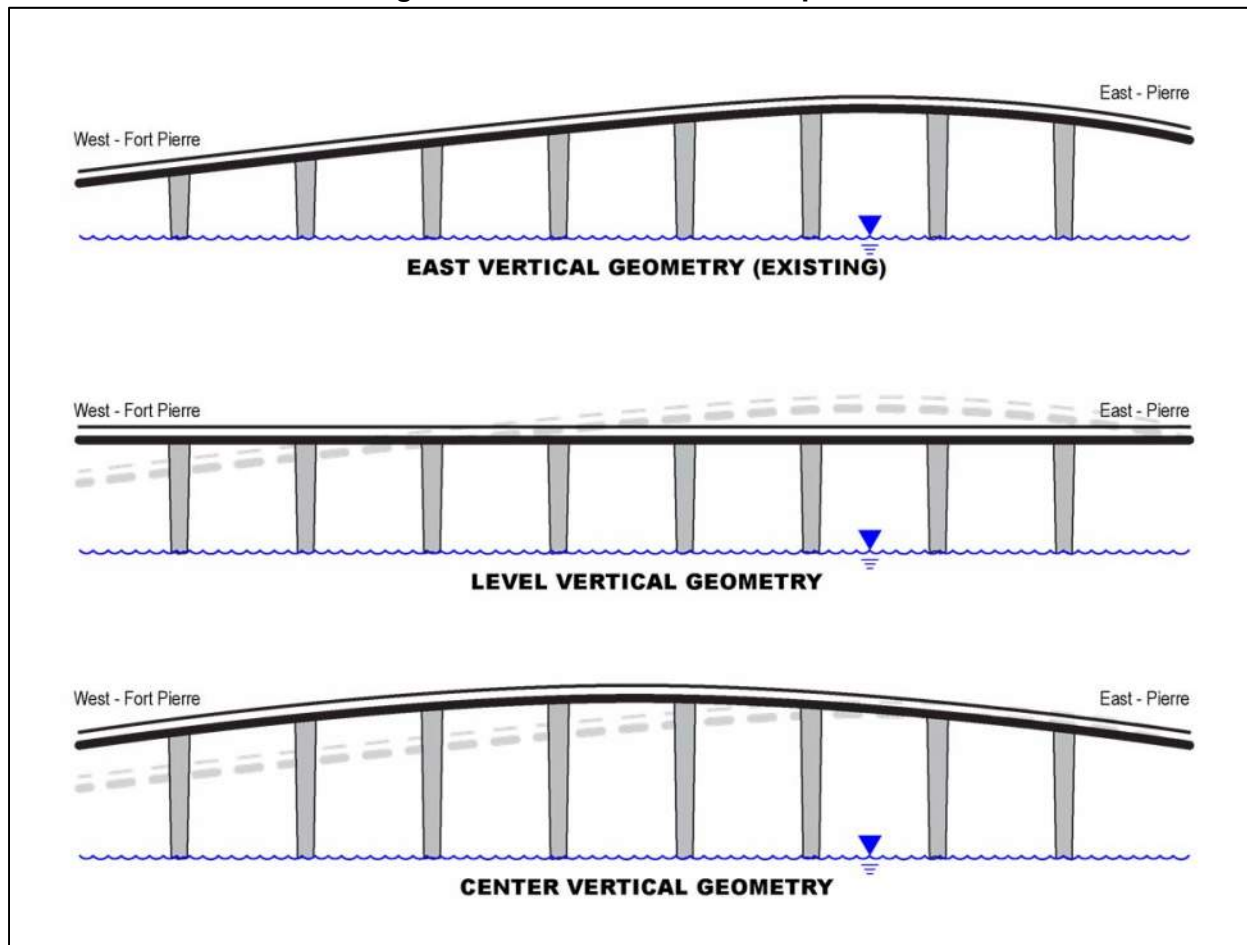
Correspondence with the USACE indicates that the old take line property was transferred to the SDGFP. This swath of land is now leased and maintained by the Cities. The new USACE take line is about 20 feet past the top of riprap (which allows the USACE access).

As an outcome of the Tier II selection process, the SAT indicated preference towards Option D2 with the caveat that the ramp corridor be preserved as ROW to allow for future construction if deemed appropriate by SDDOT and the City of Pierre at a future time.

5.3.4 Tier II - Vertical Profile

As shown in **Figure 5.8** below, options exist for a flat vertical alignment versus crest curve as well as the location of the crest curve.

Figure 5.8: Vertical Profile Options



The minimal vertical clearance allowed by the United States Coast Guard (USCG) and the Army Corp of Engineers (ACOE) is 30 feet above the BRP. However, neither the current US14 highway bridge nor the existing railroad bridge meets this requirement using the existing plan elevation of 1425.8 feet. After consulting with ACOE, USCG approved a 30' clearance measurement from the Normal Pool Elevation of 1421.3 feet, which is based on the 1929 Datum. The South Dakota Department of Transportation accepted this measurement; therefore all preliminary plans for a bridge replacement meet the necessary vertical clearances. E-mails from USCG and SDDOT regarding this issue are included in Appendix F – River Navigation Correspondence.

5.3.5 Tier II – Main Channel Location

Figure 5.9 shows three alternative arrangements for approach spans and main spans where the locations and lengths of the longest spans are adjusted. The minimal horizontal clearance required by USCG is 210 feet. Preliminary layouts for the replacement structure were set up such that multiple spans meet or exceed this requirement.

Figure 5.9: Bridge Main Channel Location Alternatives

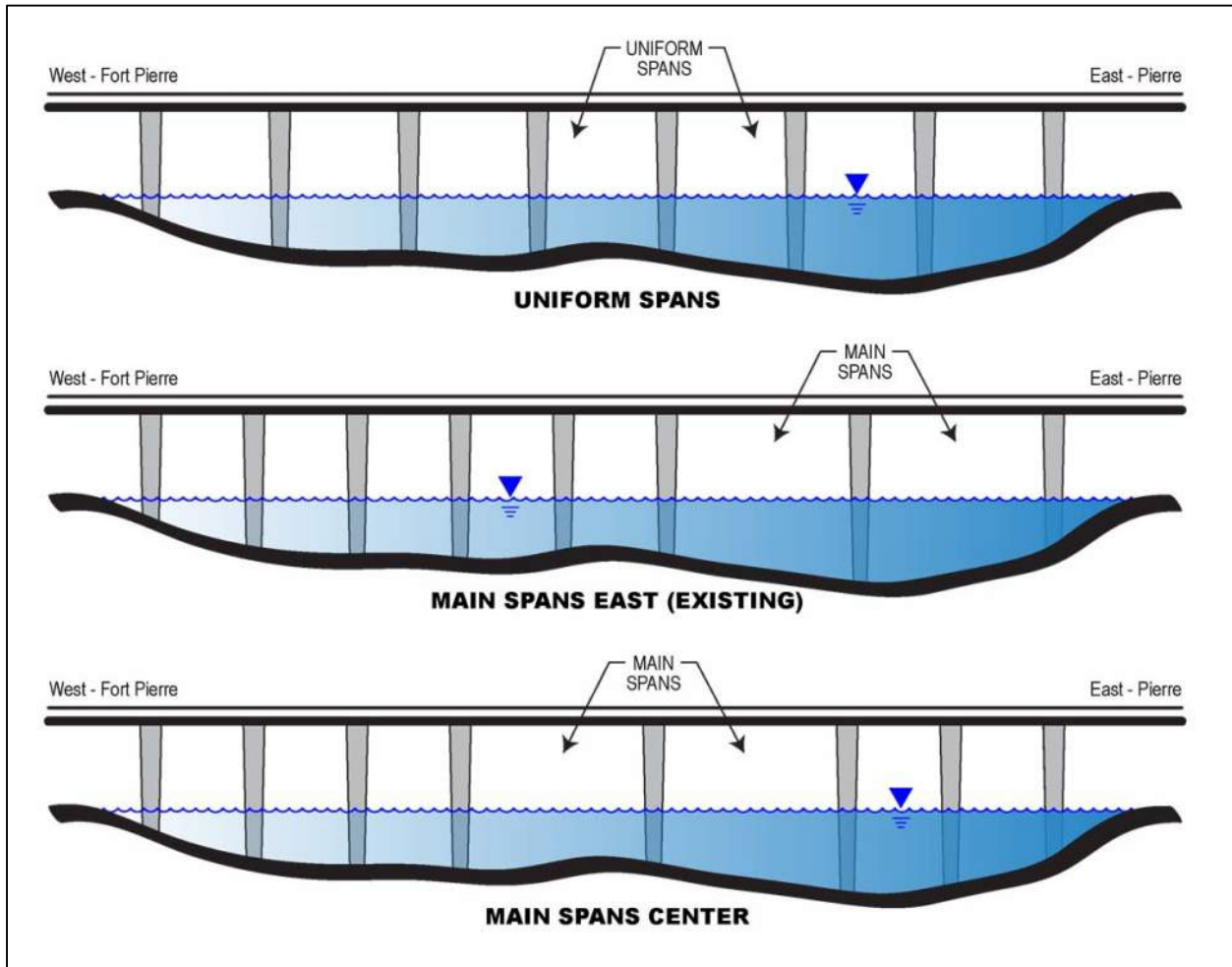
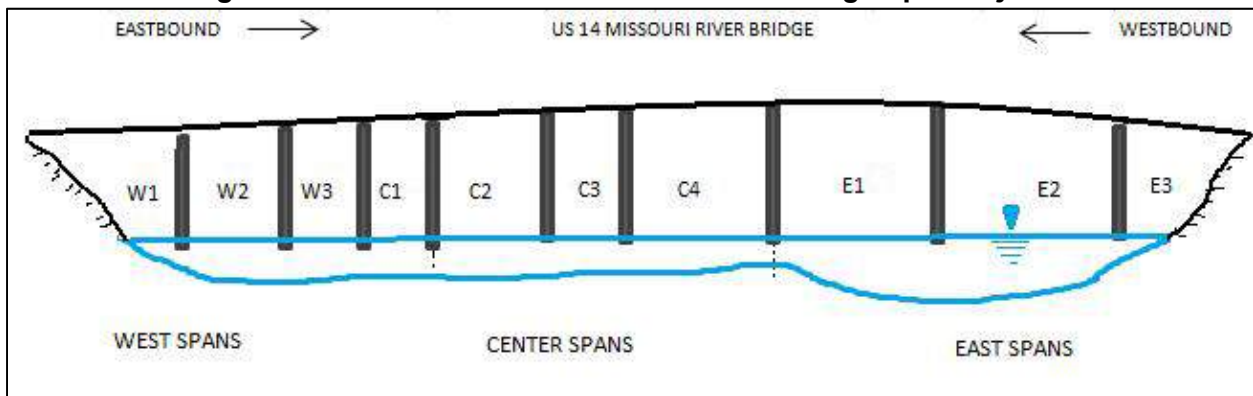


Figure 5.10: Current US14 Missouri River Bridge Span Layout.

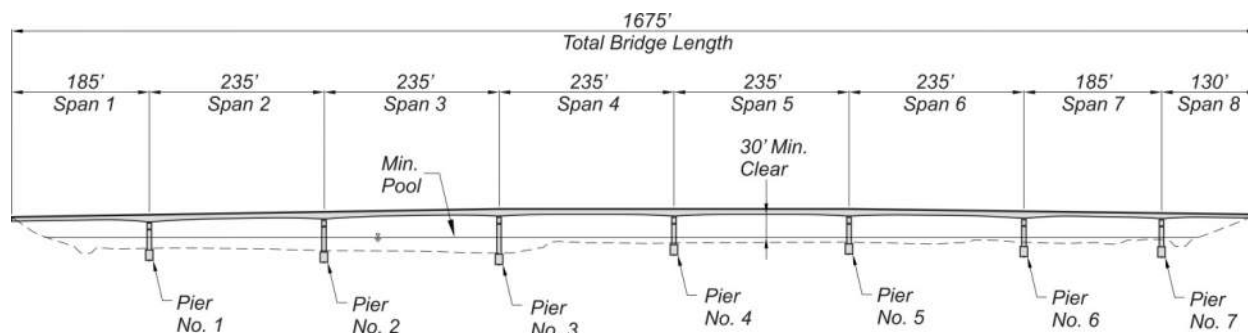


In studying span layouts for the US14 Missouri River Bridge Replacement Study, the USCG and SDDOT were consulted as to the possibility of moving the navigational lanes from their current location at the eastern end of the bridge. A field study performed indicated that western-central and eastern-central spans accommodated the highest levels of boat traffic

(Figure 5.10). Additionally, the existing railroad bridge has its largest spans on the western side so moving the navigational lanes seemed a natural choice given that there is no commercial traffic on this section of the Missouri River.

Therefore, refined span arrangement analysis undertaken in Tier III utilized a series of 235 ft. spans located at the westerly portion of the bridge.

Figure 5.11: Refined Span Arrangement



5.3.6 Bridge Cross-Section and Lighting – Alternative Refinement

Figures 5.12 and 5.13 show alternatives for the bridge cross section.

5.3.6.1. Bridge Cross-Section

Cross-section Option 4A, which had neither a median curb nor median barrier, was eliminated due to concern with head-on crashes. Thus, the remaining were Option 4B - Median Concrete Barrier and Option 4C - Median Concrete Curb with permutations of each pertaining to the type and location of roadway lighting, i.e., high level cobra lighting with pedestrian back lamps versus lower level pedestrian lights

It was noted that crash attenuators would be necessary if the median barrier was selected for final design. However, it was also noted that the cost of the attenuators was relatively low and should not greatly influence the decision.

It was acknowledged that the decision of either a median barrier or median curb would affect the preference for bridge lighting schemes. Traffic scale (30-50 ft poles) lighting along the center barrier was favored – as it interferes less with maintenance operations and reduces the number of poles.

The curb design is superior for emergency vehicles, snow storage and bridge deck inspection.

The project team selected Option 4C - Median Curb to be the preferred option to progress to Tier III, as this design requires the largest cross section. This gives later flexibility to change to a median barrier either during final design or even many years after the bridge is in operation.

Figure 5.12: Bridge Cross-Section and Lighting Alternatives



(a) Option 4A.1 – No Median, High Poles



(b) Option 4A.2 – No Median, Low Poles



(c) Option 4B.1 – Median Barrier, High Poles



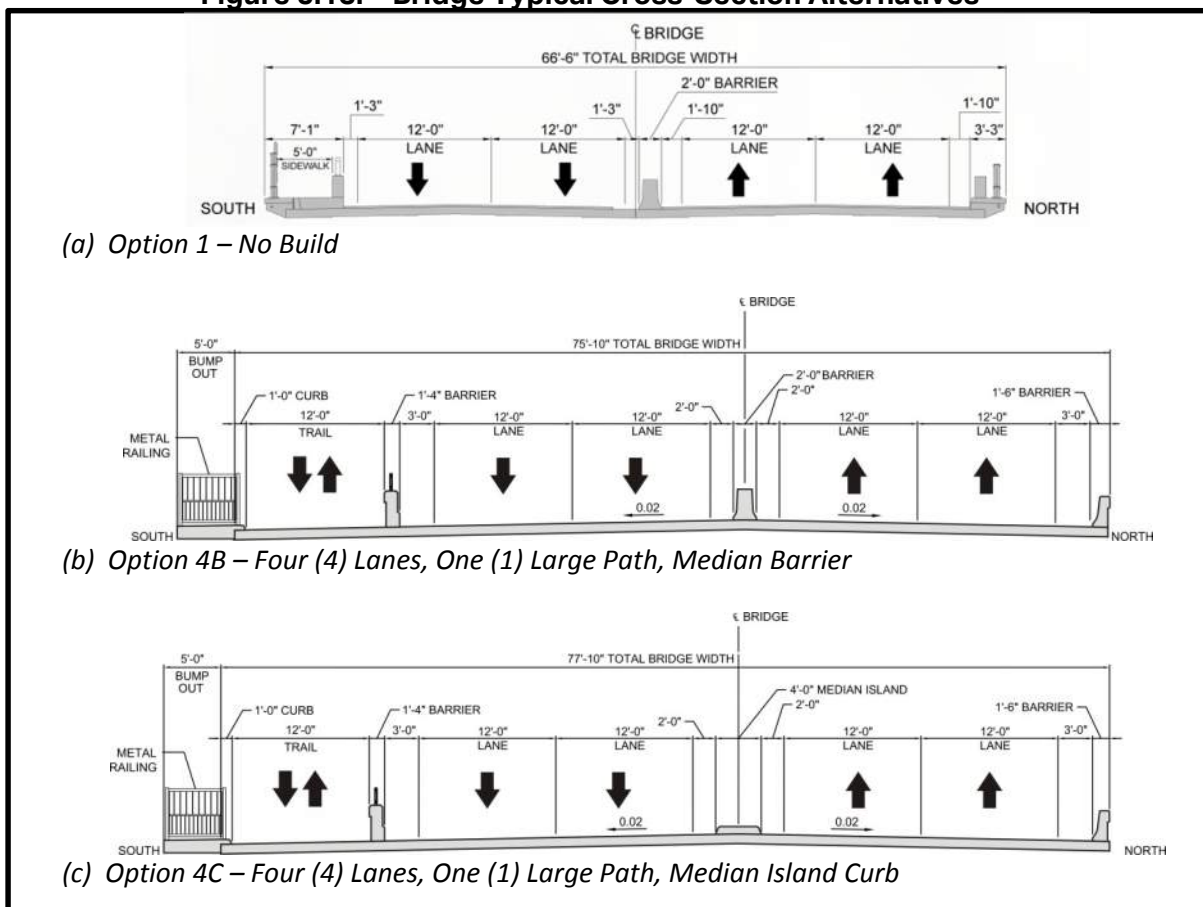
(d) Option 4B.2 – Median Barrier, Low Poles



(e) Option 4C.1 – Median Barrier, High Poles



(f) Option 4C.2 – Median Curb, Low Poles

Figure 5.13: Bridge Typical Cross-Section Alternatives

5.3.6.2. Bridge Lighting

The public survey and comments favored Concept 3 – Decorative Roadway Lighting or Pedestrian Scale (16-18 ft.).

- SDDOT's current standards and lighting policy are HPS traffic scale fixtures (30-40 ft.). Incorporation of additional fixtures at pedestrian scale or LED luminaires would require cost participation by the cities.
- The advantages for traffic scale lighting are fewer poles resulting in lower cost and less conflict with bridge inspections.
- The SDDOT inspection truck cannot clear the height of the pedestrian poles (16' to 18') therefore this type of lighting would impact the efficiency of bridge inspections.

Based on public input and SAT/CAC meeting discussions, the proposed lighting fixtures for the bridge are proposed to be traffic scale in height placed on the outside of the roadway. Additional pedestrian scale lighting may be incorporated along the concrete barrier separating the trail from the roadway. This concept is illustrated in **Figure 5.14** below:

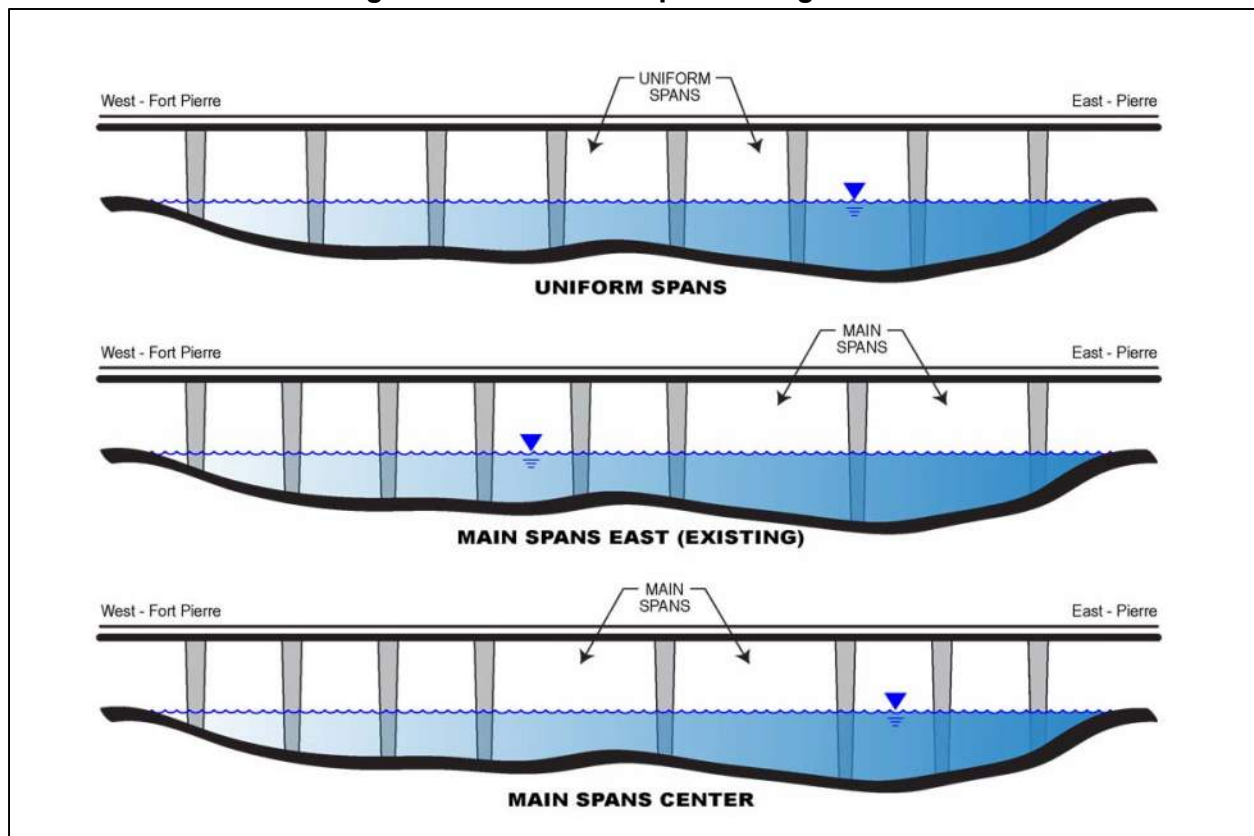
Figure 5.14: Bridge Lighting



5.3.6.3. Tier II – Span Arrangements

Reiterated from Section 5.3.5, **Figure 5.15** shows span arrangements with uniform spans, main spans to the east; and main spans centered, respectively.

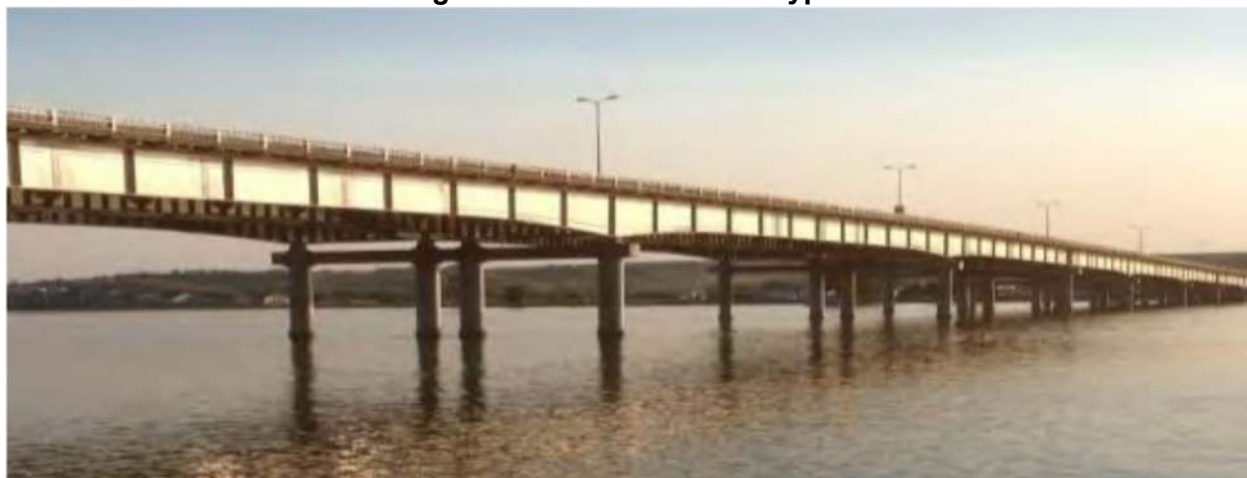
Figure 5.15: Tier II – Span Arrangements



5.3.7 Tier II - Pier Types

Six pier types presented in **Figure 5.16** (a) thru (f) were advanced during Tier II, and these were further narrowed to Concept 0 – No-Build, Concept 2B – Two Column Pier – Classic, and Concept 4 – Trapezoidal Pier. The pier type concepts were reviewed based on: 1) their accessibility for inspection and maintenance; 2) scour resistance; 3) ability to meet regulatory requirements; and, 4) overall social, environmental, and economic impacts.

Figure 5.16: Tier II – Pier Types



(a) *Concept 0 – No-Build*



(b) *Concept 1 - Single Column Hammerhead*



(c) *Concept 2A – Dual Column Chevron*



(d) *Concept 2B - Dual Column Classic - Preferred*



(e) *Concept 3 - Three Column*



(f) Concept 4 – Trapezoidal Pier

Discussion related to the selection of the preferred pier type is outlined below:

- Both options, the classic two column pier (Concept 2B) and the trapezoidal pier (Concept 4) were supported by the public in the survey. The classic two column pier (Concept 2B) was the most preferred by the public.
- The cost estimate for the trapezoidal design is much larger due to the need for cofferdams. With cofferdams the trapezoidal cost increase was approximately \$2.7M. If both designs utilized cofferdams the cost difference would be approximately \$1M.
- During Tier II, a final decision was not made on the piling (drilled shaft vs. driven) but the existing gas line presents a challenge for the footing design.

As an outcome of the Tier II selection process, the SAT selected the classical two-column pier (Concept 2B) as the preferred option. Refinements (varying column spacing, cap proportions, etc.) are anticipated during final design; nonetheless, future structural design calculations, cost estimates and renderings will assume this shape.

5.3.8 Tier II – Superstructure Types

Figure 5.17 (a) thru (f) presents parallel flange and haunched girder systems in both steel and concrete types. These were evaluated during Tier II based on: 1) structural redundancy; 2) continuity of form and function; 3) maintenance and cost; and 4), ability to meet regulatory requirements.

Figure 5.17: Tier II – Superstructure Types



(a) Parallel Flange Steel Girder



(b) Haunched Flange Steel Girder



(c) Haunched Flange Concrete Girder



(d) Dual Column Pier with hybrid concrete beam layout – haunched mainspan, parallel approach

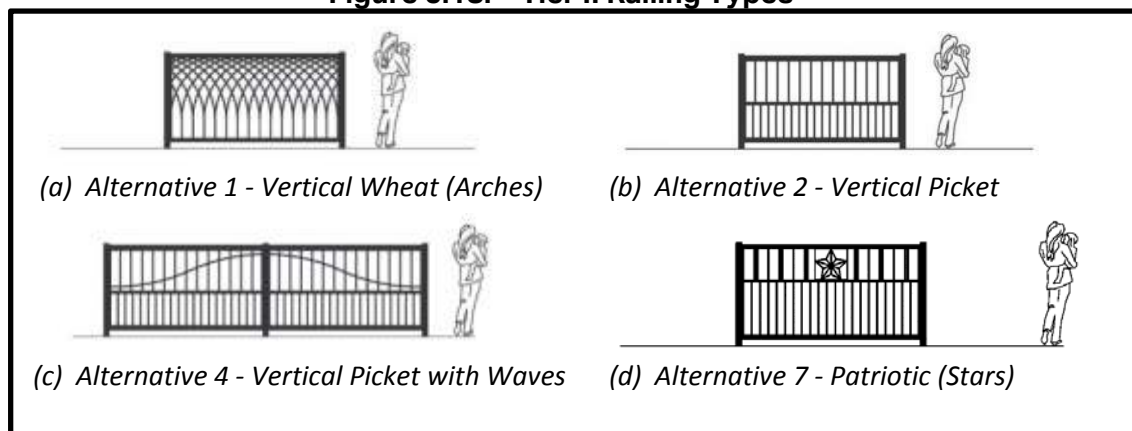
Discussion related to the selection of the preferred superstructure type is outlined below:

- Industry feedback was received from NSBA and PCI for the steel and concrete girder designs, respectively. Concrete strength should be kept below 10,000 psi if prestressed girders are selected for the final design. Concrete strength above 9,500 psi will drastically limit producers and will require aggregate from sources outside South Dakota which is not preferred.
- If concrete girders are selected, the large size would require fabrication at Forterra (formerly Cretex) in Minneapolis. Forterra in Minnesota can construct and ship sections up to 184 feet with 4 million pounds of prestressing force. Both Forterra and Gage Brothers in South Dakota have beds with capacities of 2 million pounds of prestressing force and about 150 foot maximum length.
- Public input indicated a preference for haunched girders versus parallel girders. The SAT indicated that the steel and concrete options should both include haunched beam designs to avoid favoritism for either industry. It was pointed out that haunches affect the steel price by perhaps 10% and the concrete industry by 50%. This decision makes the concrete girder option less efficient and more expensive. The optimal concrete structural design is a “hybrid” with parallel girders at the approaches and haunched girders at the main piers.
- Multiple (4) steel girder span arrangements ranging from 235 ft spans to 270 ft spans were considered in the concept design process. The 270 ft spans were recommended by the steel industry. The cost difference between the options was minimal. The current concept utilizes the 235 ft. span layout to provide a similar footprint in the river as the concrete concept design and to provide consistency for the environmental review process. During final design, additional span length maybe considered for the steel option if desired at that time.

5.3.9 Railing Types

Four railing types presented in **Figure 5.18** were evaluated during Tier II. Their review was based on their ability to accommodate pedestrians and bicycles, compatibility with the railroad bridge, continuity of form and function, initial cost and lifecycles costs including maintenance, and public preference.

Figure 5.18: Tier II Railing Types



Discussion related to the selection of the preferred railing option is outlined below:

- The Patriotic Railing (Alternative 7) was the preferred railing design picked by the public. It works well with the classical two-column pier and rounds out a federalist style for the bridge.
- Cost did not have an impact on the selection of any of the railing options.
- A suggestion was made to use brass for the "stars" on Alternative 7.
- A suggestion was made to use gold "oak leaves" instead of "stars" on Alternative 7. This would reflect the significance of Lt. Commander Waldron's rank (existing bridge's namesake).
- There was support for a number of designs, prompting a suggestion for a "hybrid" of Alternative 2, Alternative 4, and Alternative 7. This was generally accepted. Such a hybrid design would lower the cost differences between single alternatives.
- Flag holders should be fabricated with the railings rather than attached as they are now to the bridge.

As an outcome of the Tier II selection process, the SAT directed the CAC to discuss and decide which railing option should be presented as preferred via a follow-up meeting.

5.4 Tier III – Alternatives and Refinement

The bridge alternatives selected in the Tier II evaluation were advanced for detailed analysis and refinement in Tier III. This section discusses the results of the refined analysis. Some design selections that were made at the Tier II evaluation are repeated in this section to communicate the selected preferred alternate.

5.4.1 Tier III – Bridge Characteristics (Location, Section and Type)

Bridge Location:

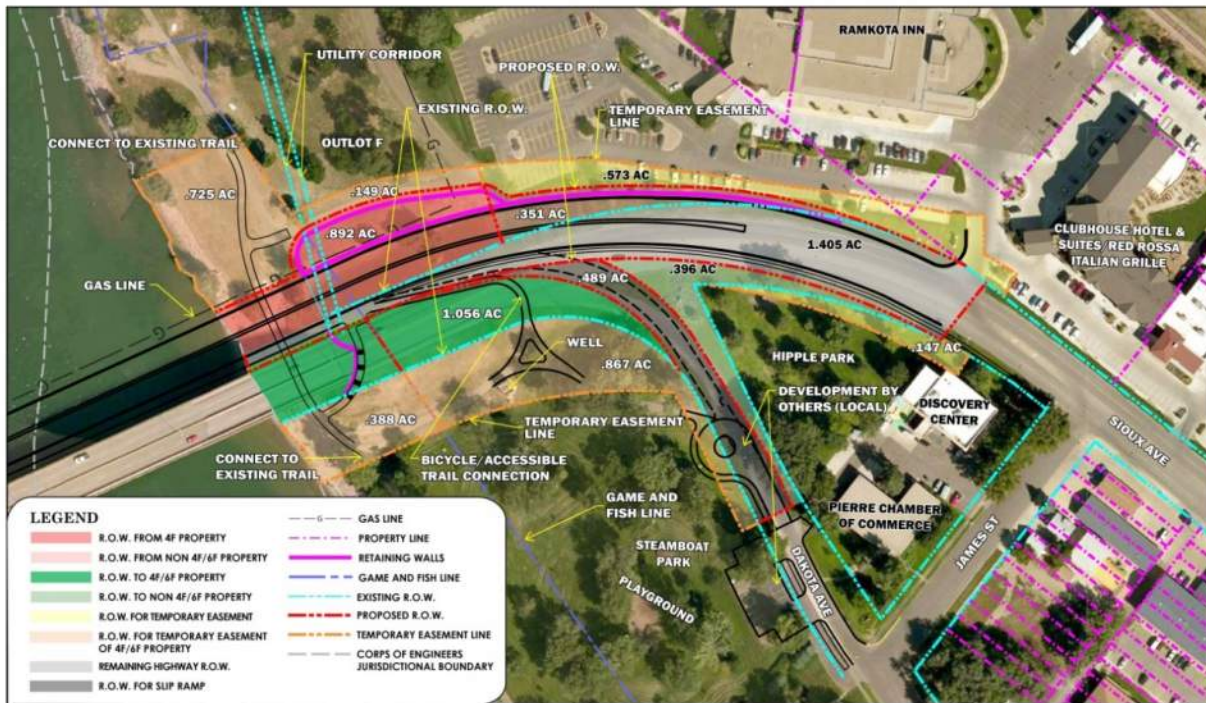
The location selected by the SAT during the Tier II selection refinement is shown in **Figure 5.18**. The preferred location encompasses the project constraints while limiting impacts to adjacent properties. The preferred location also retains the option for future intersection improvements at Dakota Ave.

Figure 5.19 (a) illustrates the selected location for the bridge (Alternate N1.1 from Figure 5.3(b)). **Figures 5.19 (b) and (c)** illustrate the bridge approaches in Pierre and Fort Pierre respectively including estimated ROW impacts, retaining wall locations and pedestrian trail connections.

Figure 5.19: Bridge Location Illustrations

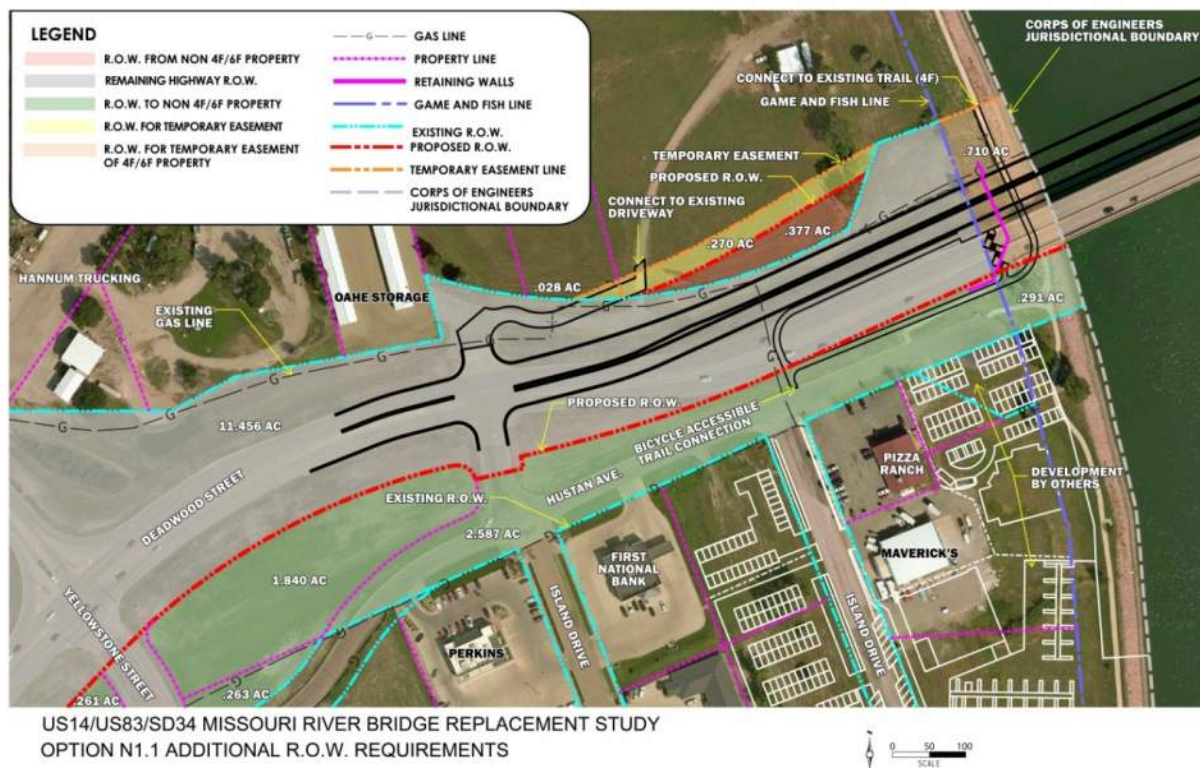


(a) Alternate N1.1 from Figure 5.3(b)



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OPTION N1.1 R.O.W. REQUIREMENTS

(b) Bridge Approach in Pierre and Fort Pierre



(c) Bridge Approach in Fort Pierre

Retaining Walls at Bridge Approaches:

The preferred location includes retaining walls as shown above on both approaches. The plan layout of retaining walls is similar between the preferred steel and concrete alternatives. However, to maintain a minimum of 30 ft. clearance over minimum pool, the roadway profile of the concrete alternative is higher relative to the steel alternative, and the height of retaining walls is larger for the concrete alternative relative to the steel alternative.

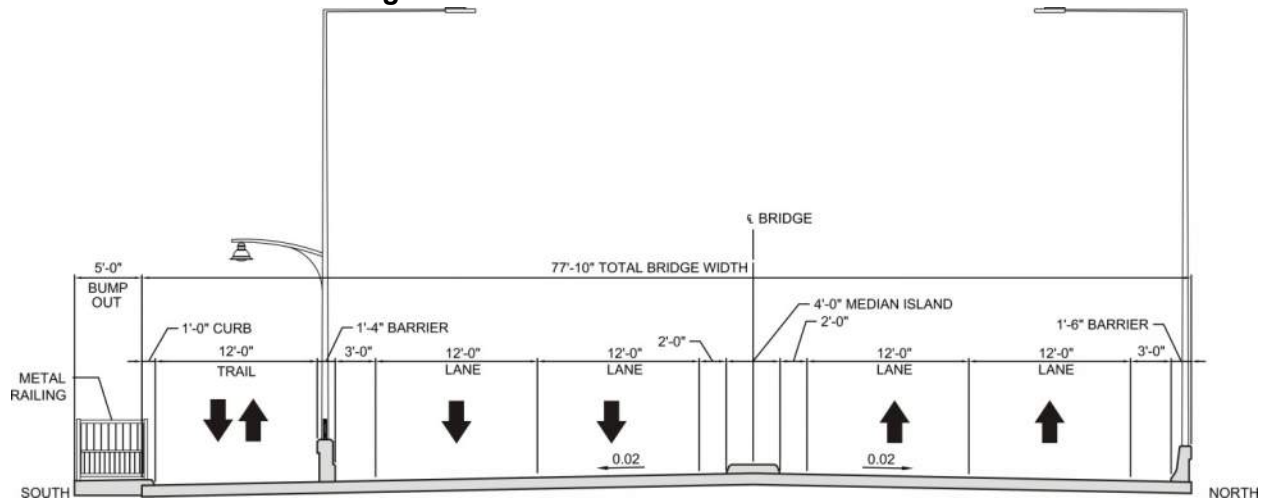
Retaining wall aesthetic design will be determined as a part of the final design process. Discussions with the CAC and the SAT included consideration of artistic patterns or form liner enhancements to retaining walls. Depending on the final aesthetic treatment selected, local communities may be responsible for participating with funding of aesthetic treatments on retaining walls.

Bridge Cross Section:

After extensive coordination and discussion with stakeholders, the preferred bridge cross section was determined to include a 12 ft. bicycle and pedestrian sidewalk, 12 ft. traffic lanes (2 eastbound and 2 westbound), and shoulders ranging from 2 ft to 3 ft. A concrete parapet with pedestrian railing separates the shared use path from the eastbound travel lanes, and a median curb separates the westbound and eastbound travel lanes. Concrete barriers bound the sidewalk and travel lanes at the exterior of the cross section. The preferred bridge cross section is shown in **Figure 5.20** below.

The bridge cross section includes deck bump outs for pedestrian observation overlooks at pier locations near the middle of the bridge. The observation overlooks provide safe areas for rest away from oncoming bicycle and pedestrian traffic, and afford expansive views southward toward Steamboat Park and La Framboise Island. The section also illustrates the 4 ft. wide raised curb median option which requires 2 feet additional deck width versus the concrete median barrier option. Lane configuration will initially be 12 feet with 3 foot outside shoulders, both requiring a total of 29 feet from face to face of curb or barrier. The lanes on the bridge will remain 12 foot lanes until the approaching highway segments are reconstructed. The bridge will then be striped to match the lane width of the approaches, which according to current SDDOT standards will be 11 foot lanes. The cross section figure below shows 12 foot lanes and 3 foot outside shoulders.

Figure 5.20: Preferred Cross Section



Span Arrangement:

Span arrangements ranging from 235 ft. spans to 270 ft. spans were considered in earlier phases of the evaluation. The 270 ft. spans were recommended by the steel industry. Based on early work, the cost difference between span options was not significant. To provide the maximum amount of flexibility in final design URS recommended 235 ft. spans be progressed in Tier III. The 235 ft. spans have the advantage of being competitive with both steel and concrete superstructures and mesh well with the environmental effort. Recommending 235 ft. spans at this stage does not preclude revisiting longer spans at final design.

Based on the discussion above, the SAT elected to progress an 8-span option with span lengths of 185-235-235-235-235-235-185-130 ft., for a total bridge length of 1675 ft. This span arrangement was used for both steel and concrete superstructure options.

Superstructure:

Based on public input, the SAT gave the instruction that both the steel and concrete superstructure options were to be haunched for all spans. With this in mind, haunched superstructure layouts were generated for the span arrangement discussed above.

For the steel superstructure option, based on the initial assessments and discussion with the SAT, the haunch parameters were as follows:

- Maximum girder depth of 9 ft.
- Use a ratio of maximum to minimum girder depth of 1.4, or 6'-5" minimum depth
- Use a parabolic haunch that extends to 1/3 point of the span
- Use the same girder depth and haunch proportions for all spans
- Assume field sections begin and end at haunch
- Optimize haunch and minimum girder depth for shorter spans
- 6 Girders are anticipated

An elevation and cross section view of the recommended steel alternative are shown in **Figures 5.21 and 5.22.**

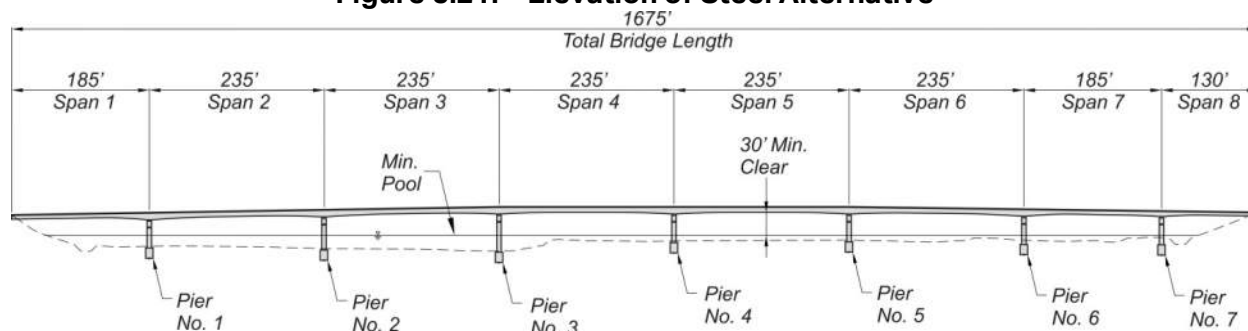
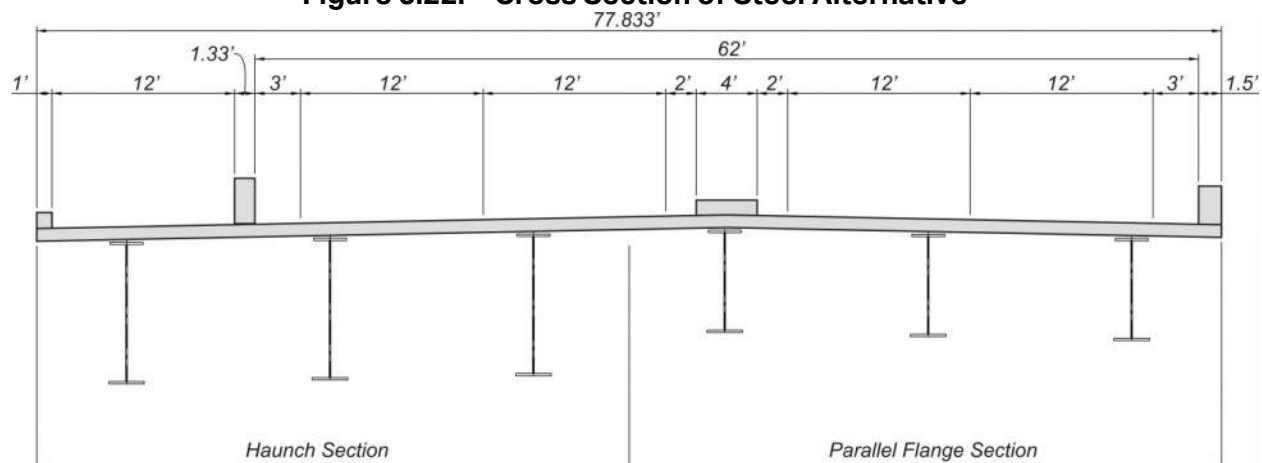
Figure 5.21: Elevation of Steel Alternative

Figure 5.22: Cross Section of Steel Alternative

Fabricating haunched sections for built-up plate I-girders is relatively straightforward and does not differ significantly from fabricating parallel flange plate girders, although it does add cost. Girder segment lengths are limited by shipping restrictions and crane lifting restrictions on-site.

Although precast concrete may provide a clean uniform look and may offer advantages over steel due to long-term maintenance costs, haunched sections for precast concrete members are somewhat more complex relative to steel, especially if custom forms are required to be purchased or fabricated for the project. Additionally, due to shipping and crane lifting restrictions, the maximum length of precast concrete haunched sections is smaller, relative to steel. With this in mind, the haunch parameters for the concrete superstructure option were as follows:

- Use spiced girder post-tensioning construction
- Use MINDOT 96MW prestressed beam (web modified) for parallel flange region
- Use a ratio of maximum to minimum girder depth of 1.4, or 11 ft. maximum depth
- Use a parabolic haunch that extends to 1/4 point of the span (to reduce the weight of haunched precast sections)
- Assume field sections begin and end at haunch
- Use the same girder depth and haunch proportions for all spans
- To limit post-tensioning losses, build the superstructure in two units.
- 8 Girders are anticipated

An elevation and cross section view of the recommended concrete alternative are shown in **Figures 5.23 and 5.24**.

Figure 5.23: Elevation of Concrete Alternative

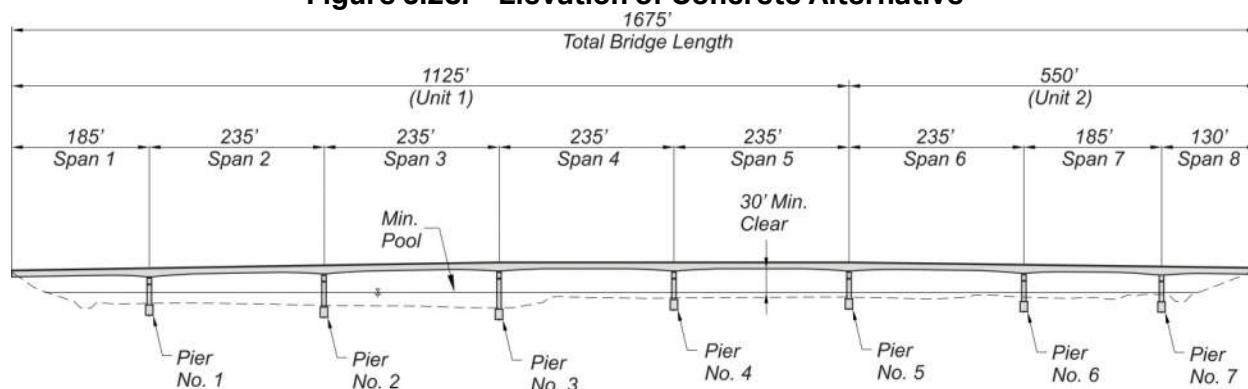
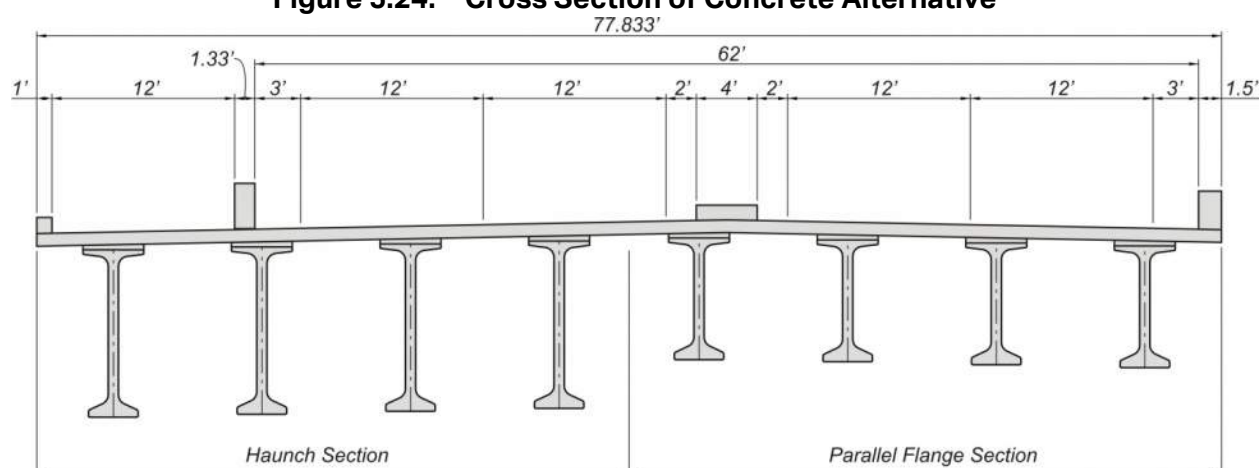


Figure 5.24: Cross Section of Concrete Alternative



The span lengths for the steel and concrete alternatives are summarized in **Table 5.3**.

Table 5.3: Span Lengths for Steel and Concrete Alternative

Option 1 – Precast				Option 2 - Steel			
Span	Length (ft)	Unit	Length (ft)	Span	Length (ft)	Unit	Length (ft)
1	185	1		1	185	1	
2	235	1		2	235	1	
3	235	1		3	235	1	
4	235	1		4	235	1	
5	235	1	1125	5	235	1	
6	235	2		6	235	1	
7	185	2		7	185	1	
8	130	2	550	8	130	1	1675
Total			1675	Total			1675

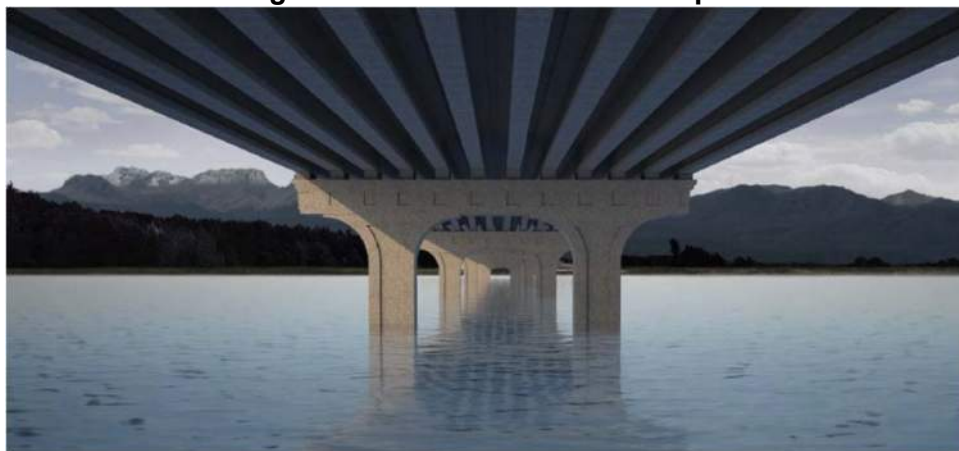
Substructure:

The piers were analyzed using a combination of transverse and longitudinal models. Because extensive geotechnical information was not available, simplifying assumptions were applied

to the analysis and design models in an attempt to envelope the design of the substructure for costing purposes.

The preferred pier type was the classical two column pier shown in **Figure 5.25** (here shown with concrete superstructure). Column spacing and member proportions may be refined during the final design.

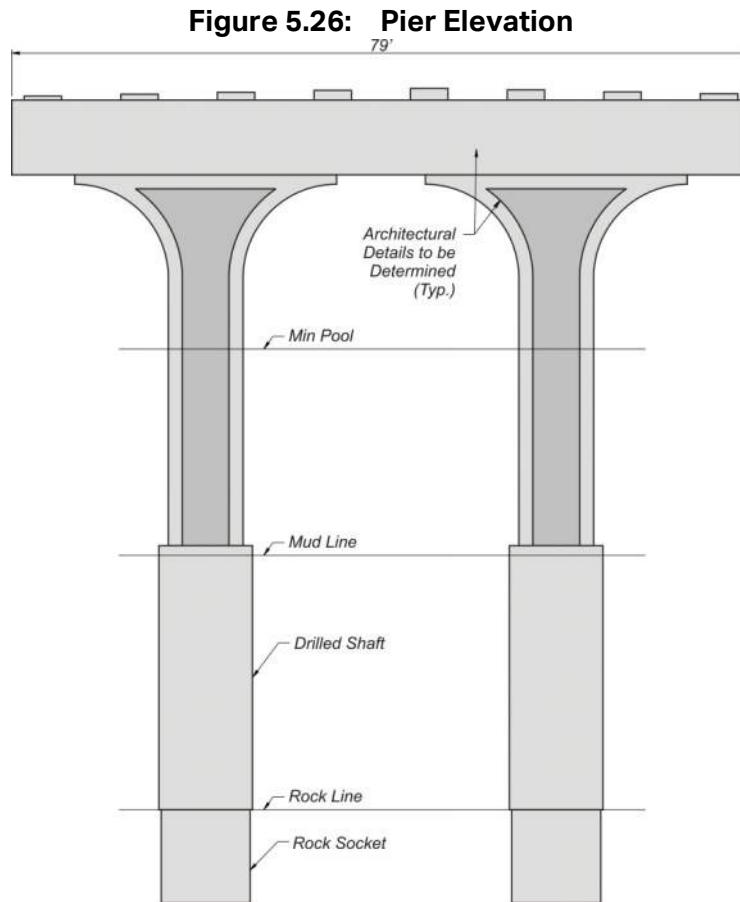
Figure 5.25: Preferred Pier Shape



A comparison was made between single drilled shafts beneath each pier column and a group of driven piles with a footing cap. Drilled shafts have the advantage of a reduced footprint, but will require additional geotechnical investigation during final design to better determine the length of rock socket required to support the loading. The length of the rock socket is a significant cost driver for drilled shafts. Drilled shafts can also be constructed over water without the use of a cofferdam.

Driven piles had the advantage of being relatively cheap and easy to install on an individual basis, but had lower axial and transverse member capacity than drilled shafts, and therefore many piles were required to support the loading. Driven piles require installing a cofferdam at each pier location to build the footing cap in dry conditions. Finally, although further study of this issue is required during final design, pile driving operations may not be feasible due to the presence of an existing gas line near the bridge.

For the reasons discussed, drilled shaft foundations are the recommended alternative at this stage. The cost estimates for steel and concrete superstructure alternatives assume the classical 2-column pier and drilled shaft foundation. **Figure 5.26** shows the general concrete outline of the classical 2-column pier and drilled shaft foundation based on preliminary analysis (note that architectural embellishments are not shown).



Figures 5.27 and 5.28 show renderings of the steel and concrete alternatives with the preferred substructure alternative.

Figure 5.27: Steel Superstructure with Preferred Substructure



Figure 5.28: Concrete Superstructure with Preferred Substructure

5.4.2 Bridge Aesthetics and Architectural Components

Lighting

Roadway and pedestrian lighting were initially presented for public input through a survey made available on the project website. The decision was made at the conclusion of Tier 2 that traffic scale lighting and cantilevered pedestrian lights would be placed at the pier locations along the length of the bridge. A conceptual bridge section with drawing of the proposed lighting is shown below in **Figure 5.29**:

Figure 5.29: Conceptual Bridge Section with Proposed Lighting

Railings

A variety of alternatives were proposed from typical DOT standard to ornamental type railings. These options were presented in the same survey as the roadway and pedestrian lighting, bridge type, pier type, and bridge cross section. Based on the results of the survey

and a cost comparison of the install cost of alternative, the ornamental railing with intermittent star motifs is proposed to be included with the final design of the bridge. The railing design compliments the dual column pier aesthetic which emulates a design aesthetic with a Capitol architectural influence. A rendering of the proposed railing is shown below in **Figure 5.30**:

Figure 5.30: Rendering of Proposed Railing

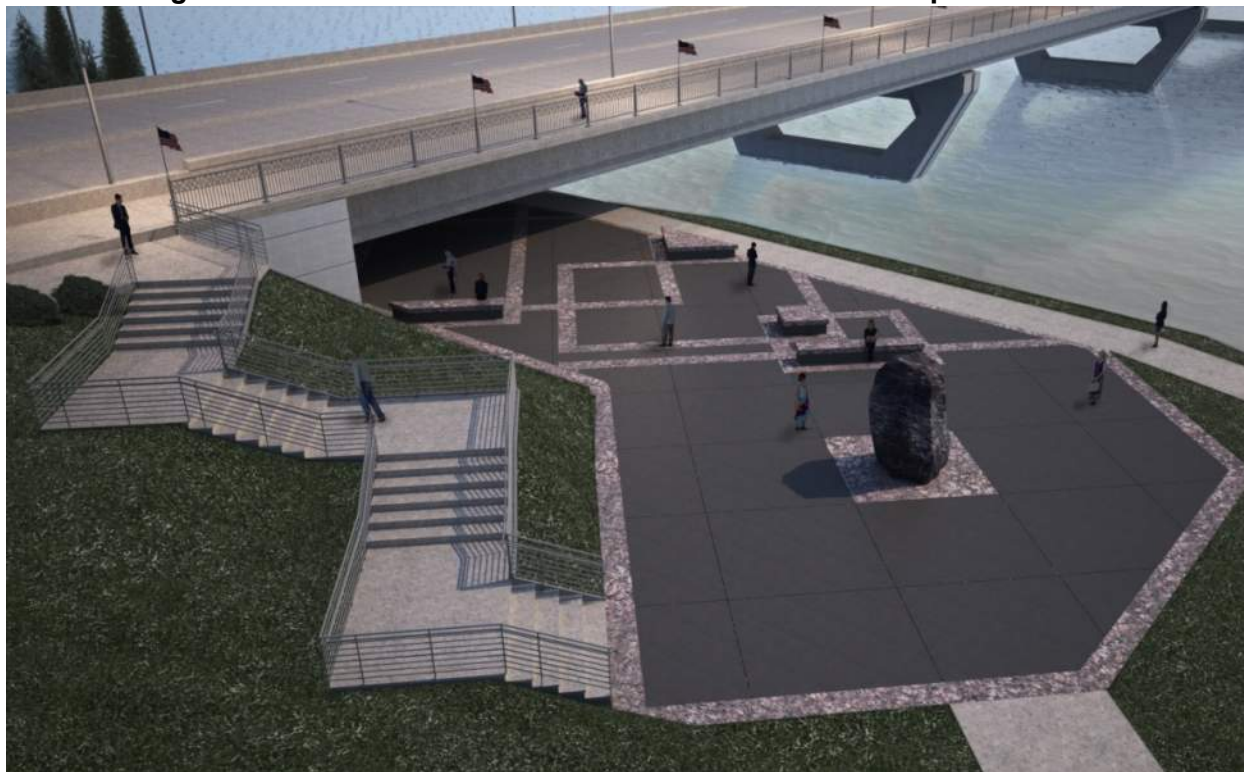


Architectural Plaza Enhancements:

Concepts were developed and discussed at Public/CAC meetings to illustrate potential improvements at each abutment area with decorative plazas. Actual improvements at each abutment area will need to be determined during the design process. Each city shall be responsible for costs of improvements greater than basic finishes (i.e. standard concrete walk) including potential colored concrete, steps and public art elements that have been discussed during the concept phase. **Figures 5.31 and 5.32** show concepts at the West and East Abutments, respectively.

Figure 5.31: East Abutment Plaza Enhancement Concept – Pierre



Figure 5.32: West Abutment Plaza Enhancement Concept – Ft. Pierre**Fishing Pier / Canoe Launch**

Public and CAC meetings have included some discussion related to incorporation of fishing piers and canoe launch facilities in conjunction with the bridge project. Although these improvements may be incorporated into the project scope, costs associated with design, construction and maintenance of enhancements of this type are assumed to be 100% local responsibility. The illustration shown in **Figure 5.33** below represents one concept related to a canoe launch/fishing platform along the river bank near the abutment area, and shows an independent fishing pier south of the bridge connected to the abutment plaza.

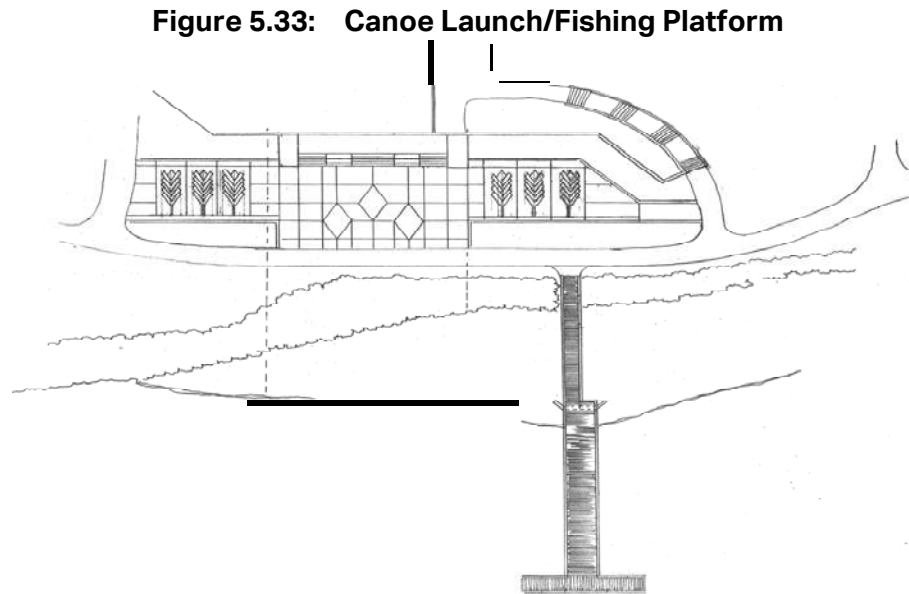
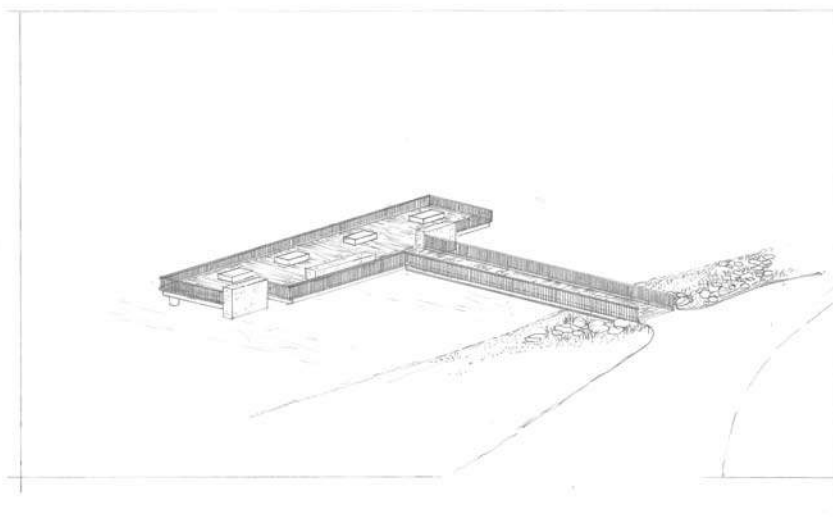


Illustration shown in **Figure 5.34** shows the fishing pier constructed around the bridge piers (represented by 4 rectangular protrusions in deck).

Figure 5.34: Fishing Pier Constructed Around Bridge Piers



The illustration shown in **Figure 5.35** outlines a concept for canoe launch/rivers edge enhancements. The location for this concept is south of the proposed bridge on the Pierre side of the river. The trail leading away from the boat launch plaza would connect to the trail system/plaza on the top of the embankment.

Figure 5.35: Canoe Launch / River's Edge Plaza Enhancement Concept

5.4.3 Demolition

Discussions with the U.S. Coast Guard and U.S. Army Corps of Engineers related to demolition of the existing bridge provided the following information:

- 1) U.S. Coast Guard requires that a 150 foot wide channel be cleared for river navigation within 24 hours of demolition.
- 2) Cut-off elevation for existing piers needs to be elevation 1403.7 or lower.
- 3) Demolition may include dropping the structure into the water as long as the channel is cleared.
- 4) Use of explosives in demolition of the existing bridge will need to be discussed further with the ACOE and USCG during final design. The USACE and USCG will consider whether alternatives such as dropping onto barges or piecing out in small sections are feasible and more acceptable from a public interest perspective. Additional considerations related to potential use of explosives include an evaluation on whether measures will need to be taken (and are feasible) to protect the newly constructed bridge from any damage resulting from the use of explosives for the demolition of the existing bridge.
- 5) Demolition of existing bridge will need to be scheduled to avoid impacts to wildlife that utilize the bridge for nesting etc. (refer to Environmental Assessment for additional information).
- 6) The bridge demolition will likely require a Section 404 of the Clean Water Act permit to account for discharge of fill (construction debris), temporary work platforms, temporary isolation/diversion of portions of the Missouri River

5.4.4 Construction

The construction of the Missouri River crossing at Pierre has the typical challenges of marine construction with fluctuating weather conditions, current, and channel depths.

Figure 5:36: Modular Barge System with Spud Piles (Photo Courtesy of mpsbv.com)



With the current channel depth, it is envisioned that construction could take place utilizing barges with barge mounted cranes. Understanding that the commercial river traffic to Pierre is blocked by downstream and upstream dams, the barges used could be of the modular type which are shipped overland and then assembled into large work platforms at the site. As shown in the photo above, spud piles at the corners of the barges are used to anchor the barge platform and assist with the stability of the barge. The Contracting team can also ballast the barges with water as needed to assist in maintaining stability of equipment.

Construction from barges with equipment is typical and would allow for the movement of personnel and materials from shore to the pier locations. The equipment to construct the foundation elements is often most challenging; nonetheless, they have been performed successfully and fairly recently at the Vermillion, Yankton, and Running Water crossings over the Missouri River.

Both steel and concrete elements for the superstructure framing elements are anticipated to be constructed at plant facilities offsite and trucked to Pierre for their assembly into the bridge permanent works.

The anticipated construction scheme also anticipates temporary falsework towers to support either steel or concrete superstructures during their erection. These towers commonly utilize driven pipe pile for their foundation elements and are likely fairly substantial elements to accommodate anticipated loads including ice loads. The falsework towers will limit channel width temporarily during construction, and the Contractor is responsible to coordinate with appropriate governmental agencies.

Once the foundations, substructures, and girder framing are in place, the majority of activities take place from the permanent structure and the need for temporary works is diminished. After the bridge deck is cast, finishing work would include placement of bridge furniture including barriers, light poles, railing and electrical, as well as other amenities included in the project.

5.4.5 Utility Coordination

Existing utilities have been considered as a part of the bridge study work completed to date. Part of the rationale for the proposed bridge alignment is to avoid significant conflicts with an existing buried gas main under the Missouri River. Utility relocation costs are not anticipated to be a significant part of this project. During the final design process, detailed information on what utilities require relocation along with new locations, proposed timeline and cost (if costs are to be reimbursed by the project). During the final design process, the SDDOT and final design engineer will conduct utility information meetings and coordinate utility relocations with the appropriate representatives. Results of the utility coordination meetings will be reflected in the final construction drawings.

5.4.6 Drainage

Stormwater runoff from the existing bridge deck is routed directly to the Missouri River below through regularly spaced deck drains on the edge of the bridge to ensure stormwater is efficiently routed away from traffic lanes and off the bridge deck. The proposed bridge design includes a similar approach to managing stormwater runoff from the bridge deck.

Stormwater management on the Pierre and Fort Pierre approaches will be accomplished using curb and gutter, catch basins, storm sewer pipe, ditches and swales in a manner and arrangement similar to existing conditions. Total impervious area drained will decrease by approximately 3% on the Pierre approaches and 2% on the Ft. Pierre side and therefore will not require the introduction of new stormwater treatment infrastructure.

Catch basin spacing and deck drain locations will be determined in final design in accordance with design criteria for the appropriate storm design event and allowable spread specified in the South Dakota DOT Drainage Manual.

5.4.7 Cost Analysis

Initial Cost Analysis:

The basis of the cost estimating for this report uses a unit-price type estimate. The unit prices were derived from a combination of historical unit price information (with adjustments for inflation and geographic location) for other similar projects. The cost estimate was established using tabulated estimates of important quantities from the preliminary engineering analyses. The cost estimate was also adjusted to include percentage adjustments for the following:

- Mobilization 5%
- Design Contingency 20%
- Construction Contingency 20%
- Escalation (3% x 2 years = 6%)

The design and construction adjustments are to capture variability and risk during both design and construction (for example, the unforeseen components of the preliminary design, limited available foundation information, and the variability of bid prices). The Escalation factor is to account for unit prices that were based on 2014 prices.

Table 5.4 is a summary comparison of the initial construction costs for steel and concrete superstructure alternatives, respectively. Note the cost summary includes retaining walls, removal of the existing bridge, and other supplemental items. Information used in the development of **Table 5.4** can be found in Appendix D.

Table 5.4: Initial Cost Summary

Alternative	Bridge Length and Width (ft)	Bridge Total (\$ Millions)	Bridge Unit Cost (\$/sf)
6-Girder Steel Haunched	1675 x 81.833	\$51.3M	\$375/sf
8-Girder Concrete Haunched	1675 x 81.833	\$55.1M	\$402/sf

Life Cycle Cost Analysis:

For life cycle cost evaluations, a schedule for items which require periodic maintenance was developed (See **Table 5.5**) for the assumed 100-year bridge life span.

Table 5.5: Bridge Maintenance Schedule (100 Year Lifespan)

Maintenance Item	Year of Occurrence
Maintenance and Inspection	Annual
Deck Rehabilitation	25, 50, & 75
Bearing Replacement	50
Expansion Joint Replacement	25, 50, & 75
Concrete Surface Treatment	25, 50, & 75
Steel Surface Treatment	25, 50, & 75

Table 5.6 is a summary comparison of present value and equivalent annual uniform cost. Real discount rates of 2%, 4% and 6% were used in the development of the life cycle cost information. Information used in the development of **Table 5.6** can be found in Appendix D.

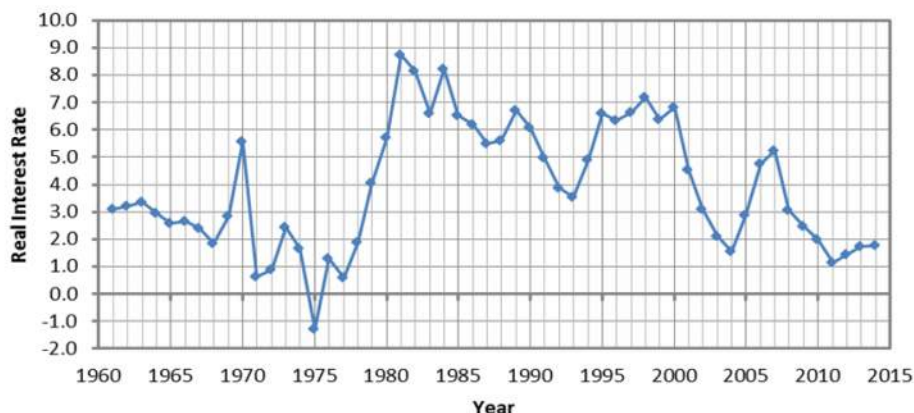
Table 5.6: Life Cycle Cost (100 Year Lifespan)

Alternative	Present Value Total (& Millions)			Equiv. Uniform Annual Cost (& Millions)		
	Real Discount Rate			Real Discount Rate		
	2%	4%	6%	2%	4%	6%
6-Girder Steel Haunched	\$56.0M	\$53.7M	\$52.7M	\$1.3M	\$2.2M	\$3.2M
8-Girder Concrete Haunched	\$58.9M	\$57.0M	\$56.2M	\$1.4M	\$2.3M	\$3.4M

Some background related to the life cycle cost evaluation is beneficial. The present value and equivalent uniform annual cost are not directly influenced by current interest or inflation rates. Rather the "Real Discount Rate" essentially represents the spread between the rate at which money can be borrowed and the rate of inflation. Thus, the life cycle cost estimates presented in **Table 5.6** are inflation rate and lending rate neutral.

Figure 5.37 presents the Real Interest Rate (the spread between the lending rate and inflation rate) for the United States over the last 55 years (Ref. <http://data.worldbank.org/indicator/FR.INR.RINR>). It can be seen that this rate fluctuates from approximately -1.5% to approximately 9% as market and economic conditions change. The mean average of the Real Interest Rate over the past 40 years is 4.0%. Currently, we are in an economic climate where the Real Interest Rate is approximately 2%.

Figure 5.37: Real Interest Rate of the United States



Summarizing this discussion, the values of the equivalent uniform annual costs presented in Table 5.6 can be compared directly. Moreover, this comparison can be made on a lending rate and inflation rate neutral basis since the above values are presented in terms of the real discount rate.

SECTION 6 REFERENCES

1. "Environmental Assessment and Section 4(f) *De Minimis Analysis* for US14/US83/SD34 Bridge over the Missouri River and its approaches", prepared for the South Dakota Department of Transportation by URS Corporation, May, 2016.
2. Crane, R.W., "A Proposal for Considering Scour in Vessel Collision Design", Southeastern Hydraulic Engineers' Conference, 1992.
3. "Recommendations for Bridge and Tunnel Security", Federal Highway Administration (FHWA), <http://www.fhwa.dot.gov/bridge/security/brp.pdf>, September, 2003.

APPENDIX A
Methods and Assumptions and
Meeting Documentation

Methods & Assumptions Meeting Documentation



1. Methods and Assumptions Cover Page

US14/US83/SD34 Missouri River Bridge Replacement Study

To: Study Advisory Team (SDDOT, FHWA, City of Pierre, City of Fort Pierre)
From: Greg Brown, URS; Carl Osberg, URS; Carrie Cooper, URS
Project: US14/US83/SD34 Missouri River Bridge Replacement Study
CC: File
Date: October 3, 2013
Job Numbers: 31811343/350/351/352/354 & Work Order PD-04-13 to Agreement 410540

Methods and Assumptions Document

This Methods and Assumptions document was developed as a summation of the Methods and Assumptions Meeting held on October 3, 2012 with representatives from the South Dakota Department of Transportation (SDDOT), Federal Highway Administration (FHWA), City of Pierre, City of Fort Pierre and URS. This document is intended to serve as a historical record of the process, dates and decisions made by the study team representative for the US14/US83/SD34 Missouri River Bridge Replacement Study.

Amendment #1: (if required)

Amendment Date: _____

Amendment #2: (if required)

Amendment Date: _____

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2. Stakeholder Acceptance Page

The undersigned parties concur with the Methods and Assumptions for the **US14/US83/SD34 Missouri River Bridge Replacement Study** as presented in this document.

SDDOT: [Signature]
Signature
Data Analysis Engineer
Title
November 6, 2013
Date

FHWA: [Signature]
Signature
Planning/Civil Rights Specialist
Title
November 13, 2013
Date

The undersigned parties concur with Amendment #1 (if required) to this document.

SDDOT: _____
Signature

Title

Date

FHWA: _____
Signature

Title

Date

The undersigned parties concur with Amendment #2 (if required) to this document.

SDDOT: _____
Signature

Title

Date

FHWA: _____
Signature

Title

Date

Methods and Assumptions Acceptance Notes:

(1) Participation on the Study Advisory Team and/or signing of this document does not constitute approval of the **US14/US83/SD34 Missouri River Bridge Replacement Study** Final Report or conclusions.

(2) All members of the Study Advisory Team will accept this document as a guide and reference as the study progresses through the various stages of development. If there are any agreed upon changes to the assumptions in this document a revision will be created, endorsed and signed by all the signatories.

3. Introduction and Project Description

A. Project Background and Understanding

The South Dakota Department of Transportation (SDDOT) in conjunction with the Cities of Fort Pierre and Pierre has selected a consultant team lead by URS to conduct the **US14/US83/SD34 Missouri River Bridge Replacement Study** for the State of South Dakota. This study will include developing context sensitive concepts for various locations and types of structures to replace the existing US14/US83/SD34 Missouri River Bridge (Also known as the John C. Waldron Memorial Bridge or NBI # 00000033100118) and performing a study in accordance with the National Environmental Policy Act (NEPA) of those concepts to determine a preferred option. As opportunities to cross the Missouri River in central South Dakota are limited, the new structure concepts will be required to be built with limited disruption to existing traffic and will need to perform beyond a 100 year service life. The study will require 3-D renderings be created, for each build alternative considered in the NEPA process, and presented to the public and decision makers.

B. Project Location

The existing bridge crosses the Missouri River between Pierre and Fort Pierre. These communities lie roughly in the center of South Dakota. Pierre is the state capital and Fort Pierre is the state's oldest continuously occupied white settlement. The replacement bridge options for this study will be positioned either slightly to the north or south of the existing location, as dictated by the prescribed Study Area.

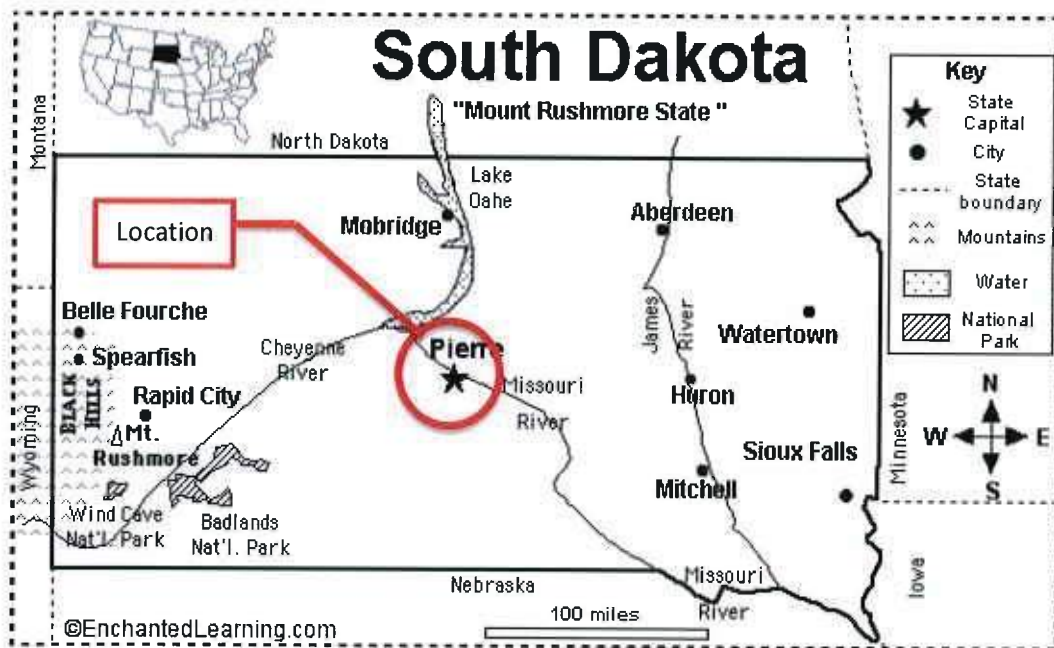


Figure 1: Regional Location Map

The study area is defined in greater detail in Section 4.0 of this document.

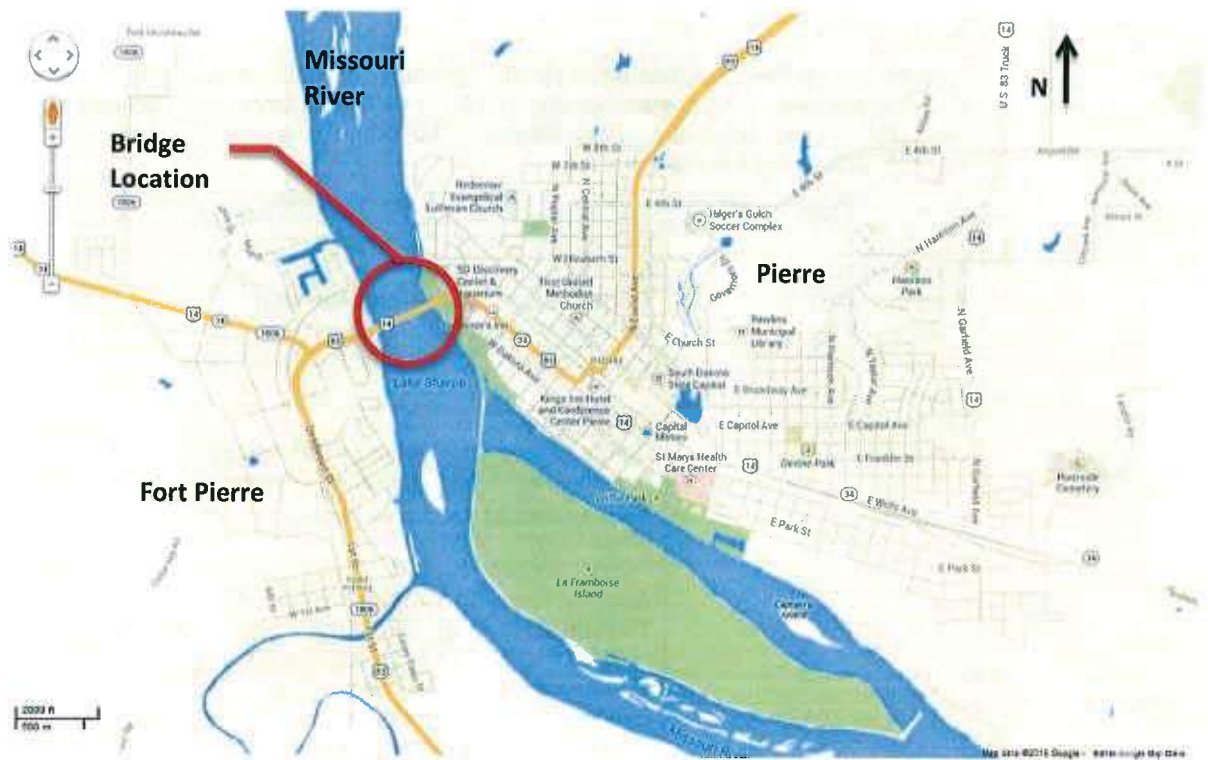


Figure 2: Municipal Location Map

C. Need for Study

The purpose of and need for the project is to address the bridge's and/or project area's: deteriorated condition, current and future capacity and safety issues – while fitting into local and regional land-use and transportation plans (that have been developed) with an emphasis on minimizing environmental and socioeconomic impacts. The preferred alternative(s) that will be chosen for the bridge will address those needs into the future - 2045 design year for the corridor and 2125 service year for the bridge.

The study phase will include fulfilling the planning and NEPA environmental activities necessary to meet the following objectives:

1. Complete a structure location and type study for a new long-term (100+ years) performing bridge considering economics, aesthetics, maintenance, and impact to the community.
2. Complete the NEPA process necessary to advance the project into the final design phase.
3. Complete a safety analysis of the highway corridor within the study area.
4. Identify locations on the highway corridor within the study area not in compliance with current design standards under both the current and forecasted future traffic conditions.
5. Create final products (environmental assessment, study reports, conceptual designs, architectural details, TS&L plans) for use by the SDDOT which will guide the Department in the design phase for the bridge replacement project.

D. Study Schedule

The schedule for this study has been set at 18 months. The study began on July 1, 2013 and is set to be completed by December 31, 2014. The table below and Appendix C show the anticipated project schedule. Also Section 10.0 contains an environmental schedule and Appendix D contains the meetings list.

Date	Task/Event
July 2013	Notice to Proceed, Kickoff Meeting
August 2013	SAT and CAC Kickoff Meetings
September 2013 – October 2013	Methods & Assumptions Meeting Methods & Assumptions Document
November 2013- February 2014	Baseline Conditions Analysis / Data Collection
October 2013 – November 2013	Field Survey Bridge Conceptual Options/Alternatives Created Existing Traffic and Operations Analysis Safety Analysis Utility Coordination Project Website Kickoff Agency Scoping Meeting (Project Kickoff) 1st Public Meeting - November (Project Kickoff/Purpose and Need, Initial Bridge Type and Location Concepts) Purpose & Need Document
December 2013 – February 2014	Existing Traffic and Operations Analysis - <i>continued</i> Future Needs Analysis - <i>continued</i> Safety Analysis – <i>continued</i> Utility Coordination – <i>continued</i> Initial Analysis of Bridge Concepts/ Alternatives Determination of 4(f)/6(f) Properties Bridge/Roadway Concepts Screened
February 2014 – March 2014	Future Needs Analysis - <i>continued</i> Safety Analysis – <i>continued</i> Build Alternative(s) Selected Removal Plan of Existing Structure Refinement of Build Alternative(s) Bridge Architectural Detailing
April 2014 – May 2014	Build Alternatives Refined – <i>continued</i> Removal Plan of Existing Structure – <i>continued</i> Constructibility of Build Alternatives Life-cycle Cost Analysis 2nd Public Meeting – May (Refined Build Alternative(s) with 3-D graphics) Stakeholder Meeting #1 (Discuss Alternative(s))
May 2014 – August 2014	Removal Plan of Existing Structure – <i>continued</i> Recommended Alternative(s) Refinement Complete Environmental Documentation
September 2014 – December 2014	Final Environmental Documents 3rd Public Meeting – September (NEPA process findings, and other issues to be determined by SDDOT) Stakeholder Meeting #2 (Discuss ROW issues with preferred Build Alternative(s))
December 2014	FONSI Final Study Report TS&L Plans Complete
June 2015	Project Website Ends

Figure 3: Project Schedule Summary

E. Facilities that will be affected by Study

Facilities that potentially will be affected by this study and are present in the study area, include but are not limited to:

- Existing US14/US83/SD34 Missouri River Bridge
- Missouri River
- Existing Bike/Pedestrian Trail System and Markers (Lewis and Clark Bicentennial Trail)
- The Highway US14/US83/SD34 (Deadwood St/W. Sioux Ave) corridor between Poplar Ave and Yellowstone Street
- Historic Railroad Bridge
- Original car bridge abutment/pier footing on Pierre side
- Pierre Side Facilities include, but are not limited to:
 - SD Discovery Center
 - City of Pierre Water Well Pump houses
 - Pierre Chamber of Commerce Building
 - W. Dakota Avenue and intersections in study area
 - James Street and intersections in study area
 - S. Charles Street and intersections in study area
 - S. Poplar Ave and intersections in study area
 - Hipple Park
 - Steamboat Park facilities in study area
 - Frisbee Golf Course,
 - Historic Schoolhouse,
 - Playground
 - Pavilion and Restrooms
 - Parking Lot
 - Potential Pierre / Ft. Pierre Community Pool Development
 - Businesses
 - Best Western Ramkota Hotel
 - Clubhouse Hotel & Suites, Red Rossa
 - Governor's Inn
 - River Lodge Hotel
 - McDonalds
 - China Buffet
 - Friman Oil and Gas Inc
 - Shel's Gas Stop
- Fort Pierre Side Facilities include, but are not limited to:
 - Old Deadwood Trail Marker
 - Lt Commander John C. Waldron Memorial Marker
 - Hustan Ave and intersections in study area
 - Island Drive and intersections in study area
 - Royal Court and intersections in study area
 - Riverwalk Landing Development
 - Businesses
 - Pizza Ranch
 - First National Bank
 - Perkins
 - Mavericks Recreation Equipment Sales
 - Oahe Storage
 - Hannum Trucking

The corridors/roadways that are included in this study (potential affect) are as follows:

- US HWY 14/ US HWY 83/ SD HWY 34 – level of service analyzed per HCM2010.
- Poplar Street – level of service analyzed per HCM2010.
- Yellowstone Street – level of service analyzed per HCM2010.
- Dakota Ave – level of service analyzed per HCM2010.
- James Street – level of service analysis will not be conducted.
- Charles Street – level of service analysis will not be conducted.
- Hustan Avenue – level of service analysis will not be conducted.
- Island Drive – level of service analysis will not be conducted.

The intersections included in this study (potential affect) are as follows:

- Poplar Street/Sioux Avenue – level of service analyzed per HCM2010.
- Poplar Street/W. Dakota Avenue – level of service analysis will not be conducted.
- Charles Street/Sioux Avenue – level of service analysis will not be conducted.
- Charles Street/W. Dakota Avenue – level of service analysis will not be conducted.
- James Street/Sioux Avenue – level of service analysis will not be conducted.
- James Street/W. Dakota Avenue – level of service analysis will not be conducted.
- Yellowstone Street/Deadwood Street – level of service analyzed per HCM2010.
- Yellowstone Street/Hustan Ave – level of service analysis will not be conducted.
- Hustan Ave/Island Drive – level of service analysis will not be conducted.
- Deadwood Street / Island Drive – level of service analysis will not be conducted.
- Dakota Avenue Eastbound Off-Ramp From Bridge – level of service analyzed per HCM2010.

The trails that are included in this study (potential affect) are as follows:

- Trail on existing bridge
- Trail under existing bridge on Pierre side
- Trail under existing bridge on Ft. Pierre side

F. Previous Studies

Previous studies that are pertinent to this study include, but are not limited to:

- City of Pierre Comprehensive Plan, December 2008
- City of Pierre Strategic Plan 2013-2014, January 2013
- City of Pierre Historic Preservation Plan, October 2008
- City of Fort Pierre Comprehensive Development Plan, (publish date unknown at this time)
- City of Fort Pierre Housing Study, December 2012
- City of Fort Pierre: Community Assessment Survey Final Project Report August 13, 2008
- Fort Pierre Chouteau Historic Site Management Plan, February 2010
- Comprehensive Economic Development Strategy 2013-2017, Central South Dakota Enhancement District, December 2012
- Community & Economic Development Survey Results, Central South Dakota Enhancement District, December 2012
- Hughes County Comprehensive Plan, 1997 (*newer plan in progress*)
- Pierre Downtown & Waterfront Development Master Plan, (*in-progress*)
- Pierre Area Riverfront Improvement Study, (Stockwell Engineering- in progress)
- Fort Pierre Riverwalk Landing Development Study, Midwest Construction, (*in-progress*)
- Pierre Waterpark Study Report (Pierre Retail) August 2009
- Pierre Outdoor Water Park Survey and Study (*in-progress*)
- Coordination Assessment and Transit Development Plans for River Cities Public Transit Pierre, SD, 2007
- FEMA Flood Mapping – post 2011
- USACE Final Oahe Dam/Lake Oahe Master Plan, Sept 2010
- USACE Omaha District, Missouri River Mainstem System: 2011-2013 Annual Operating Plan, January 2012
- USACE Omaha District, Missouri River Mainstem Reservoir System: Post 2011 Flood Event Analysis of Missouri River Mainstem Flood Control Storage, April 2012
- USACE Omaha District, Draft, Oahe Dam/Lake Oahe Project South Dakota & North Dakota Surplus Water Report, vol.1, August 2012
- Seismic Evaluation Causative Fault Study, Missouri River, Oahe Dam, Lake Oahe, SD 1985
- US 14B/Garfield Avenue Pierre, SD Access Plan, June 2003
- SDDOT Public Involvement Plan, 2010
- South Dakota Department of Agriculture – Community Threat Protocol (*in progress*)
- South Dakota Comprehensive Wildlife Conservation Plan - Department of Game, Fish, and Parks Wildlife Division Report 2005-2007, September 2005
- FHWA FONSI for Project EM 2014(11)229 PCN 00T6 Hughes County, SD Railroad Improvements in Pierre, SD, July 2009
- National Parks Conservation Association: National Parks along the Lewis and Clark Trail – State of the Parks, September 2006
- Local Rural Road Safety Audit Guidelines and Case Studies (SD2007-06), 2010

- Eastern Dakota and Pierre to I-90 Expressway Feasibility Study, 1994
- South Dakota Statewide Long Range Transportation Plan, Sept 2010
- State of South Dakota Hazard Mitigation Plan – Standard Plan, March 2011
- SDDOT Decennial Interstate Corridor Study, Phase 1, March 2010
- SDDOT Decennial Interstate Corridor Study, Phase 2, August 2010
- SDDOT Decennial Interstate Corridor Study, Phase 3 - Implementation Plan, Nov 2010
- Lewis and Clark Multiuse Trail, Iowa DOT, June 2013

G. Study Advisory Team Members

A Study Advisory Team (SAT) and a Community Advisory Committee (CAC) have been formed to provide input on the study through completion. The SAT is comprised of representative parties of the SDDOT, the City of Fort Pierre, the City of Pierre and the Federal Highway Administration (FHWA). Members of the Study Advisory Team include, but are not limited to:

Mark Clausen	FHWA – Bridge
Sonia Downs	SDDOT – Project Development
John Forman	SDDOT – Pierre Region
Tom Gilsrud	SDDOT – Bridge Design/Maintenance
Kevin Goeden	SDDOT – Bridge Design
Steve Gramm	SDDOT – Project Development
Mark Hoines	FHWA – Planning
Steve Johnson	SDDOT – Bridge Design
Brad Lawrence	City of Fort Pierre – Public Works
Tom Lehmkuhl	SDDOT – Project Development
Mark Leiferman	SDDOT – Road Design
Leon Schochenmaier	City of Pierre – Administrator
Dean VanDeWiele	SDDOT – Pierre Area

This study also includes a Community Advisory Committee (CAC). Members of the CAC include, but are not limited to:

Dave Bonde	Fort Pierre Development Corporation
Laurie Gill / Mike Harmon	City of Pierre
Gloria Hanson	City of Fort Pierre
Captain Dave Panzer	Pierre Police Department
Tom Lee	Capital City Bicycle Club
Anne Lewis	Discovery Center
Ray Lewis	Great Lakes of SD Tourism Association
Scott Rounds	Pierre/Ft Pierre Exchange Club
Laura Carbonneau / Tony Jockheck	Pierre Chamber of Commerce
Paul Lepisto	Izaak Walton League & SD Walleyes Unlimited
Family of Lt. Commander Waldron	Current Bridge Namesake Family

Applications for the public to join the CAC will be available at the public involvement meetings. Thus, additional team members will likely be added as the study progresses.

H. Complexity of Study

This study will evaluate a variety of options for a replacement bridge across the Missouri River between Pierre and Fort Pierre. This study has numerous complexities including:

- Long-span bridge – numerous types and locations
- 100-year bridge design life
- Numerous stakeholders
- Public involvement
- River crossing – federal waters
- Historically eligible bridge
- Numerous utilities around bridge
- Existing bridge removal plans
- Maintain traffic during construction
- Interface with existing trails and pedestrian facilities (ADA compliance)
- Section 4(f) of DOT Act

4. Study Area

The study area, as prescribed by the SDDOT in the RFP, is to include the area surrounding the existing US14/US83/SD34 Missouri River Bridge bounded in red in Figure 4, including the intersection of Deadwood Street and Yellowstone Street in Fort Pierre and the intersection of Sioux Avenue and Poplar Street in Pierre.

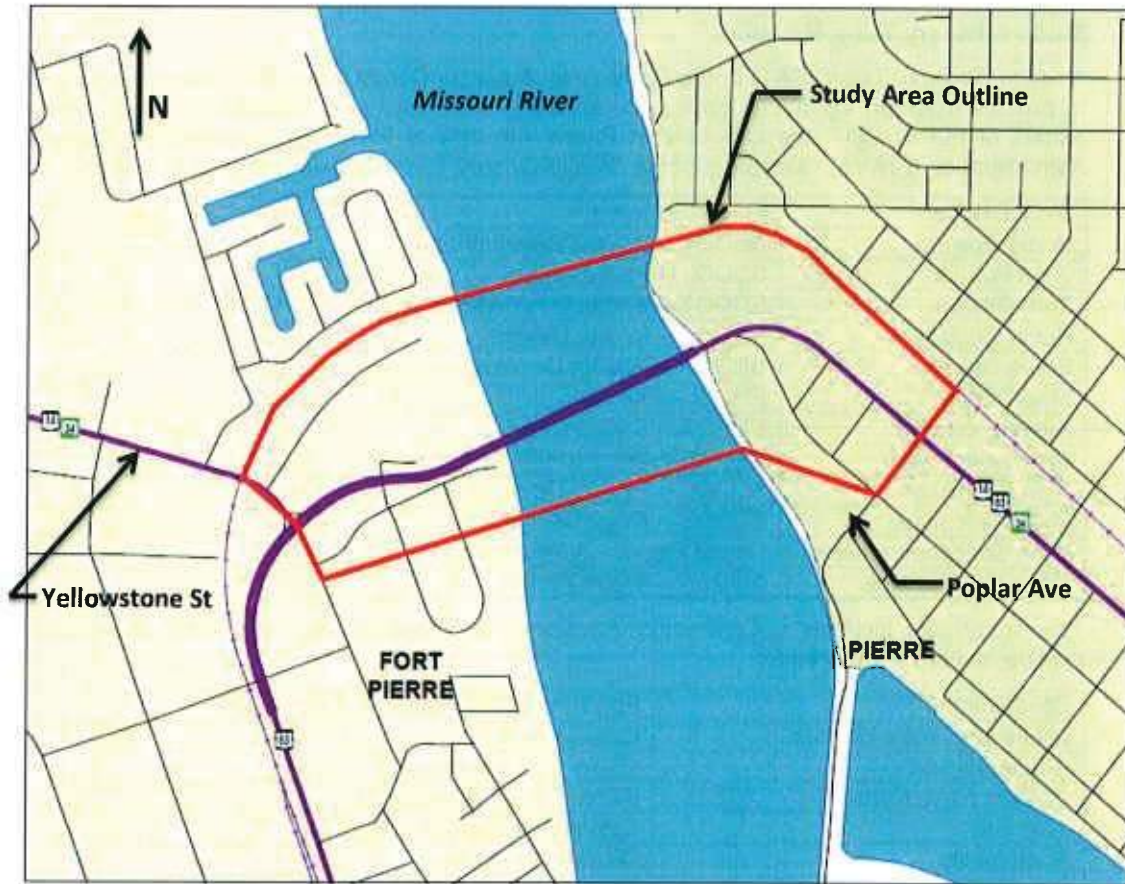


Figure 4: Project Study Area 1

The existing railroad bridge, tracks and at-grade railroad crossings are not included in this study.

5. Analysis Years/Periods

Traffic data in the study area will be collected for the existing year conditions (2013). This data includes, but is not limited to: corridor and intersection geometry and traffic control; peak hour corridor and/or intersection traffic volumes; and traffic signal phasing and timing. Traffic conditions will be forecasted to conditions for the expected year of opening for the new bridge (2025) and the planning horizon year (2045).

Traffic analysis will be performed in each of these years, existing (2013), project (2025) and planning (2045), during the AM, noon and PM peak hour periods (7:30AM-8:30AM, 11:00AM-1:30PM, and 4:30PM-5:30PM). Therefore, the forecasting task will include three peak hour periods for each of the three analysis years.

URS anticipates the bridge design period to extend to 100 years. Typically roadway and traffic analysis are 20-25 years. Since the bridge design life is much longer than typical roadway design life, URS anticipates a sensitivity analysis for traffic operations that will help confirm that the proposed bridge cross-section (from a traffic perspective) will provide adequate performance over the intended service life.

6. Data Collection

Data collection is one of the most important facets during any transportation planning study. URS has started reviewing the available project information. The approved project objectives and Methods and Assumptions Document will be our guide. All available documentation for the existing bridge and study area (Sioux/Poplar and Yellowstone/Deadwood) will be gathered and reviewed by the URS Team. This information will include: existing roadway alignments, access points, existing bridge plans, geotechnical information, GIS data, hydraulic studies, local planning documents and available environmental conditions documents. The information gathering will be broken down into smaller pieces and assigned to the appropriate disciplines. For instance, the environmental team will start looking at historical elements in the study area, while the bridge and roadway teams will start identifying alignments and structure types. Meetings with appropriate agencies will take place during this task to discuss the documentation, needs of the project and potential variances to existing standards. The information evaluation and documentation will include, but will not be limited to:

- Existing bridge, street/roadway standards of all applicable agencies.
- Current ordinances and guidelines.
- Previous transportation planning studies in the area – such as the US 14B/Garfield Ave Access Plan
- Traffic safety problems of the existing bridge - crash history, sightlines, merging, icing and lighting.
- Bicycle / pedestrian facilities, connections and needs – use, maintenance, access points.
- Watercraft desires and needs – from current recreational boats to dredgers.
- Existing railing types and light poles on the bridge.
- Existing utility corridors within the study area and future utilities on the bridge.
- Existing U.S. Corp of Engineers and U.S. Coast Guard plans and requirements for this section of the Missouri River – navigational clearances, channel location, silting/dredging issues, future of dam.
- Base mapping data and verify control points.
- Available traffic volume counts where needed – from automatic traffic recorder.
- Traffic classification data as needed – from SDDOT with additions from field investigations
- Turning movement counts where needed – obtained thru field data collection (see Fig 5).
- Traffic safety problems based on crash history and local knowledge.
- City and County development practices within the study area.
- Other relevant data - land use, old design plans, functional classifications, existing development plans, etc.
- Existing Canadian Pacific Railroad use of RR on perimeter of study area - identify their future plans as they pertain to impacts on the area's transportation system
- Existing capacity, geometric, right of way, and other deficiencies along the key routes identified within the study area.
- Develop a list of transportation issues currently facing the area.
- Identify possible disruptions to users with new construction.
- Environmental Data: Wetlands, T&E Plants and animals, Archaeological, historical, HazMAT sites, 4(f)/6(f) data, floodplain data, parcel data, census data, tribal coordination, utilities.

Traffic data collection will be performed at the identified intersections during the AM (06:00 – 09:00), noon (11:00-13:30) and PM (15:00 – 18:30) peak hour periods. Turning movement data including pedestrian and heavy vehicle counts will be collected in 15-minute intervals at the following intersections:

1. Yellowstone Street and Deadwood Street
2. Deadwood Street / Island Drive
3. Sioux Avenue and James Street
4. Sioux Avenue and Charles Street
5. Sioux Avenue and Poplar Avenue
6. Dakota Avenue eastbound off-ramp from Sioux Avenue

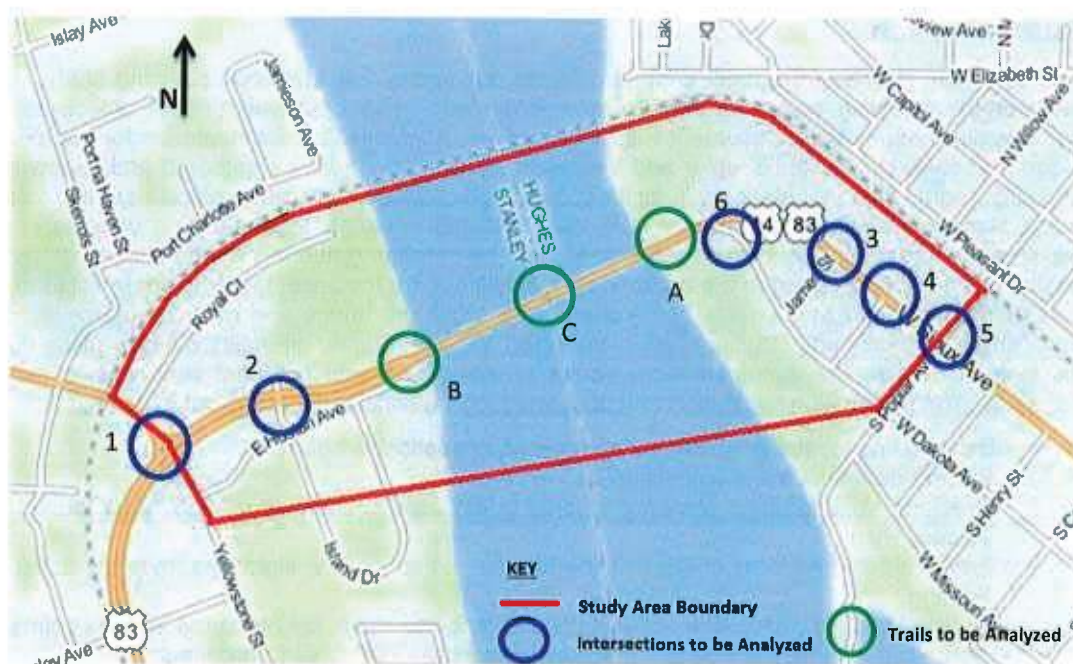


Figure 5: Map of Intersections for Data Collection

In addition to collecting turning movement data, hourly directional volumes will be collected for a 48-hour period on the bridge. An Automatic Traffic Recorder currently exists at the west bridge approach, which may be used – likely set at 15 minute intervals. Included in this data collection effort will be volumes, vehicle speeds, and vehicle classification.

Furthermore, pedestrian traffic counts on the trails will be collected in 15-minute intervals during the PM peak (16:30-18:30) time period, and will include the following locations:

- A. Trail under bridge on Pierre side
- B. Trail under bridge on Fort Pierre side
- C. Trail on bridge

Reviewing existing bridge data (plans, inspections, maintenance and repair records, project meetings to-date, and geotechnical reports) may provide information that can be used to understand potential issues with a new bridge and assist with cost estimating. This information will also be valuable in evaluating and estimating the cost of removal of the existing bridge and determining if additional borings and geotechnical analysis will be needed to verify subsurface conditions – reducing potential risks and limitations for the replacement bridge options.

A. Additional Data Supplied By SDDOT

- Roadway Design Standards
 - ◊ Available online at: <http://www.sddot.com/business/design/forms/roaddesign/>
- Crash History Geodatabase
 - ◊ Supplied by SDDOT - Includes crash records dated Jan 2008 to Dec 2012 (5 years)
- GIS Base Mapping Data (parks, streets, rail, utilities)
- 2012 Aerial SID files
- 2012 SDDOT Structure Costs Report
- 2012 SDDOT Underwater Bridge Inspection Report (Existing Bridge)
- SDDOT Bridge Plans and Bid Tabs for Existing Bridge, Vermillion Bridge, Yankton Bridge
- Geotechnical Reports and Data

B. Additional Data Collection Needed

- Survey of the study area will start in the fall of 2013 – topo, trails, bridge, utilities, access points, shoreline (3D mapping file of survey data displayed using SDDOT settings, completed surface (dtm file), and all of the projection information (coordinate system, state plane/county, and county projection if applicable))
- Parcel and Plat Information - obtained from Cities and/or Counties

7. Traffic Operations Analysis

The URS Team will conduct a thorough analysis of the existing traffic operations within the study area. This analysis will be based upon the 2010 Highway Capacity Manual (HCM2010) methodology. Our work will include:

- Collection of existing traffic data
- Gather any existing data obtained in the study area by the SDDOT.
- Analyze the existing traffic operations using the HCM2010 methodologies. The study area segments will be analyzed using Highway Capacity Software (HCS2010) to determine the operational conditions, and will include evaluation of the traffic volumes and related characteristics of the traffic. The roadway geometric characteristics will also be accounted for, including the roadway cross section and merge/diverge aspects of the operations. Intersection analyses will be performed using Synchro/SimTraffic 8.0, which follows HCM2010 methodologies. The six previously identified study area intersections will be evaluated for individual movement levels of service (LOS) to not only identify deficient intersections, but also to evaluate heavy peak hour movements that currently experience individual movement capacity issues. These deficiencies will be considered while seeking improvement scenarios for the project.
- A speed distribution study will be conducted in the highway corridor to determine the 50th and 85th percentile speeds. URS will utilize Nu-Metrics data collection devices to collect volume and speed data for a minimum of 24-hours. Collecting this information for an entire day will reveal time of day performance measures that will assist in the development of improvement scenarios to improve the overall operational conditions in the project area.

Documentation of the traffic operations, including existing segment, intersection and speed analyses, will be provided with the methodology, results, and figures to appropriately demonstrate the project area traffic operations within the study area.

A. Variables

The traffic analysis variables that will be used are the default values of:

1. Peak Hour Factor (PHF)
 - a. Existing (year 2013) conditions analysis will either use new counts or, if available, use calculated PHFs from existing counts with a maximum value of 0.90.
 - b. Design year (year 2025) conditions analysis will use new counts or, if available, existing PHFs rounded up to nearest 0.05 with a maximum value of 0.90
 - i. The increase in the PHF is to account for traffic growth that is likely to be spread throughout the peak periods
 - c. Planning horizon year (year 2045) conditions analysis will use new counts or, if available, existing PHFs rounded up to nearest 0.05 with a maximum value of 0.90
 - i. The increase in the PHF is to account for traffic growth that is likely to be spread throughout the peak periods
2. Saturation Flow Rate
 - a. SDDOT Design Manual (Page 24, Chapter 15) requires the use of 1,600 vhr. This value will be used for the signalized intersections within the study area.
3. Traffic Signal Controllers
 - a. Operational analysis will allow both actuated and coordinated controllers
4. Left-Turn Phasing
 - a. Protected, Permitted/Protected or Split Phasing will be allowed at intersections
5. Heaviest Lane Volume (Lane Utilization)
 - a. Default HCS Streets Value used for ramp terminal/arterial intersections
6. Heaviest Vehicle Percentage
 - a. Study Intersections
 - i. Use existing turning movements counts that included truck counts to determine arterial truck percentages
7. Phase Change Intervals

- a. Existing (Year 2013) Conditions
 - i. Existing signal timings will be used for phase change
 - b. Future No-Build (Year 2025) Conditions
 - i. Existing signal timings will be used for phase change intervals of phases that exist at intersections that have no geometric change from existing conditions
 - ii. Phase change intervals will be calculated for the following locations:
 - 1. New phases added to an intersection where geometry is unchanged from existing conditions
 - 2. All phases at an intersection where geometry is changed from existing conditions
 - 3. The calculated values will be based on methodologies presented in the *Institute of Transportation Engineers (ITE) Traffic Engineering Handbook*. The methodologies presented in the handbook use vehicle length and speed and the distance needed to track through the intersection to calculate phase change intervals.
8. Speeds
- a. Arterials – Use resulting free flow speed from speed distribution data collection
9. Pedestrian Traffic on the trails will be counted in the early evening hours (PM peak) of a weekday. These measurements will be taken in the fall and may be adjusted according to seasonal and weather fluctuations.
10. The City of Pierre currently has a construction project (sewer/water/surfacing) taking place on Dakota Avenue just southeast of the study area. The impacts this has on the traffic analysis will be discussed and accounted for.

8. Travel Forecast

The URS Team will build upon the data collection, baseline analysis and existing traffic operations, to determine the future transportation needs within the study area. All traffic analyses will be performed for both the AM, noon and PM peak hours and based upon the 2010 Highway Capacity Manual methodology. The following list includes our approach and idea on the future needs analysis process:

- The future needs analysis will provide operational elements necessary to properly plan for the future roadway design. Traffic forecasts and traffic operations analyses will be developed for future years to evaluate the project year (2025), and the planning horizon year (2045). Traffic forecasts will also be developed for the long term year of 2125.
- The most important aspect of the future year analysis will be the forecasting efforts. The URS Team will collect historic and existing information that will be used to evaluate the project area traffic forecasts. Information that will be used for the forecasts will include historic and existing land use and traffic volume. The relationship of the land use and traffic volumes will provide relevant indications of how land use forecasts relate to the future traffic volume forecasts for the do-nothing conditions. The URS team will also forecast trips generated by expected future development or redevelopment in the vicinity of the study area. The change in land use or intensity will be reflected in an increase or decrease in vehicle trips on the roadway system. These trips will be distributed across the roadway network based on the type and location of the expected development, and the location of origins and destinations in the area.
- Similar to the existing conditions analysis, HCS2010 will be used to evaluate roadway segments, and Synchro/SimTraffic 8.0 will be used to evaluate intersection operations, each of which follow HCM2010 methodologies. Based on the project influence on traffic, the operational impacts area will be evaluated as part of the project. Project area deficiencies will be identified, and potential improvement elements will be identified, along with associated right of way requirements to accommodate potential improvements.
- The future conditions analysis will determine whether any traffic operational characteristics are deficient, and what improvement measures would solve the problem. Improvement measures that will be evaluated include potential intersection capacity improvements such as additional lanes and alternative methods of traffic control and/or access management. Improvements may also include grade separation or new connections that could eliminate conflicting movements.

Documentation of the future no-build traffic operations, including existing segment, intersection and speed analyses will be provided with the methodology, results, and figures to appropriately demonstrate the project area traffic forecast methodology, forecast volumes, forecast characteristics and operations with the study area.

9. Bridge/Roadway Options Process

For previous major bridges, URS has successfully used a 3-tiered process for the development, selection and advancement of a preferred alternative or alternatives. Each of these tiered steps will be carried out in conjunction with a series of stakeholder group meetings that will include the Study Advisory Team (SAT) and the Community Advisory Committee (CAC) workshops. Information on alternatives under consideration during each step will also be integrated into what will be provided to the stakeholder community and the public involvement process.

A. Conceptual Options (Tier 1):

URS will first develop numerous conceptual options (referred to as concepts) to replace the existing US14/US83/SD34 Bridge over the Missouri River. These initial concepts (types and locations) will be given to the SDDOT for their review and comment, which will set the stage for the brainstorming meeting.

URS will then conduct a brainstorming meeting with the Study Advisory Team (SAT) to discuss other potential concepts. A multitude of potentially feasible and practical alternatives meeting the project design criteria will be identified and concept level bridge and roadway alignment sketches for each will be prepared. Numerous configurations and variations of main spans utilizing truss, arch, segmental concrete girder, steel girder, extradosed prestressed girder, spliced prestressed girder, and cable-stayed type superstructures will be considered. In addition, several replacement bridge locations will be considered and conceptualized. Construction costs would be estimated for each one based on square foot prices from previous similar structures. After the meeting, these conceptual options will be further developed and presented to the SAT and CAC – followed by a public open-house for review and comments.

At the end of tier 1, some concepts will be dropped from further consideration due to their inability to satisfy project design criteria and requirements.

B. Initial Analysis of Concepts (Tier 2):

During this phase, the pros and cons of the alternatives, which made it through the tier 1 selection process, will be further studied. Structural analysis will be performed to confirm the structural feasibility for each alternative and to provide sufficient detail to develop major quantities. The concepts will be judged according to the project Purpose and Need Document as well as other criteria, to be discussed with the SAT and CAC. The visualizations of the concepts will be refined some during this phase also.

The following would then be evaluated for each alternative:

- Refined construction cost based on estimated major quantities and unit prices from historical averages
- Life cycle cost estimates
- Advantages/disadvantages and risks with each alternative (such as deck replacement and redundancy issues)
- Plan elevation and typical section drawings
- Environmental impacts
- Construction duration
- Level of inspection, maintenance and future rehabilitation effort
- Visual renderings

Typically each bridge concept is analyzed and scored in matrix form according to criteria, which are classified as major categories and subcategories. Each category could use a point system to score suitability. See Figure 6 for an example of this matrix.

Some prescribed project design criteria from the RFP, which will be used in the matrix include:

- All concepts will provide for a long-term (100+ years) service life for the proposed structure. Highway improvements away from the structure should be for the typical planning horizon of 20 years beyond the build year of 2025.
- For structure types requiring medians along the highway, URS will determine the minimum length of median access control necessary along the highway beyond the structure to ensure operation of the highway corridor within the SDDOT acceptable LOS of C or

better.

- All concepts shall provide for the maintenance of the continuous crossing of the Missouri River by pedestrian and vehicular traffic for at least one lane in each direction during construction.
- All concepts shall provide for the continuous capability for watercraft to travel through the construction zone during construction activities.
- All concepts shall make every effort possible to avoid impacts to existing buildings.
- At a minimum, the concepts are to show:
 - Conceptual structure types, length(s) & width(s).
 - Estimated structure touchdown points
 - General location of bridge piers relative to road, river, trail and utility crossings
 - General vertical and horizontal alignment and typical section of the mainline highway and all streets and trails affected by the build option.
 - Lane requirements on the mainline highway (including the structure) and all intersecting streets necessary to maintain a corridor LOS of C or better and intersection LOS of D or better.
 - Turn lane requirements at all intersections within the study area.
 - Right of Way limits
 - Permanent signing, lane delineation, and other traffic control items necessary through the study area for each option
 - Local street connection modifications that may be needed as a result of implementing the option.
 - Utility impacts/needs.
 - Access locations that should be removed/consolidated/relocated with the concepts to enhance traffic flow through the study area.
 - Impacts to recreational facilities, including the trail system and watercraft access and crossings.
 - Pedestrian and bicycle facilities along the highway (including the structure) and other connecting streets and the connection to the trail system.
 - Impacts to neighborhood travel patterns.
 - Effective traffic flow for emergency vehicle routes during construction.
 - Impacts to the Missouri River flood plain, wetlands and floodway, including navigational clearances.
 - Right-of-Way Impacts.

This information would then be presented and discussed at another round of stakeholder workshops and meetings. It is envisioned that two preferred alternatives will be identified at the culmination of this step. This concept(s) will be screened for fatal flaws before moving forward within the NEPA process.

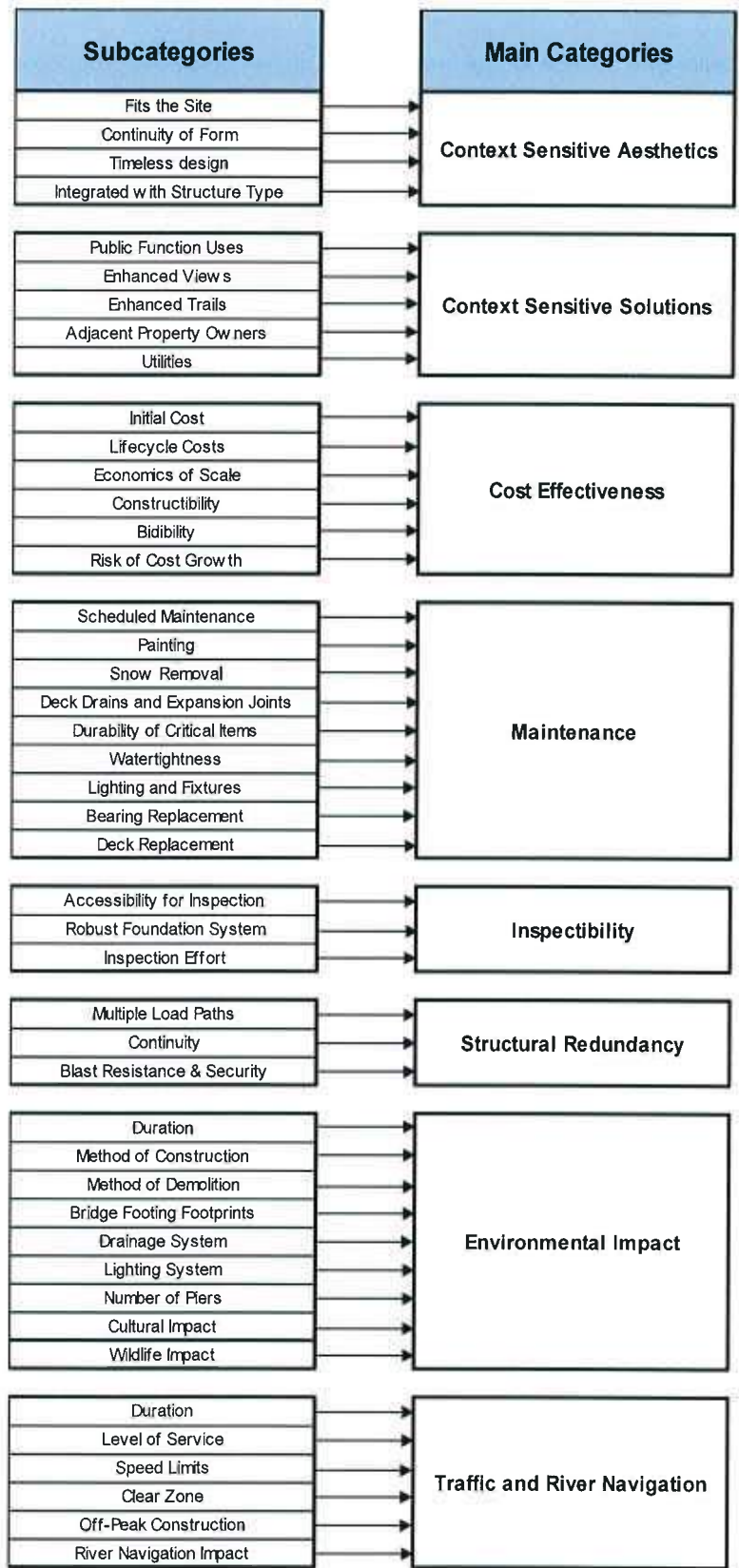


Figure 6: Example Bridge Category Scoring Matrix

C. Refinement to Build Alternatives (Tier 3):

During this phase, the advancing bridge/roadway alternatives from tier 2 will be further refined in detail. Following further refinement and a ½ day workshop, the 1-2 preferred bridge/roadway alternatives will be thoroughly analyzed. Our bridge architect, Bradley Touchstone, will focus his attention and efforts to this phase.

Additional facets of the preferred alternative(s) would then be studied in greater depth to refine the specifics of this alternative. Items to be further studied would include details of major components of the main span superstructure and substructure, the configuration, arrangement and type of the approach spans, construction sequencing, aesthetics, approach roadway details and required intersection modifications, right-of-way requirements, and traffic maintenance. The cost estimate would be updated taking into account specific aspects and methods of construction.

Typically only one alternative is the preferred option, but we recognize that there may be two, such as a steel bridge and a concrete bridge. At this point in the process, the cost evaluations are performed on a quantity and unit cost basis. Public involvement to determine context sensitive solutions will be substantially progressed; however, they may still be refined. Life cycle costing will also be developed and compared between the contending solutions. The stakeholders and disciplines will be polled to discuss unresolved and partially resolved issues. Also at this point, it is envisioned that the architectural treatments applied to the structure, such as formliners, will be narrowed down to a single basic concept for each alternative.

With the goal of finding the best bridge type and location for this site, this phase's results will be presented for review and comment. With the receipt of final comments, these will be resolved to SDDOT's satisfaction and will be incorporated into the final Concept Evaluation Report.

The future conditions analysis will determine whether any traffic operational characteristics are deficient, and what improvement measures would solve the problem. These improvement measures that will be evaluated include intersection capacity improvements, such as additional lanes to improve operations. Improvements may also include grade separation or new connections that could eliminate conflicting movements.

Each build alternative will include:

- *right-of-way needs,*
- *proposed access point changes,*
- *grade separations,*
- *number of lanes,*
- *trail information,*
- *future signal locations,*
- *structure widths and lengths, and*
- *an aesthetic assessment with the SAT and CAC.*

The designs for these alternatives will be sufficient enough to complete the NEPA activities. Based upon the refinements made, the consultant will refine the estimate of both benefits and improvement costs. The improvement costs will be in today's dollars and will include an estimate for ROW (permanent and easements), preliminary engineering services, construction costs, and other costs associated with the various alternatives.

Professional 3-D rendered drawings for the proposed build alternatives will be created for aesthetic evaluation and presenting those ideas at the second and third public meetings. These 3-D rendered drawings will allow for realistic insertion of the build alternative into photos from multiple view sheds.

D. Constructability Analysis of Build Alternative(s):

The URS Team will analyze the issues associated with the replacement bridge to determine viable means and methods for construction. Throughout the preliminary design process, we will strive for systems that promote Contractor ingenuity and promote competition, as well as, make use of available local material and manpower resources and expertise.

URS will also generate ideas related to construction techniques, useful to SDDOT for cost savings, and for both simplifying construction and reducing the duration of construction. This will include evaluation of:

- Marine construction techniques, such as top down construction, which incorporates a trestle and minimizes the footprint of the construction upon the river bottom.
- The use of prefabricated superstructure and substructure elements to the fullest extent which permits work to be done offsite and out of harsh weather conditions. An example would be the use of a precast footing template to locate driven piles inside a cofferdam.
- The use of shoring towers to temporarily support the framing elements for both the steel and concrete girder options.
- Accelerated Bridge Construction (ABC) techniques will be evaluated for bridge replacement. Since traffic will be maintained on the existing bridge throughout construction, ABC techniques will only be addressed if they are a no-cost or low cost solution.
- Determine the most feasible construction detours and phasing for each build alternative based upon researching similar installations, coordination with SDDOT staff, and generalized analyses of construction timelines and costs for each build alternative.

With SDDOT's prior authorization, URS will make inquiries to both the contractor and fabricator community as part of the alternative vetting process. This could include understanding reasonable concrete placement rates for particular footing pours or the availability of equipment necessary for large picks and material installation.

Because the preliminary assessment of alternates leads into, and is a stepping stone for, the final design phase of the project, a sound technical approach that is contractor and fabricator friendly is imperative. URS understands the importance of this concept throughout design development.

URS will analyze each build alternative to determine an estimation of the overall time duration of construction. The process and findings of this task will be presented in a Constructability Analysis Report for the build alternatives.

E. Life-Cycle Cost Analysis:

The URS Team will also take a three tier approach to pricing of the major bridge concepts.

The first tier is square foot costing. URS maintains extensive historical records on all bridge types that may be considered at this site, in terms of overall square foot cost versus span lengths. URS typically adjusts these costs for geographic location using the MEANS construction indices, and for inflation using the ENR price indices, so all costs are adjusted for current dollars at the central South Dakota pricing.

The second tier costing is an "engineers" cost estimate, based on unit prices. URS will perform sufficient preliminary engineering to size the major structural elements in the bridge and develop preliminary quantities. We will utilize unit prices from SDDOT historical averages, supplemented by URS bid records on all bridge types throughout the country. URS will also adjust these costs for geographic location using the MEANS construction indices, and for inflation using the ENR price indices, so all costs are adjusted for current dollars at the central South Dakota pricing.

The third tier of cost estimating is using a "Contractor" approach, developing the costs based on an analysis of mobilization requirement, materials, equipment, labor, transportation, temporary works, overhead and other related costs. URS typically utilizes personnel for this type of estimate who are experienced in heavy construction (former contractors). These last two estimate types are typically compared and reconciled in order to provide a reliable final cost estimate.

During the life-cycle cost analysis for each structure type and each build alternative, a list of projects will be proposed. The proposed maintenance projects that can be reasonably anticipated, to be needed beyond the build year of 2025 to ensure a 100 year service life, will be listed and priced.

F. Future Inspection, Maintenance and Rehabilitation:

The formulation and evaluation of structural alternatives will consider the future requirements and needs. To lessen future inspection requirements, attention will be paid to eliminating or minimizing non-redundant and fracture critical members. Providing inspection and maintenance vehicle access to the trail/path on the bridge and eliminating or lessening obstructions along the outside edges of the bridge will be considered.

Particular attention will be paid to such details as deck joint and deck drainage system with the goal of minimizing future maintenance. URS will investigate the possibilities of providing a 100-year deck, and will compare the value of this deck with a more conventional deck.

G. Geotechnical Investigation and Foundation Studies:

Foundation systems will constitute a major cost component of this structure and therefore will be thoroughly studied. Alternative deep foundation systems such as driven steel H-piles and drilled shafts will be evaluated. Conventional cofferdam versus waterline footing construction methods will be studied for feasibility and cost effectiveness. With the possibility of large approach spans, identification and comparison of foundation alternatives for that portion of the structure will also be important

H. Agency and Utility Coordination:

Regulatory agency coordination will be required with numerous agencies including, but not limited to: the South Dakota Department of Environmental and Natural Resources, South Dakota Game Fish and Parks, US Fish and Wildlife, US Coast Guard and US Army Corps of Engineers. The existing structure has a main span navigational opening of roughly 210 feet horizontal and 28.7 feet vertical. Confirming the required minimum navigation channel width, height, centerline alignment and location will be a critical task to complete early on in supporting development of bridge concepts for each viable alternative. The span arrangements and lengths will dictate concept feasibility and aesthetics.

Early coordination with private and public utility companies is critical in projects of this type. The type and location of existing utilities, as well as the options available for relocation, can have an impact on the design concepts or the construction methods that may be used. The URS Team will identify the utility companies with facilities in the area and will use this preliminary data when developing initial concepts. Once the alternatives have been developed, the URS Team will facilitate a utility coordination meeting with the affected utilities and the SDDOT utility coordination engineers. This meeting will allow further refinement of the design concepts based on more detailed information about potential utilities.

I. Existing Bridge Removal:

URS will review the project and provide suggestions on contractor means and methods for bridge removal, temporary shoring and construction of the deck in stages, maintaining at a minimum two lanes of vehicle traffic on the bridge. Modeling cases will be developed for the potential construction stages that may occur.

The existing bridge is a pair of two-girder floor beam and stringer structures, which will present a unique set of challenges in planning for its demolition and removal. Approaches to demolition vary by contractor. Thus, in planning for this structure's removal sequence, generally accepted means and methods will be employed. Of prime importance in this planning process, will be working out an approach to the removal methodology with the regulatory agencies. To do this effectively, they will be brought onboard early in the process while various removal alternatives are being considered and prior to decisions being made. Navigation and other uses of the waterway will also play an important role in the planning process, which may bring restrictions such as time of year limitations for certain construction activities. One very important decision will be whether to install a trestle, use barges to access the structure, or both. This will have sizeable cost impact on the project with a lot depending on proposed superstructure removal methods, water depth and other construction requirements.

The URS Team will develop a bridge removal plan for the existing bridge structure that will include the sequencing necessary to construct the new bridge and coordination with pedestrian traffic. The level of detail will comply with the NEPA process, including an asbestos survey of the

bridge. Various options for dismantling the superstructure can be considered including piecemeal demolition of the deck and girders, cutting spans and lowering them onto barges. The most cost-effective methodology will highly depend on the feedback received from the regulatory agencies. Stability of two-girder system superstructures will be an important factor during the demolition process and may require back stays or temporary shoring towers during certain removal operations. Also, being a two-girder structure, this makes partial demolition across the width of the bridge very difficult and most likely not a cost effective option.

While the SDDOT's RFP asked that the bridge removal shall, at a minimum, include all structural elements above the footing of each pier - the removal of the piers may not necessarily need to be demolished down to the footing. Often times one or two feet below the mudline is considered adequate. The exception to this will be adjacent to the navigation channel, where deeper removal depths may be required to avoid foundations becoming an underwater hazard. An important cost savings strategy, in the demolition of the substructure, will be avoiding the use of cofferdams. Depending on the regulatory agencies policies, demolition may be accomplished in open water, or within some type of containment, such as sheeting, but without having to pump the containment area dry.

10. Environmental Process

Following the National Environmental Policy Act (NEPA), alternatives for the bridge and roadway will be evaluated within an Environmental Assessment (EA) document. That evaluation will include a thorough environmental review process to address the social, economic and physical effects of the range of alternatives, following the various state environmental regulations and NEPA laws including:

- Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*
- *National Historic Preservation Act*
- Section 4(f) of the U.S. DOT Act
- Section 6(f) of the *Land & Water Conservation Fund Act*
- Section 404 of the *Clean Water Act*
- Executive Order 11990, Protection of Wetlands
- Floodplain Management
- Endangered Species Act
- Migratory Bird Treaty Act
- Clean Air Act

The public involvement process included in NEPA allows for the public to participate in each step of the decision-making process. As the study progresses, there will be several opportunities for the public and stakeholders to weigh in, including three public information meetings (PIM) to take place in the Pierre/Ft. Pierre area. Also, a Community Advisory Committee and a Study Advisory Team have been formed and a project kick-off meeting was held to discuss the study. Coordination with local, state and federal agencies will take place throughout the study.

The EA document will include the identification and evaluation of a range of alternative sites for the bridge and bridge types to be considered, ultimately leading to a preferred alternative for the bridge. The document will also include a chapter describing the Purpose and Need for the project. At the first PIM, scheduled for November 2013, the Purpose and Need factors for the project will be shown and public input on those factors will be encouraged.

The proposed bridge alternatives that meet the objectives of the purpose and need for the project while minimizing environmental and socio-economic impacts, and are consistent with local, future plans will be carried forward for further study. Ultimately a preferred alternative type and location will be selected for the bridge.

The environmental documentation will be completed within a 17-month timeframe. This 17-month schedule will allow for the necessary environmental process while incorporating public input and outreach.

A. Section 4(f) Parks & Recreation and Historical Sites

The proposed area of potential effects (APE) of the bridge will be inventoried for cultural resources pursuant to Section 106 of National Historic Preservation Act (NHPA) of 1966. In addition, an assessment of Section 4(f) properties will be made as defined by the Department of Transportation (DOT) Act of 1966. URS will initiate a Class I literature review at the South Dakota State Historic Preservation Office (SDSHPO) in Pierre. This task will identify previously recorded archaeological sites, isolated finds, and prior inventories that have occurred within the project APE. This will allow early identification of cultural resources that may be impacted by the proposed bridge development.

The Canadian Pacific Railroad and Bridge, originally known as the Chicago and Northwestern Railroad Bridge [site 39HU568], is a Section 4(f) property that crosses the Missouri River along the northern boundary of the project APE. This bridge has been made eligible for the National Register of Historic Places (NRHP). Potential visual impacts to the railroad bridge will be reviewed throughout the study.

Mark Hufstetler of Renewable Technologies documented the US14/US83/SD34 Missouri River Bridge, Structure Number 33-100-118 [site 39HU623], in 2004 and made the recommendation that

this resource be determined not eligible for NRHP. Mr. Hufstetler indicated in his review that “[w]hile this bridge retains integrity in most respects, integrity has been diminished by the addition of some modern guardrail. Nevertheless, the structure is a very long example of a multi-span variable depth steel girder bridge type. Bridge 33-100-118 is not National Register eligible at this time because it is less than 50 years old. In 2012, however, it will be considered eligible under criterion C as a good example of the steel girder type, provided that it has suffered no major alterations by that time.” The South Dakota State Historic Preservation Office (SDSHPO) concurred with this recommendation on April 15, 2004 in the Historic Bridge Survey Report (included in Appendix I). However, in 2008 further structural retrofit/repair work was performed on the bridge that will need to be assessed. Using a qualified architectural or bridge historian, URS will perform an evaluation of the bridge pursuant to SDSHPO and SARC recommendations.

A significant portion of land in the study area falls under the USACE’s jurisdiction (including sandbars or islands), however a larger amount is within the Cities of Pierre and Fort Pierre. An existing pedestrian trail lies on the bridge and connects with a paved municipal trail system in both Pierre and Fort Pierre. In Pierre, the municipal Steamboat Park/Steamboat Disk Golf Course/Hipple Park encompasses both the south and north side of the bridge approach. In Fort Pierre, there is a cul-de-sac on the south side of the bridge abutment with commemorative plaques for the Old Deadwood Trail and Lt. Commander John C. Waldron (bridge’s namesake). Impacts to these publicly owned parks, as well as any other recreational areas, wildlife and waterfowl refuges, or public and private historical sites will be evaluated thoroughly, as the FHWA and SDDOT cannot approve the use of this land unless the following conditions apply:

- There is no feasible and prudent alternative to the use of land.
- The action includes all possible planning to minimize harm to the property resulting from use.

B. Cultural Resources

URS will perform a Class III cultural resources inventory of the APE. This will involve systematically surveying the project APE in transects spaced no more than 20 meters (m) apart. A desktop review of the study area suggests that intact natural landforms may exist. In areas of low ground surface visibility (GSV), URS will place shovel probes to determine whether subsurface cultural remains are present. The preliminary review also indicates that residential neighborhoods fall within the study area and could contain older buildings. This may require an assessment by an architectural historian.

Following the survey, URS will submit a summary report to the SDDOT and provide site eligibility recommendations for the National Register of Historic Places (NRHP). This document will also recommend site avoidance or mitigation measures. In the event that an NRHP eligible resource cannot be avoided, URS will assist the SDDOT in developing a Phase II (testing) or Phase III (mitigation) treatment plan for the site. URS recommends initiating the cultural resources survey early in the fall to avoid snow delays.

SDDOT Missouri River Bridge Study																	
Title	2013					2014											
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Environmental Review																	
Agency Scoping Meeting				▲													
Purpose and Need	■	■	■	■	■												
Initial Range of Alternatives Determined			▲														
Determination of 4(f)/6(f) Properties					▲												
Section 106 Evaluation																	
Alternatives Screened						▲											
Recommended Alternative Defined											▲						
Final Environmental Documents													■	■	■	■	■
FONSI																	▲
Public Meetings				★						★				★			

Figure 7: Environment Schedule

C. Website

URS will develop and maintain a project website which will include the following pages:

- Project Description and Background
- Public Meeting Process
 - General information (text and graphics) that apply to all public meetings.
- Upcoming Public Meetings
 - Specific public meeting advertisements that include relevant information about upcoming public meetings (dates, times, locations, descriptions, and graphics).
- Public feedback/comment submission form.
- The website will be uploaded to a location where it is visible to SAT and other personnel to review. The SAT will review the website and provide feedback and requested changes.
- Once approved, the website will be uploaded to the live domain/url and will be available to the public.

Assumptions

- Before the website is to be deployed to the public, a list of desired domains/urls for the new website will be provided to URS, ranked in order of preference.
 - i.e.:
 - MissouriRiverBridge.com
 - US14MissouriRiverBridge.com

11. Safety Issues

URS will identify existing and future safety issues (actual & perceived) along the highway corridor. The analysis will predict and compare crash frequencies of existing facilities and design alternatives. If a regional or statewide Calibration Factor is available, the analysis will be done in accordance with Chapter 12 of the AASHTO Highway Safety Manual. Otherwise, observed crash frequency and crash rates will be used to compare existing facilities to facilities similar to the design alternatives. Data required will include a minimum of 12 months of historical site characteristics, traffic volumes, and crash records, with 5 years of data recommended.

URS assumes that the study area crash data from the Crash Geodatabase (2008-2012) will be used in the calculation of crash rates and critical crash rates. The following information will be provided as a result of the crash analysis:

- Segment and Intersection Crash Rates
- Segment and Intersection Critical Crash Rates (per AASHTO Highway Safety Manual)
- Crash Trends
- Potential Mitigation Measures to Improve Locations above Critical Crash Rates

Safety risks, which may include inadequate site distances, geometry, lighting or speed and driver confusion will be explored and discussed during project meetings and workshops.

12. Selection of Measures of Effectiveness (MOE)

The main goals of this study are as follow:

- 1) Complete a Traffic level of service (LOS) analysis and Delay analysis (for either individual movements or overall) for both the existing and future (2025 & 2045) conditions on the US14/US83/SD34 Highway corridor and select intersections. For the US14/US83/SD34 Highway corridor, average speed and travel time will be evaluated.
- 2) Complete a safety analysis of the US14/US83/SD34 Highway corridor and select intersections.
- 3) Identify locations on US14/US83/SD34 not in compliance with current design standards under both the current and forecasted future traffic conditions.
- 4) Determine the effects of incidents on traffic operations within the study area.
- 5) Prepare materials for EA Document.

- 6) Prepare, present and analyze bridge and roadway alternatives including:
 - Presentation and initial analysis of numerous Bridge Type & Location Concepts (Tier 1)
 - Selection and Refinement of multiple Bridge Type & Location Concepts (Tier 2)
 - Final Refinement and Analysis for Bridge Type & Location Build Alternatives (Tier 3)
- 7) Create final products (environmental documents, TS&L plans, Final report) for use by the SDDOT which will guide the Department in the final design and construction phases – follow-up projects.

13. FHWA Interstate Access Modification Policy Points

It is not anticipated that this study will involve and/or result in any Interstate access or interchange work, thus an Interchange Justification Report (IJR) and/or Interchange Modification Justification Report (IMJR) are not required.

If it is determined during the study that Interstate access or interchange work will be required, the methods and assumptions document will be amended prior to proceeding.

14. Deviations/Justifications

No deviations from standards are currently known. However the following list contains items that may become deviations:

- 1) Navigational clearance requirements: The US Coast Guard stipulated during the existing bridge design that a 210 foot wide x 29 foot high navigational opening lie under the bridge's main span. Since the adjacent train bridge's swing span is non-operational and the Oahe Dam limits commercial traffic on this area of the river, discussions will be held to determine if the span length and arrangement, channel location, and freeboard can be modified. Modifying these standards could impact the replacement bridge alternatives significantly - resulting in possible cost savings, additional aesthetic options and possible improvement to boat traffic operations.
- 2) State-of-the-art technologies: Since the replacement bridge construction is likely 10 years away, URS will evaluate promising new technologies and construction techniques, which may become more ordinary when the bridge is to be constructed. For example new concrete admixtures on the market have shown great promise in eliminating or significantly lessening bridge deck cracking.

If it is determined during the study that deviations are required, the methods and assumptions document will be amended prior to proceeding.

15. Conclusion

The purpose of and need for the project is to address the bridge's and/or project area's deteriorated condition, current and future capacity, and safety issues, fitting into local and regional land-use and transportation plans that have been developed while minimizing environmental and socioeconomic impacts. All the sections and processes described within this document will ensure that all reasonable design alternatives will be vetted, and that the chosen refined preferred alternative(s) will address those needs into the future of the 2045 design year for the corridor and 2125 service year for the bridge.

16. Appendices

Appendix A.1: Methods and Assumptions Meeting Agenda

Appendix A.2: Methods and Assumptions Meeting Minutes

Appendix A.3: Project Schedule

Appendix A.4: Meeting Chart

Appendix A.5: Additional Maps

Appendix A.6: Additional Pictures

Appendix A.7: Contacts List

Appendix A.8: Design Criteria

Appendix A.9: Previous Reports

APPENDIX A.1
Methods & Assumptions Meeting Agenda

**US14/US83/SD34 Missouri River Bridge
Replacement Study**



**US14/US83/SD 34 Missouri River Bridge Replacement Study
Methods & Assumptions Meeting**

Agenda

Thursday, October 3, 2013 1:00 PM (Central)

Videoconference

1. Introductions:

- a. URS
- b. Goldsmith Heck
- c. Study Advisory Team
- d. Others

2. General Purpose of Meeting

3. Review Methods & Assumptions Draft Document

4. Other Items

5. Next Steps

- a. Revise and Finalize Methods & Assumptions Document
- b. Begin Data Collection
- c. Draft Purpose & Need Statement/Document
- d. Public Involvement Meeting – mid November

6. Adjourn

7. Contact information in case technical difficulties

- a. Carl Osberg, URS 612-816-2533 (cell) or 612-373-6402 (conference room)
- b. Steve Gramm, SDDOT 605-773-2716 (conference room)
- c. Minneapolis: IP = 64.253.234.166 contact Brad Doll 612-370-0700
- d. Milwaukee: IP = 209.90.221.162 contact Nate Gardner 414-831-4188
- e. Tampa: IP = 64.253.250.122 contact Jeff Mayner 813-675-6746
- f. Denver: IP = 64.253.228.227 contact Robie Abraham 303-740-2775

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APPENDIX A.2
Methods & Assumptions Meeting Minutes

**US14/US83/SD34 Missouri River Bridge
Replacement Study**



US14/US83/SD 34 Missouri River Bridge Replacement Study Methods & Assumptions Meeting

Record of Meeting

Thursday, October 3, 2013 1:00-3:00PM

SDDOT Pierre Central Office/Videoconference

ATTENDEES:

Steve Gramm, SDDOT	Brad Lawrence, City of Fort Pierre
Tom Lehmkuhl, SDDOT	Greg Brown, URS
John Forman, SDDOT	Carl Osberg, URS
Tom Gilsrud, SDDOT	Carrie Cooper, URS
Dean VanDeWiele, SDDOT	Bob Anderson, URS
Mark Leiferman, SDDOT	Rigden Glaab, URS
Sonia Downs, SDDOT	Jim Arndt, URS
Kevin Goeden, SDDOT	Erik Seiberlich, URS
Steve Johnson, SDDOT	John Tweet, URS
Mark Hoines, FHWA	Todd Goldsmith, Goldsmith Heck
Mark Clausen, FHWA	

- A. URS welcomed everyone and introductions were given. Study Advisory Team member Leon Schochenmaier, City of Pierre, was not present.
- B. At this time, the attendees went through the document. Below is the list of items discussed:
- 1) Page 5 of 27
 - a. Eliminate the words "obsolete design".
 - i. Kevin Goeden also indicated that he will send Steve, a list of grammatical corrections to be sent to URS after the meeting.
 - 2) Page 6 of 27
 - a. Correct "Stakeholder Meeting #2" to "Stakeholder Meeting #1".
 - i. Carl Osberg and Carrie Cooper discussed the difference between the stakeholder meeting #1 and #2. The main difference is that the 1st stakeholder meeting is conducted early on in the project during concept development/refinement. The second meeting is conducted after or as the built alternative(s) is selected.
 - 3) Page 8 of 27
 - a. Add issue dates for all previous studies. If a study has not been completed, the issue date will be under development.
 - b. URS will look for documents and studies pertaining to the area trails.
 - c. The Flood Studies to be reviewed will only go back to the Flood of 2011.

- d. Carl Osberg is looking for the Riverfront Development Study and Pool Development Study documents that are in progress. He will contact these groups to see what information they have to date.
 - e. URS will contact the cities directly for their most recent Comprehensive Development Plans.
- 4) Page 9 of 27
- a. Add CAC "At Large Participants" to be determined, and indicate that there will be an application process for more members.
 - i. Steve Gramm indicated that he has not yet heard back from the Waldron family.
 - b. For complexity Part H add "Interface with Existing Trails and Pedestrian Facilities."
 - c. ADA Compliance as "heads up".
 - d. For complexity Part H add "Section 4(f)."
- 5) Page 10 of 27
- a. Confirm analysis year (2012 versus 2013).
 - b. Add traffic counts over noon hour, as this time may govern the peak hour, but not peak 15 minutes.
 - c. Vehicle classifications will be identified (passenger versus truck) and pedestrian counts will be included at intersections.
 - i. Steve Gramm informed the group that a traffic recorder has been in place on the west approach of the bridge for about 10 years.
- 6) Page 11 of 27
- a. Correct owner of RR to Canadian Pacific.
 - b. Include noon hour traffic data collection.
- 7) Page 12 of 27
- a. Strike out language for finger joints.
 - b. Cities and counties have parcel data.
 - c. Crash records database – URS has verified that we have this.
 - d. URS will verify with the cities if there is any development in the next 3 months. URS will also look at the impact to traffic due to Dakota Ave closure outside the study area.
- 8) Page 13 of 2
- a. URS will identify # of trucks at intersections, and the lane volume data will classify trucks.
 - b. It was noted that the truck traffic may fluctuate significantly in the next 100 years, as is presently being seen in North Dakota. URS will consider this in the analysis of bridge fatigue.
- 9) Page 14 of 27
- a. URS will count pedestrians in the evening period on the bridge, west bank trail under bridge, and at east bank trail under the bridge.
- 10) Page 15 of 27
- a. URS will include the noon period traffic data in the traffic analysis and forecasting.
- 11) Page 16 of 27



- a. URS will clarify that alternatives will be dropped at end of Tier 2.
 - b. Bob Anderson noted that Tiers 1 and 2 must mesh with public hearing schedule.
- 12) Page 20 of 27
- a. Soften wording of ABC since additional cost is not wanted if traffic can be maintained on existing bridge.
- 13) Page 21 of 27
- a. Strike for example wording related to 12 foot trail.
 - b. Add more regulatory agencies or else just state resource agencies and do no list.
 - c. Add wording to try to achieve 100-year design life for deck system.
 - d. Bob Anderson stated that a 100-year deck may be optimistic with current technology.
- 14) Page 22 of 27
- a. Kevin Goeden stated that the bridge demolition will likely be in the same contract as the new bridge construction.
- 15) Page 23 of 27
- a. Correct railroad to be Canadian Pacific.
 - b. The last paragraph should be altered to say that it not only the bridge, but other structures in the study area will be evaluated for historic significance.
 - c. The SARC will recommend, but not hire a historian.
 - d. Add Part B and label it "Section 4(f) Historic, Parks & Recreation." Include these issues and processes in this section.
- 16) Page 24 of 27
- a. Two different types of historians may be needed – bridge and architectural. It would be beneficial a single historian could evaluate both.
 - b. Steve Gramm was fine with the website listed domain/urls. He did mention that it might be appropriate to have "US14" in the beginning of the domain/urls.
- 17) Page 26 of 27
- a. Delete "obsolete design".
- 18) Page 27 of 27
- a. Kick-Off Meeting Minutes not needed to be included in Appendix per Steve Gramm.

Next Steps:

- 1) URS Team
 - i. Receive additional comments on M&A Document
 - ii. Send out Appendix H – Design Criteria for review
 - iii. Send out M&A Meeting Minutes for review
 - iv. Incorporate all comments/revisions into M&A Documents
 - v. M&A Document Signed by SDDOT and FHWA
- 2) SAT Team
 - i. Send URS all comments on M&A Document Draft



- ii. Review Appendix H and Meeting Minutes and send comments to URS
- iii. Review revised M&A Document, and sign when acceptable.

If there are additions or corrections to these minutes, please contact Carl Osberg of URS at 612-373-6394 or carl.osberg@urs.com.



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APPENDIX A.3 Project Schedule

US14/US83/SD34 Missouri River Bridge Replacement Study

PROPOSED MEETINGS TABLE

		Parties Involved				
		URS	CH2	SAT	CAC	Public
	Meeting	Description	Result(s)			
1	SAT Meeting (Kickoff)	The URS Team plans to meet with the Study Advisor Team (SAT) to establish communication lines, confirm expectations, establish project goals and to finalize the scope, budget and work plan prior to doing any work beyond basic data collection. The SAT will also advise the URS Team on the role of the CAC and public outreach for this project.	✓	✓	✓	
		At this meeting, URS will give the SAT a draft list of general design criteria that is often used for projects like these, which may be beneficial in preparing for meeting 2. The URS Team will also visit the site and internally discuss ideas.				
2	SAT Workshop (Methods and Assumptions) (Video Conference)	The URS Team plans to meet with the Study Advisor Team to determine the methods, assumptions and design criteria to be used during the course of the study. Workshop discussions will also include the approach to the CAC and Tasks 3-4 Approach.		✓	✓	
3	CAC Meeting (Kickoff)	The URS Team next plans to meet with the Citizen's Advisory Committee to explain to them their purpose and gather their expectations and ideas prior to the first public meeting.		✓	✓	✓
4A	SAT Meeting/Workshop (Initial Presentation) (Video Conference)	The URS Team next plans present the initial findings (Tasks & Task 3), NEPA progress and the several rough conceptual options with 3-D visualizations to the SAT one week prior to public meeting. Also, the Methods and Assumptions Document will be completed and any final revisions will be made unless new data warrants changes. In addition, the URS Team's approach to Tasks 4-6 -Existing Traffic/Operations, Future Needs and Safety Analyses will be discussed.		✓	✓	✓
4B	CAC Meeting (Initial Presentation) (Video Conference)	On the same day as meeting 4, the URS Team plans present the initial findings, NEPA progress and the several rough conceptual options with 3-D visualizations to the CAC also 1 week prior to public meeting. This meeting to be held in conjunction with Meeting 4A		✓	✓	✓
		The URS Team proposes holding the CAC meetings the same day as some of the SAT meetings or in conjunction with the SAT meetings, to maintain efficiency and avoid additional preparation and travel costs.				
5	Public Meeting (Presentation)	The URS Team plans to lead a presentation and meeting with the public on the initial findings of data/NEPA/concepts in Pierre or Fort Pierre. Public input will be encouraged and documented.		✓	✓	✓
		Tasks 2-3 & 14 Findings Presented Several 3-D Concepts Presented Fort Pierre public informed and their input documented.		✓	✓	✓

PROPOSED MEETINGS TABLE

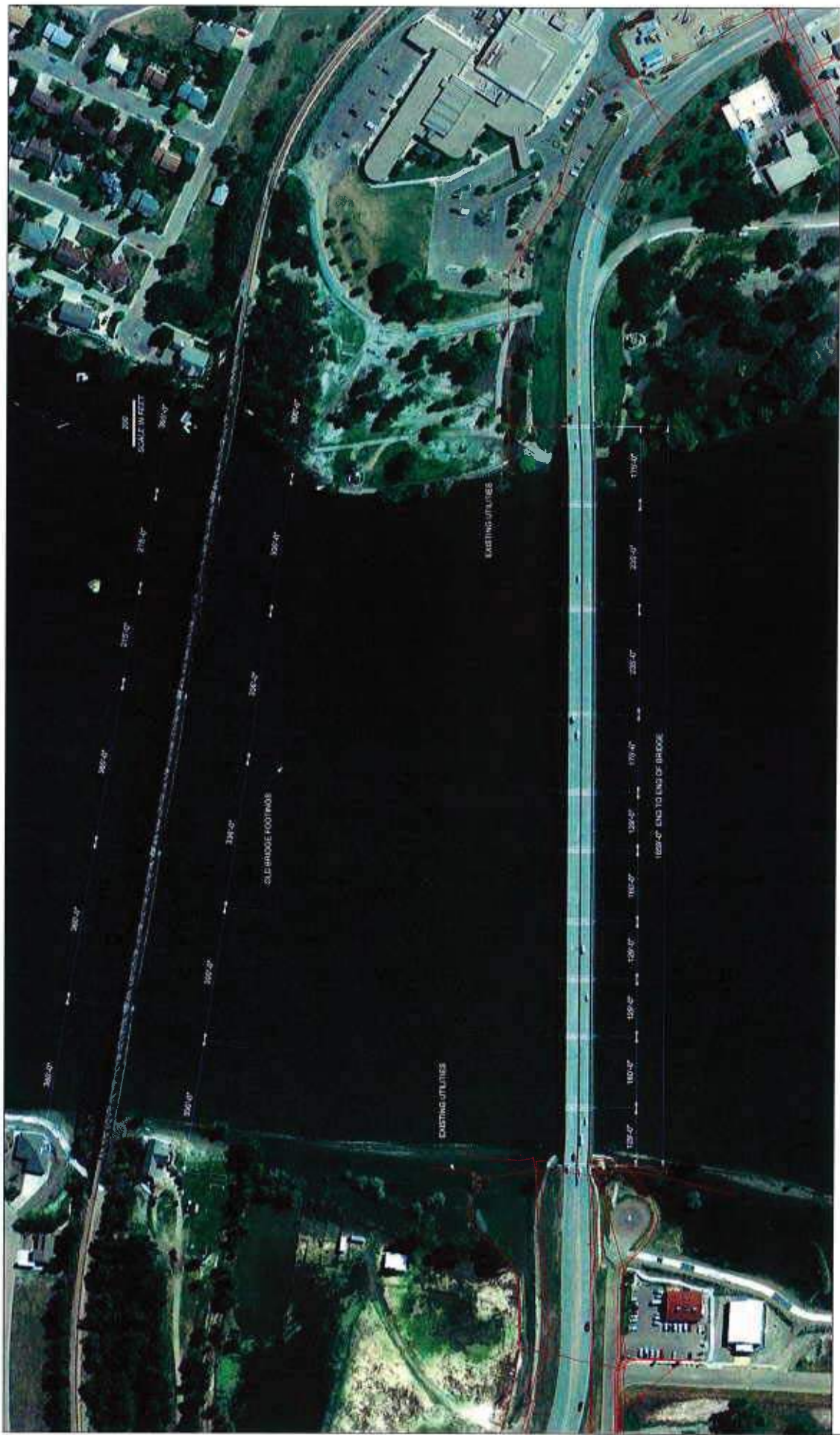
	Meeting	Description	Result(s)	Parties Involved				
				URS	GHE	SAT	CAC	Public
6A	SAT Meeting (Conceptual Options)	The universe of conceptual options that fit into the Methods and Assumptions and initial findings will be explored – we envision several bridge/roadway alternatives will be presented as the starting point. These should be whittled down to 2-3 bridge concepts for further analysis. In addition, URS will be prepared to discuss architectural finishes for the bridges and walls. Preliminary bridge costs will be completed as per square foot costing for screening studies. The URS Team's analysis findings for Tasks 3-7 and '4 will be discussed in detail. Also, the URS Team's approach and initial findings to Task 8 (Initial Analysis of Concepts) will be discussed.	Tasks 3-7 & 14 findings discussed. Initial Bridge/Roadway concepts presented Cost estimating will be per square foot 2-3 Bridge/Roadway concepts selected for refinement Task 8 approach discussed	✓	✓	✓		
		 After this meeting if is a good idea to not revisit bridge types, unless new information obtained warrants rework.						
6B	CAC Meeting (Progress/Input)	The process and results of meeting 8 will be presented to the committee. The CAC's feedback will be documented and discussed with the SAT. Meeting to be held in conjunction with Meeting 6A.	Gather CAC feedback of Concepts.	✓	✓	✓	✓	
7A	SAT Workshop (Concept Initial Analysis) and selection of Build Alternative	URS will present the refinement and analysis of the 2-3 bridge/roadway concepts. This analysis will include draft cost estimates, environmental issues, stakeholder consequences, constructability. This meeting should serve as a workshop with collaboration between the SAT and URS/GHE teams. The preferred concepts will be weighed against each other and the needs of the project. URS envisions that some of the alternatives will be modified and some will be eliminated. URS envisions a single preferred bridge/roadway concept will be selected for further analysis. Furthermore, the architectural finishes for the bridges and walls will be discussed and refined. At this stage of the project, all the tasks will be discussed, referenced in discussions and coordinated. Bridge cost estimating and constructability/staging will be more refined at this stage.	Tasks 4-7 & 14 findings discussed. Bridge/Roadway concepts presented. Issues matrix will be compared to each alternative. Preferred Bridge/Roadway concept selected as Build Alternative. Tasks 8-9 & 14 approach discussed.	✓	✓	✓	✓	
7B	CAC Meeting (Selection of Build Alternatives)	The process and results of meeting 10 will be presented to the committee. The CAC's feedback will be documented and discussed with the SAT. Meeting to be held in conjunction with Meeting 7A.	Gather CAC feedback of Build Alternatives.	✓	✓	✓	✓	
8	SAT Workshop (Refinement of Build Alternatives, Constructability / Cost Analysis) (Video Conference)	URS will present the refined analysis of the 1-3 bridge/roadway alternatives. This analysis will include more detailed cost estimates, environmental issues, stakeholder consequences, construction ideas, and utility conflicts. The preferred concepts will again be weighed against each other and the needs of the project. This meeting should serve as a workshop with collaboration between the SAT and URS/GHE teams to refine and slightly modify the alternatives. URS envisions that 1-2 bridge/roadway alternatives will be selected for final refinement and final presentation. Also, at this point is envisioned that the architectural treatments applied to the structure, such as formlines, are narrowed down to a single basic concept for each alternative. Bridge cost estimating will be completed on a quantity and unit cost basis. Context sensitive solutions will be substantially progressed. Life cycle costing will be developed and compared between the contending solutions.	Tasks 5-6 & 9-14 findings discussed 1-3 Bridge/Roadway concepts presented 1-2 Bridge/Roadway concepts selected Environmental review type determined.	✓	✓	✓	✓	
9	SAT Meeting (Further Refinement of Build Alternatives) (Video Conference)	URS will deliver a first draft of the concept report including: detailed graphics, methods and assumptions, constructability analysis, cost analysis, environmental documentation, traffic studies, safety studies and drainage. This meeting will also identify modifications to the concepts that are necessary at this point.	1-2 Bridge/Roadway concepts Tasks 1-8 completed Tasks 9-14 findings discussed Draft Report discussed	✓	✓	✓	✓	

PROPOSED MEETINGS TABLE

Meeting	Description	Result(s)	Parties Involved				
			URS	GHE	SAT	CAC	Public
10A	SAT Meeting (Presentation) (Video Conference)	URS will present the refined build alternatives to the SAT with numerous 3-D graphics, at least one week before the public presentation/meeting. The presentation will include refinements to alternatives from meeting 13. As with all the meetings, discussions will take place as to the progress of the project and potential issues. If desired, URS will also discuss our recommendations at this phase. In addition, the environmental documentation findings will be discussed in detail at this time.	✓	✓	✓		
10B	CAC Meeting (Presentation) (Video Conference)	URS will present the refined build alternatives with numerous 3-D graphics, at least one week before the public presentation/meeting. This presentation is envisioned to be a dry run before the public meetings to come.	✓	✓	✓	✓	✓
11	Public Meeting (Presentation)	URS will present the refined build alternatives with numerous 3-D graphics, at this public open house meeting.	✓	✓	✓	✓	✓
12	Stakeholder Meetings Set #1	We envision that earnest discussion with the stakeholders of the two build alternatives will take place at this time. The issues pertinent to the stakeholders will be discussed, including ROW issues and access changes. The SAT, stakeholders and all disciplines will be pulled to discuss unresolved and partially resolved issues. Meeting to be held in conjunction with Meeting #11.	✓	✓	✓	✓	✓
13A	SAT Meeting (Report Refinement) (Video Conference)		✓	✓	✓	✓	✓
13B	CAC Meeting (Report Refinement) (Video Conference)		✓	✓	✓	✓	✓
14	Public Meeting	A final public meeting will be held to discuss the findings of the NEPA process and documentation, any other issues the SDDOT would like to be addressed at this time.	✓	✓	✓	✓	✓
15	Stakeholder Meetings Set #2	Another round of stakeholder discussions and/or negotiations will take place at this time. This set of discussion is envisioned to be more detailed than the first. Meeting to be held in conjunction with Meeting #14.	✓	✓	✓	✓	✓
16A	SAT Meeting (Report Refinement) (Video Conference)	URS will deliver another draft of the Bridge Replacement Report. Bridge removal discussions and any other outstanding issues will be discussed and moved towards resolution. Further refinement of the study and report based on public feedback will be made at this time.	✓	✓	✓	✓	✓
16B	CAC Meeting (Report Refinement) (Video Conference)	URS will discuss with the CAC the progress to date and seek input from the committee as we move closer to the final report.	✓	✓	✓	✓	✓
17	SAT Meeting (Finalization of Report) (Video Conference)	URS will deliver a last draft of the concept report detailing all the information gathered to date. This report will include alternatives analysis and recommendations, public input documentation, detailed graphics, constructability analysis, cost analysis, bridge removal analysis and estimates, environmental documentation, traffic studies, safety studies and drainage. This meeting will determine any last changes that need to be made to the report.	✓	✓	✓	✓	✓

APPENDIX A.5 Additional Maps

US14/US83/SD34 Missouri River Bridge Replacement Study



US14/US83/SD34 MISSOURI RIVER BRIDGE REPLACEMENT STUDY



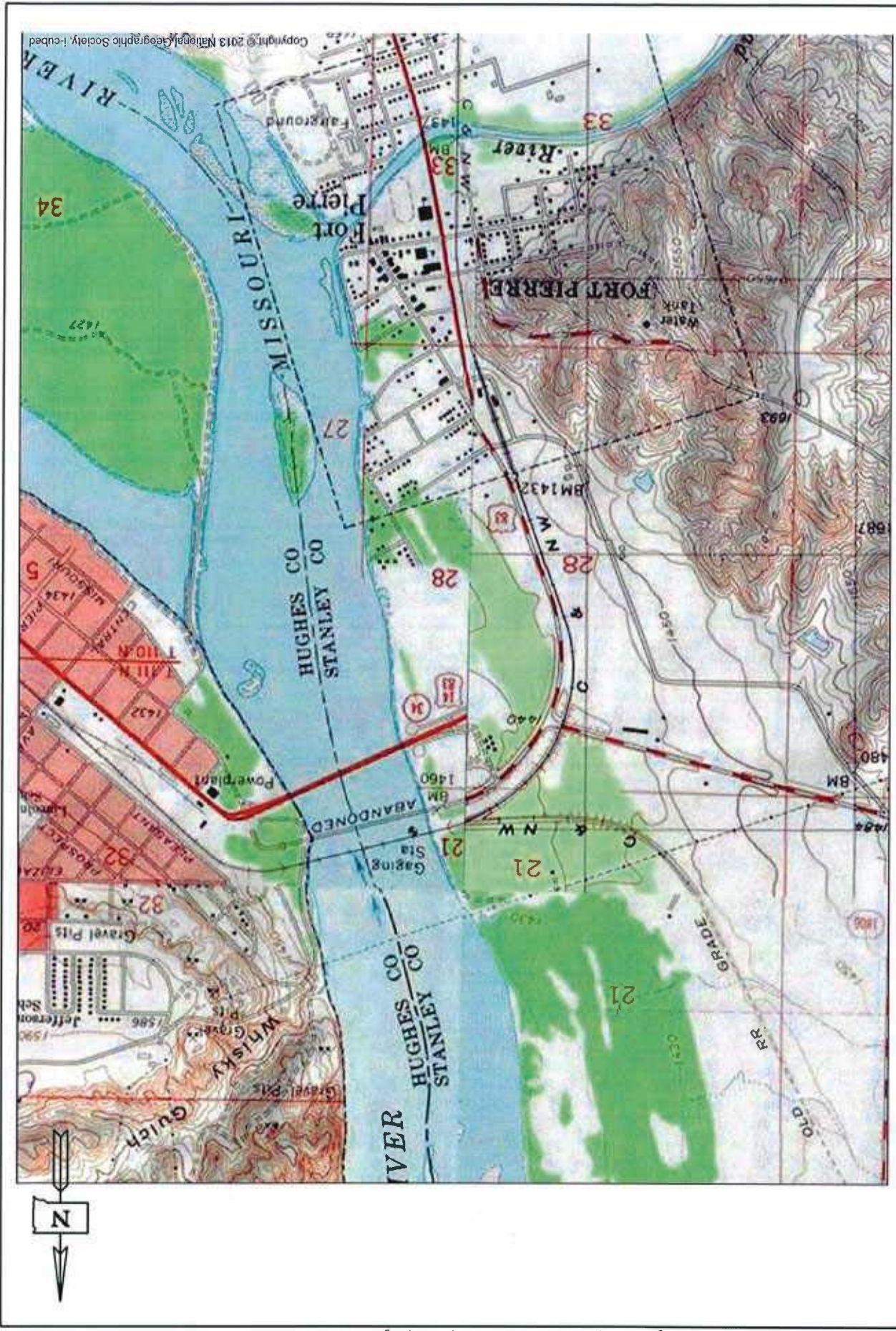
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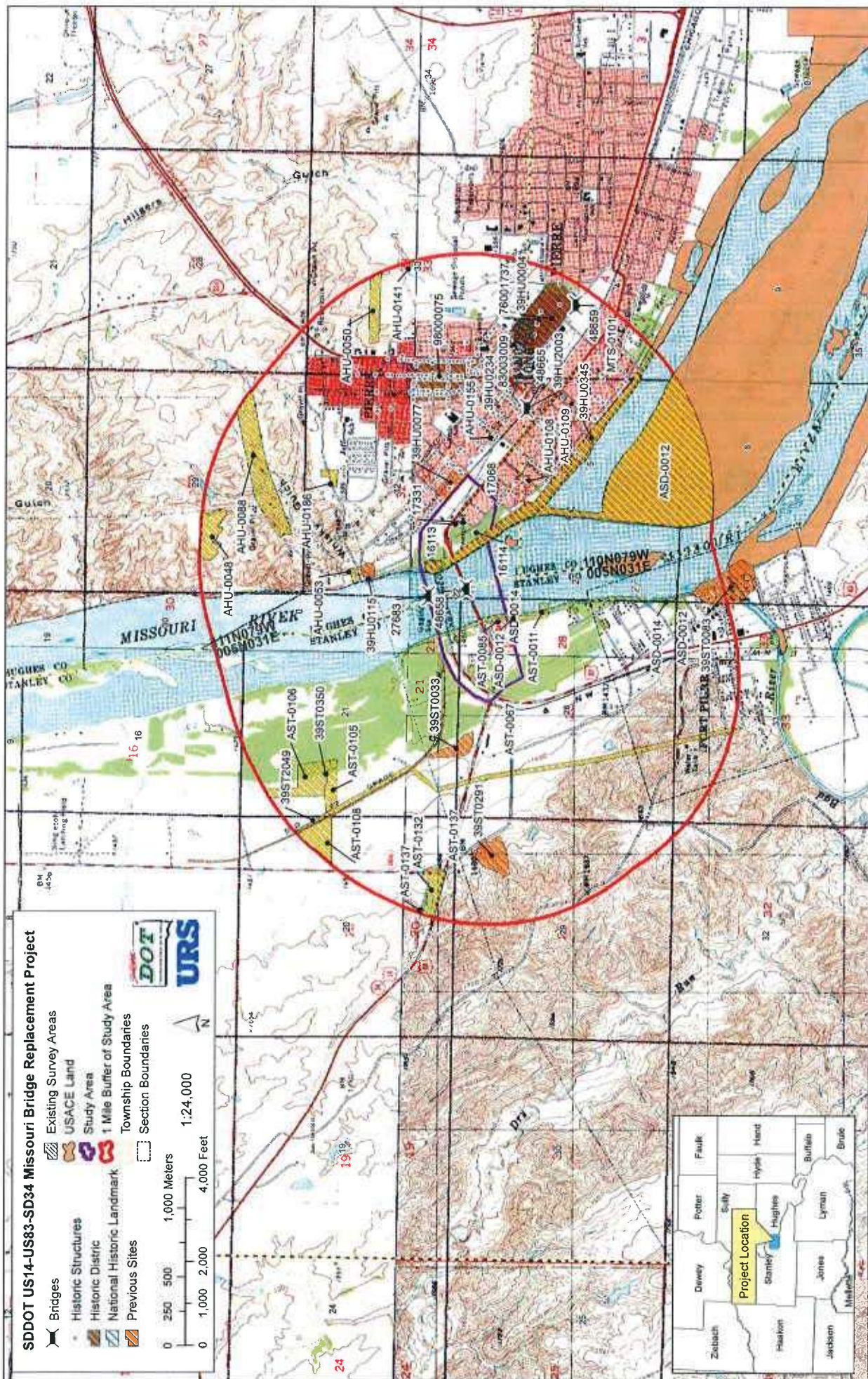
US14/US83/SD34 MISSOURI RIVER BRIDGE REPLACEMENT STUDY



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US14/US83/SD34 MISSOURI RIVER BRIDGE REPLACEMENT STUDY



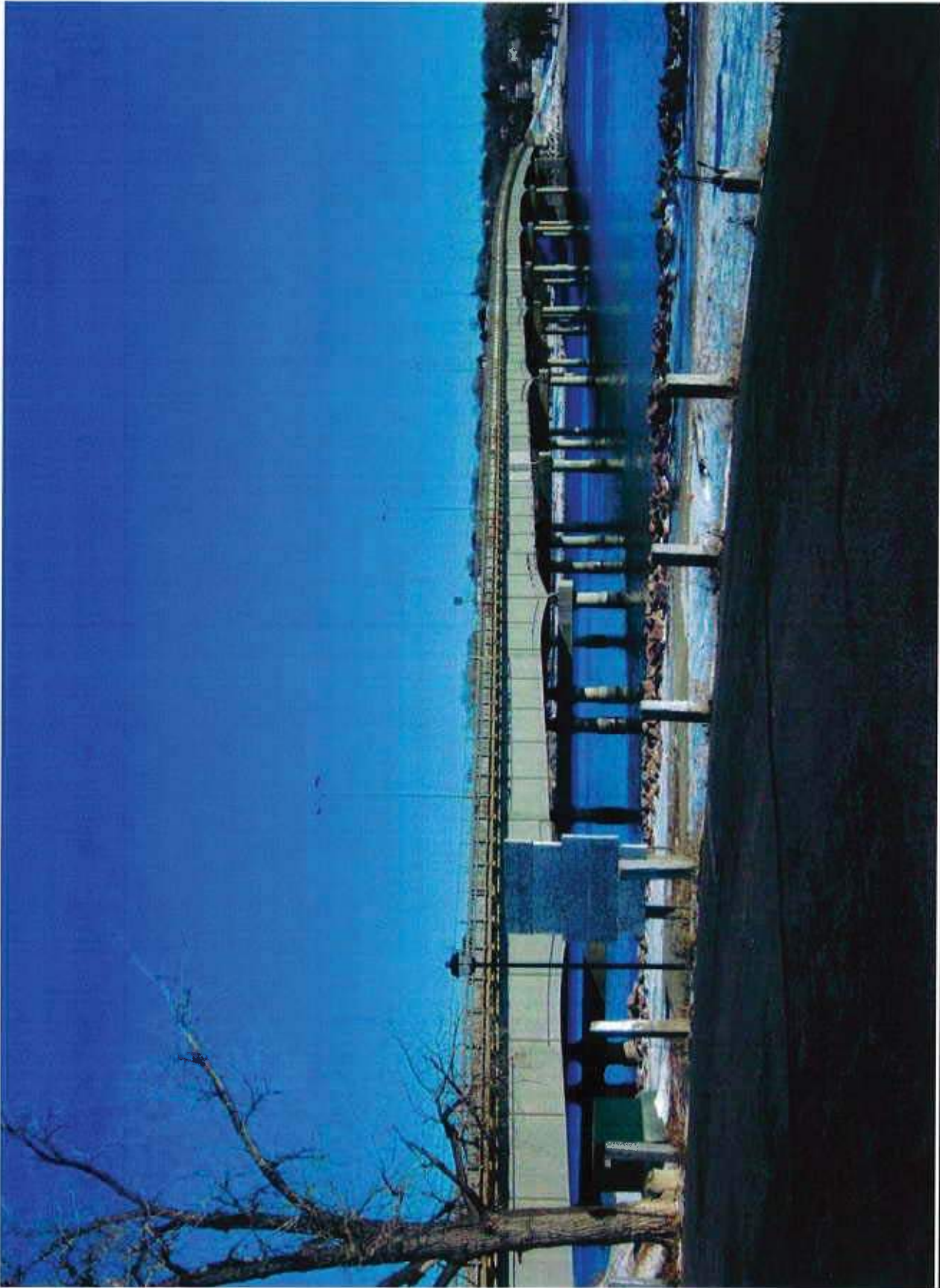
SDDOT US14-US83-SD34 Missouri Bridge Replacement Project

- Bridges
- Historic Structures
- Historic District
- National Historic Landmark
- Previous Sites
- Existing Survey Areas
- USACE Land Study Area
- 1 Mile Buffer of Study Area
- Township Boundaries
- Section Boundaries



APPENDIX A.6 Additional Pictures

US14/US83/SD34 Missouri River Bridge Replacement Study

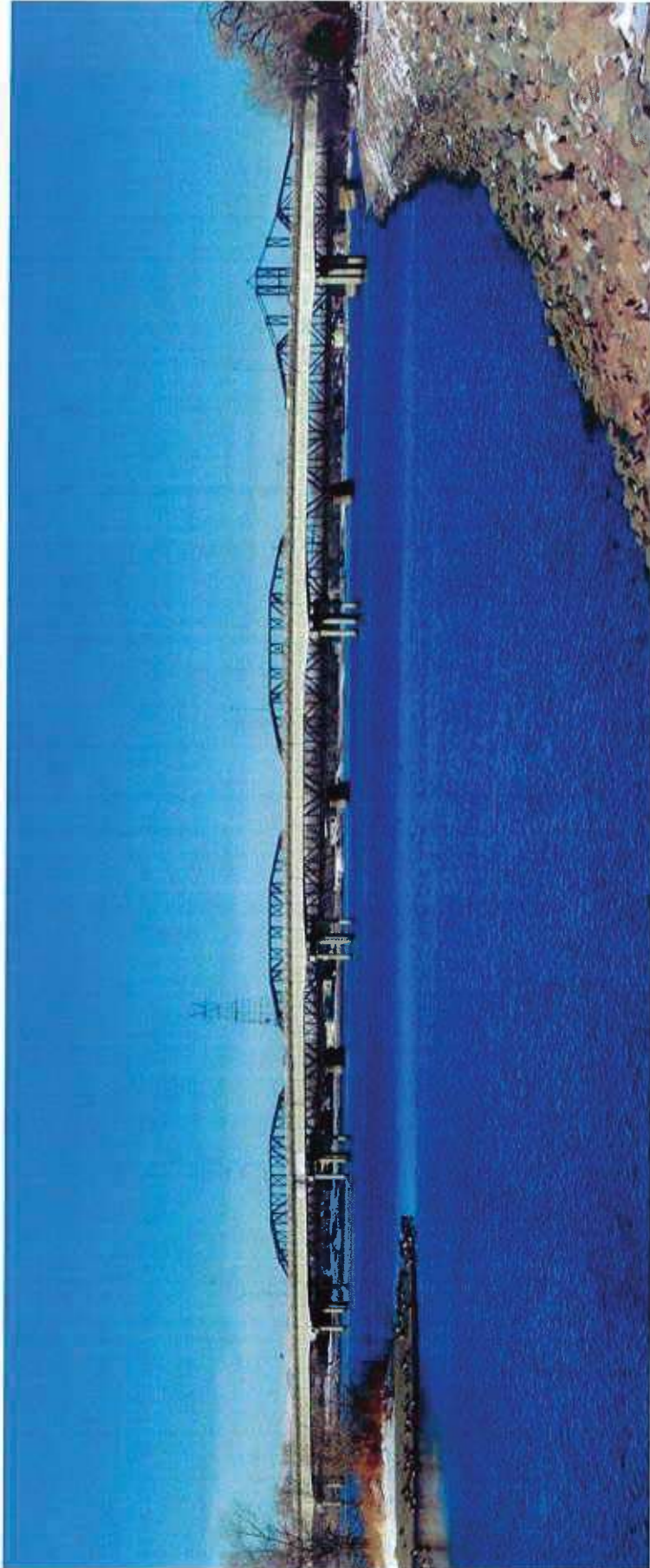


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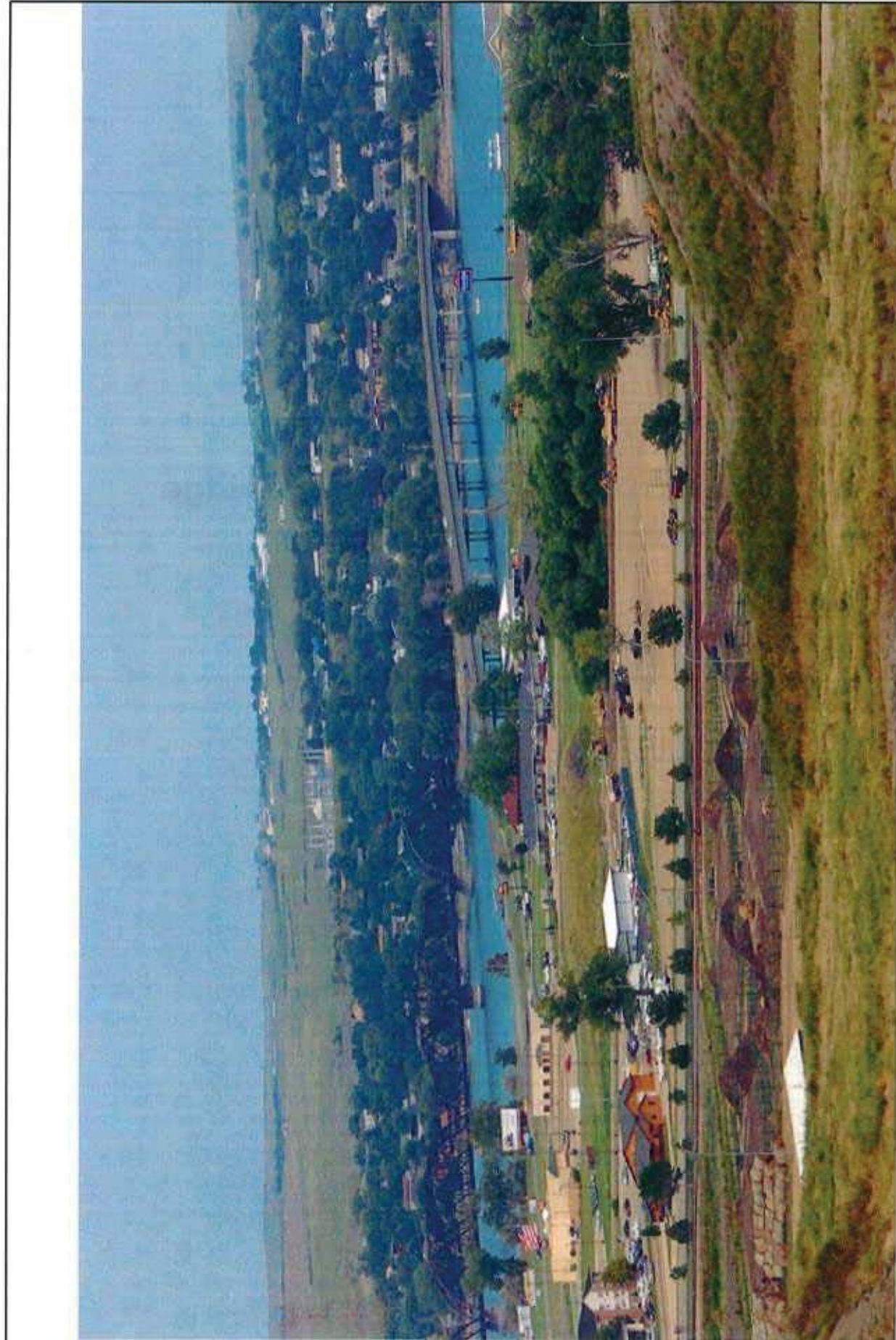
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US14/US83/SD34 MISSOURI RIVER BRIDGE REPLACEMENT STUDY

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US14/US83/SD34 MISSOURI RIVER BRIDGE REPLACEMENT STUDY



APPENDIX A.7

Contacts List

US14/US83/SD34 Missouri River Bridge Replacement Study

SDDOT Missouri River Bridge - CONTACT LIST

Last Name	First Name	Title	Group	Email	Phone	Cell Phone	Affiliation	Address
Anderson	Bob	Bridge Engineer - Lead		bob.anderson@sdsu.com	613-673-6602	613-695-9878	URS	7655 West Caraway Campbell Casperwy, Denver, CO, 80207-4462
Arndt	Jim	Materials & Soil Engineer		jim.arndt@urs.com	613-673-6320		URS	100 South Fifth Street, Ste 1500, Minneapolis, MN 55402
Bancroft	Richard	PHWA - Environmental		richard.bancroft@urs.com	605-773-1013		PHWA	7655 West Caraway Campbell Casperwy, Tampa, FL, 33607-4462
Bosch	Diana	Bridge Engineer		diana.bosch@urs.com	613-673-6600		URS	
Brown	Greg	PHWA - Development Consultant	C&C	greg@brownconsult.com	613-673-6478	613-620-3371	PHWA Development	100 South Fifth Street, Ste 1500, Minneapolis, MN 55402
Burp	Vern	Geotechnical Engineer		vern.burp@urs.com	605-223-9333	605-223-0495	AET	3700 East Highway 34, Pierre, SD 57501
Burns	Jan	Civil Technician		jan.burns@urs.com	613-673-6424		URS	141 West Jackson Suite 2007, Chicago, IL 60604
Carras	Paul	Chicago Expressive Bronzes		pcarras@expressivebronzes.com	605-776-1006	1-3-263-4304	PHWA	Denver Tech Center, 8181 East Yale Ave, Denver, CO 80231
Chabert	Mark	PHWA - Bridge		mark.chabert@urs.com	603-286-4887		URS	342 North West Street, 7th Floor, Minneapolis, MN 55202
Cobbler	Carrie	Environmental - Lead		carrie.cobbler@urs.com	414-691-4103	414-693-1197	URS	111 2nd Street East, Box 70, Moorhead, SD 57901
Duffy	Michael	Surveys		mcduffy@urs.com			Geospatial Heck	
Downs	Sonia	Project Development	S&T	sonia.downs@urs.com	605-273-4462		SDDOT	
Forman	John	Pierre Station	S&T	john.forman@urs.com	605-773-3484		SDDOT	100 South Fifth Street, Ste 1500, Minneapolis, MN 55402
Geller	Steve	Methods Specialist		steve.geller@urs.com	613-673-6688		URS	222 E. Dakota Ave, Pierre, SD 57501
Gil	Laura	Pierre Water	C&C	laura.gil@urs.com	605-773-7241		URS	Becker-Hansen Bldg, 700 East Broadway, Pierre, SD 57501-2686
Givens	Thayne	Bridge Maintenance Engineer	S&T	thayne.givens@urs.com	605-773-7203		SDDOT	1000 East Capitol Ave, Ste 1, Minnapp, MN 56503
Glab	Robin	Cultural Resources Specialist	S&T	robin.glab@urs.com	701-321-4142		URS	Becker-Hansen Bldg, 100 East Broadway, Pierre, SD 57501-2686
Gooden	Karen	Chief Bridge Engineer	S&T	karen.gooden@urs.com	605-773-3385	605-846-0040	SDDOT	111 2nd Street East, Box 70, Moorhead, SD 57901
Goldschmidt	Todd	roadway Engineer - Lead		todd.goldschmidt@urs.com	605-845-3123		Geospatial Heck	
Gedamath	Lane	Survey/Drainage Engineer	S&T	lane.gedamath@urs.com	605-773-8641		SDDOT	111 2nd Street East, Box 70, Moorhead, SD 57901
Gurran	Steve	PHWA - SDDOT	C&C	steve.gurran@urs.com	605-223-5534		URS	Becker-Hansen Bldg, 700 East Broadway, Pierre, SD 57501-2686
Hanson	Steve	Fort Pierre	S&T	steve.hanson@urs.com	605-773-3068	605-330-0466	URS	524 North Sycamore Ave, Ste 1, Soule Falls, SD 57110
Hansen	Neil	City of Pierre		neil.hansen@cityofpierre.com	605-223-3683		City of Pierre	
Hark	Jon	Civil Engineer - Geometrics, ROW	S&T	jon.hark@urs.com	605-223-3683		Geospatial Heck	
Hayes	Mark	PHWA - Planning	S&T	mark.hayes@urs.com	605-776-1010		PHWA	1745 Marco Road, Rapid City, SD 57702
Holst	William	Geotechnical Engineer		william.holst@urs.com	605-388-0028		AET	1600 E.H. Gallegry Ave, Ste 1, Bismarck, ND 58503
Hurt	Brian	Midwest Construction and Redback		brian.hurt@redback.com	605-223-6628		URS	Becker-Hansen Bldg, 700 East Broadway, Pierre, SD 57501-2686
Jacobson	David	Environmental Planner	C&C	david.jacobson@urs.com	705-221-1146		SDDOT	Becker-Hansen Bldg, 700 East Broadway, Pierre, SD 57501-2686
Jacobson	Tommy	Pierre Area Chamber of Commerce		tommy.jacobson@chamber.com	605-224-7881		URS	111 2nd Street East, Box 70, Moorhead, SD 57901
Johnson	Andrew	Bridge Engineer		andrew.johnson@urs.com	605-773-3265		SDDOT	
Jones	Neil	Visual Quality		neil.jones@urs.com	613-373-6817		SDDOT	
Jones	Randy	Tanks, Earth/Health District		randy.jones@urs.com			URS	
Lawrence	Brad	SD Dept Game Park & Parks Survey		brad.lawrence@state.sd.us			SD Dept Game Park & Parks	
Lee	Tom	Public Works	S&T	tom.lee@cityofpierre.com	605-224-0481	605-222-4440	City of Pierre	
Lehmkuhl	Tom	Public-Private Club	C&C	tom.lehmkuhl@cityofpierre.com	605-773-3186		Capital City Bicycle Club	
Lefferman	Mark	Project Development	S&T	mark.lefferman@urs.com	605-773-3452		SDDOT	
Lepisto	Paul	Road Design	S&T	paul.lepisto@urs.com	605-224-7770	605-220-7213	SDDOT	
Lewis	Ray	Team Work/Language / ICF/CAI	C&C	ray.lewis@icfca.com	605-224-4817		Team Wilson and Wilsons Unlimited	
Lewis	Ann	Great Lakes of SD Tourism Association	C&C	ann.lewis@greatlakesofsd.com	605-224-8286		Great Lakes of SD Tourism Association	
McCasky	Rick	Public - Pedestrian & Discovery Center	C&C	rick.mccasky@discoverycenter.com	605-224-8286	605-220-4950	SD Discovery Center	
McLaren	Bruce	Count Guard		bruce.mclaren@state.sd.us	114-205-2181		US Coast Guard	St. Louis, MO
Monst	John	Quality Manager, Civil Eng		john.monst@urs.com	605-223-2585		URS	4225 Stevens Blvd, St. Louis, MO 63102-2632
Morris	Mark	Public Relations, EIT		mark.morris@morris-nc.com	605-266-1136		URS	100 South Fifth Street, Ste 1500, Minneapolis, MN 55402
Osborg	Carl	Display/PM, Bridge Engineer		carl.osborg@urs.com	613-373-6394	613-619-2633	URS	PO Box 1162, Pierre, SD 57501-madison
Oscar	Carl	Public - Exchange Club	C&C	carl.oscar@urs.com	605-266-5857		URS	100 South Fifth Street, Ste 1500, Minneapolis, MN 55402
Oscar	Scott	Public - Exchange Club		scott.oscar@urs.com	605-856-1268		Truststone Architecture	5011 Powell Road, Tallahassee, FL 32308
Schickelmeier	Lois	City Administrator	S&T	lois.schickelmeier@cityofpierre.com	605-224-7101 ext. 134		City of Pierre	222 E. Dakota Ave, Pierre, SD 57501

APPENDIX A.8

Design Specifications

US14/US83/SD34 Missouri River Bridge Replacement Study



REVISIONS:

Project: SDDOT - US14/US83/SD34 Missouri River Bridge Replacement Study

Document: APPENDIX H – Design Specifications

Revision	Date of Issue	Description
D0	October 24, 2013	Draft Issue – For Client and FHWA Comment

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APPENDIX H: DESIGN SPECIFICATIONS

H.1 INTRODUCTION

This appendix contains the bridge design specifications and criteria used for the preliminary engineering and development of the preferred bridge concept(s) for the replacement of the US14/US83/SD34 Missouri River Bridge Replacement Study for the South Dakota Department of Transportation (SDDOT). Many of these criteria are judgment calls, which are needed to treat all the alternatives fairly. These criteria may be refined during final design, if necessary.

H.2 DESIGN OVERVIEW

H.2.1 Design Documents

The following documents and references were used in the development of these design specifications and in evaluating the US14/US83/SD34 Missouri River Bridge replacement concepts.

- 2012 AASHTO LRFD Bridge Design Specifications
- 2010 AASHTO Highway Capacity Manual
- AASHTO Highway Safety Manual
- 2013 SDDOT Structures Construction Manual
- 2012 SDDOT Average Unit Bid Prices
- 2012 SDDOT Annual S.D. Construction Cost Index (CCI)
- 2004 SDDOT Standard Specifications for Roads & Bridges, with Supplemental Specifications
- SDDOT Road Design Manual
- SDDOT Drainage Manual
- SDDOT Water Quality Program Design Manual
- SDDOT Road Design's CADD Procedures Manual
- SDDOT Standard Plates Index
- SDDOT Highway Surveying Manuals

H.2.2 Design Goals and Guidelines

The following project goals were expressed in the project RFP:

- The design life (Durability Criteria) was stated as 100 years for replacement. The deck design goal is also 100 years. Periodic maintenance items necessary to achieve a 100 year design life will be identified and included in life cycle analyses.
- Typical cross sections are dictated by traffic volumes and requirements.
- Span lengths for the river bridge are driven by structure type & height, superstructure depth and economics as well as US Coast Guard (USCG) requirements. Maximum and minimum lengths are not specifically limited. The USCG will be contacted directly with requests for clearance requirements. Proposed bridge options may reduce the existing navigational clearances - provided they are acceptable to the USCG and SDDOT.
- Aesthetic considerations will be a result of stakeholder input as evaluated by the SDDOT / URS Team. All aesthetic concepts or proposals shall be provided for SDDOT review/acceptance prior to their publishing or public access.
- Aviation and Railroad restrictions or requirements may be specific to the location and will be the investigative responsibility of the URS Team with assistance of SDDOT as necessary.
- If two superstructures are implemented for the river bridge, a minimum distance of 8 feet shall be provided between adjacent copings. If a single superstructure is implemented, means of superstructure maintenance and inspection shall be provided and included in feasibility studies.

H.3 DESIGN LOADS, FORCES AND DESIGN EFFECTS

Design loads, forces and design effects will follow AASHTO LRFD unless noted otherwise. Major load effects considered during the conceptual engineering phase are highlighted below and include:

H.3.1 Dead Loads: (See Table H.3.1)

Table H.3.1 - Dead Loads

Material	Density
Reinforced Concrete	150 lb/ft ³
Prestressed Concrete	150 lb/ft ³
Post-Tensioned Concrete	155 lb/ft ³
Structural Steel	490 lb/ft ³
Soil	120 lb/ft ³

H.3.2 Superimposed Dead Loads: (See Table H.3.2)

Table H.3.2 - Superimposed Dead Loads

Superimposed Dead Loads	Weight
Future Wearing Surface	22 lb/ft ²
Sidewalk Wearing Surface	TBD lb/ft ²
Traffic / Pedestrian Barriers:	
Adjacent to Traffic	TBD lb/ft
Adjacent to Pedestrians	TBD lb/ft
Center Median	TBD lb/ft
Total all Barriers and Parapets	TBD lb/ft
Utilities:	5 lb/ft ²

H.3.3 Live Loads:

Traffic:

- TBD = LRFD HL-93 plus dynamic load allowance
- Multiple Presence Factor (m) = 1.0.

Pedestrian:

- 75 lbs/ft² without dynamic load allowance loaded in the worst configuration.
- Pedestrian loads on sidewalks and vehicular loads in traffic lanes shall occur concurrently.

The study of bridge vibration due to dynamic influences of pedestrians and traffic shall be undertaken during final design. Bridges carrying pedestrians and traffic generally have sufficient mass and stiffness to preclude any significant dynamic effects.

H.3.4 Temperature:

Temperature ranges considered are based upon AASHTO Bridge Design Specifications Section 3.12 – Procedure B as follows:

Uniform Temperature:

Concrete Structure:

Maximum Temperature	= +110° F
Minimum Temperature	= -10° F
Median Temperature	= +70° F
Design Temperature Range	= 130° F

Steel Structure:

Maximum Temperature	= +120° F
Minimum Temperature	= -30° F
Median Temperature	= +70° F
Design Temperature Range	= +150° F

Temperature Gradient:

Solar Radiation Zone = 2

Uniform temperature differential between the stay cables (if used) and the superstructure and towers = ± 15°F for light colored stays.

Uniform temperature differential between the arch rib hangers (if used) and the superstructure and arch rib = ± 15°F for galvanized hangers.

Combine extreme values of uniform temperature and temperature gradient at 50% intensities.

H.3.5 Creep and Shrinkage:

Strains are calculated in accordance with CEB/FIP Model Code for Concrete Structures, 1978.

Relative Humidity = 65%

H.3.6 Wind:

Quasi-static design per Section 3.8 of AASHTO LRFD. The basic wind speeds and corresponding wind pressures shall be adjusted for the height above low ground in accordance with Eq. 3.8.1.1-1.

The study of vibration (if cables are used) due to the interaction of wind and rain shall be undertaken during final design.

The geometry proportions (span length, width and depth) of the bridge should not warrant the investigation of dynamic responses such as vortex excitation, galloping, flutter and divergence. Wind tunnel testing will not be undertaken.

H.3.7 Ice Loading:

Design Thickness = 250 psi @ 12 inches of AASHTO Ice Load

Point of Application = 100-year flood elevation

H.3.8 Vessel Collision:

Vessel Collision forces will be neglected due to river navigation restrictions in this area.

H.3.9 Bridge Hydraulics and Scour Data:

URS will review the existing bridge scour information and rock profiles and develop engineering assumptions regarding replacement bridge scour. The type study report will include a section which discusses hydraulics/scour assumptions and foundation alternatives. A comprehensive final hydraulics report was not included as a part of URS' scope; however, it can be added to this study or be a requirement of final design depending upon the requirements of the environmental analysis portion of the study.

- Scour design for the river piers shall include stability in a 500 year flood event and Strength Limit States at the 100 year scour event. Extreme load events per AASHTO LRFD will be considered with ½ the 500 year scour.
- Stream flow - maximum velocity for design = TBD ft/s. Debris rafts shall be considered as appropriate. Temporary works including cofferdams and shoring towers will be designed for a seasonal operation max water level from the USACE.

H.3.10 Geotechnical Recommendations and Foundation Design

- 6 ft., 8ft, and 10 ft. diameter drilled shafts at approximately 3D minimum spacing will be evaluated.
- Driven steel piles (HP14x73) will be evaluated.
- River bridge replacement options will not reuse existing foundations. Standard design and construction practices dictate proximity of adjacent new foundations.
- Foundation evaluation should consider typical piling and drilled shafts. Economic comparisons will be made.
- Final geotechnical recommendations are to be provided under separate cover prior to the commencement of final design.

H.4 GEOMETRY

The structural geometric analyses (span arrangement) performed for US14/US83/SD34 Missouri River Bridge Replacement Study will be developed to a level that allow: 1) confirmation of the structural feasibility of the preferred type; and 2) preparation of preliminary cost estimates.

The preliminary structural span length and height arrangements will employ some optimization, and will be further refined during the final design phase.

H.4.1 Bridge Horizontal Geometry

Main Navigational Span: (TBD)

Original Bridge Span	= 338.5 feet
Existing Bridge Span	= 235.0 feet
Existing Bridge Min Opening	= 210.0 feet
DM&E Railroad Span	= 300.0 feet
US Coast Guard Requirement	= TBD

H.4.2 Bridge Vertical Geometry

Main Navigational: (TBD)	
DM&E Railroad Minimum Clearance Span	= 15.0 feet
Original Bridge Minimum Clearance Span	= 30.0 feet (NW)
Existing Bridge Minimum Opening	= 28.7 feet (1425.8')
US Coast Guard Standard	= TBD

H.4.3 Bridge and Road Geometrics

Geometrics for roads and bridges included in this project shall follow the SDDOT Road Design Manual (<http://www.sddot.com/business/design/forms/roaddesign>).

Design Speed: = TBD

Traffic Widths:	
Traffic Lane Minimum	= 12 feet
Traffic Shoulder Maximum	= 14 feet
Traffic Shoulder Minimum	= 4 feet

H.4.4 Trail/Sidewalk Geometry

On-Bridge Trail/Sidewalk Width:	
Trail(s) Width	= TBD
Maintenance Vehicle Minimum	= 12 feet
Maintenance Vehicle Max from Shoulder	= 8 feet

Under-Bridge Trail Width: = TBD

H.4.5 Center Median Geometry

Minimum length of median access control beyond the structure = TBD

H.5 ANALYSIS AND DESIGN DETAILS

The structural analyses and trial designs performed for US14/US83/SD34 Missouri River Bridge Replacement Study will be developed to a level that allows: 1) confirmation of the structural feasibility of the preferred type; and 2) preparation of preliminary cost estimates.

The preliminary structural arrangements will employ some optimization, and will be further refined during the final design phase.

H.5.1 Reinforcing Cover Requirements

Superstructure:

100-year Deck Design Option:

Top Cover	= 2.0 inches
Bottom Cover	= 1.0 inches
Additional cover may be used to accommodate 100 year service life	

*The top of the deck slab shall be designed with ½ inch sacrificial thickness.

Substructure:

Abutments and Columns = 2.5 inches
 Footings = 3.0 inches
 Additional cover may be used to accommodate 100 year service life

Drilled Shafts:

Casing = 6 inches
 Rock Socket = 3 inches

H.5.2 Distribution of Reinforcing

Use Class 2 exposure conditions for crack control per AASHTO Article 5.7.3.4.

H.5.3 Stay-In-Place Forms

Stay-in-place forms and associated weight will not be considered for the construction of deck slabs. The deck slabs shall be assumed to be cast-in-place with conventional formwork that is removed after the concrete gains sufficient strength.

H.6 MATERIALS

The materials selected for the US14/US83/SD34 Missouri River Bridge Replacement will be selected to be durable and consistent with providing a design that meets a 100-year overall design life for the bridge concepts.

H.6.1 Concrete:

Concrete mixes and strengths typically utilized by SDDOT, and shown in Table H.6.1, are valid for the project; however, proposed revisions for the sake of increased durability or corrosion protection will be considered. Recommendations for concrete will be refined as the study progresses and will be discussed in the final report.

The Type II cement and Class F fly ash required for all concrete.

Table H.6.1 – Concrete Classes

Location	Class	f'ci (psi)	f'c (psi) 28 Days
Drilled Shafts	A45	-	4,500
Traffic Rails	A45	-	4,500
Seal Concrete	TBD	-	3,000
Foundation Caps	A45	-	4,500
Substructure Concrete	A45	-	4,500
Reinforced Concrete Slab	A45	-	4,500
Center Median (TBD)	A45	-	4,500
Prestressed Concrete (TBD)	TBD	5,500	8,000

The life cycle study shall investigate the use of life prolonging admixtures.

H.6.2 Reinforcing Steel:

- ASTM A615 Grade 60 ($F_y = 60$ ksi)
- Superstructure – TBD (epoxy coated, stainless, galvanized, dual coated (ASTM 1055))
- Substructure and Foundations: Black

The life cycle study shall investigate the use of life prolonging reinforcing steels for the superstructure including epoxy coated, stainless, galvanized, and dual coated (ASTM 1055).

H.6.2 Prestressing Steel:

- ASTM A416 Grade 270 ($F_{pu} = 270$ ksi) Low Relaxation
- 0.60 in. dia. – Area = 0.217 in.²

H.6.3 Structural Steel:

- No specific restrictions have been identified with HPS Grades 50 or 70.
- ASTM A709 Grade 50 Painted; or,
- ASTM A709W Grade HPS 50W Weathering (Unpainted); or,
- ASTM A709W Grade HPS 70W Weathering (Unpainted).
- Field connections shall be bolted using 7/8 in. dia. ASTM A325 bolts.
- All materials of domestic manufacture.

The life cycle study will investigate the use of painted versus weathering steel.

H.6.4 Bearings and Expansion Joints:

- The following will be investigated:
 - Finger joint;
 - Silicone; and,
 - Strip seal
- Steel reinforced neoprene bearings are anticipated; however, loads may require the use pot or disk bearings.
- Concrete surfaces adjacent to bearings shall be sloped to permit free drainage and to prevent debris build-up.
- Bearings shall be designed to be removed and replaced.

H.6.5 Arch Hangers:

- Galvanized, braided wire.
- ASTM A586 - Class A 245 Ton Maximum Breaking Strength
- 4 to 1 Minimum Factor of Safety

H.6.6 Stay Cables:

- ASTM A416 Grade 270 ($F_{pu} = 270$ ksi) Low Relaxation
- 0.60 in. dia. – Area = 0.217 in.²
- Designed in Conformance with PTI Spec – “Recommendations for Stay Cable Design, Testing and Installation” (PTI DC45.1-12)

H.6.7 Lighting and Power:

- Roadway lighting – TBD
- Aesthetic lighting – TBD

- Power and outlets for inspection – TBD
- Future ducts – TBD

H.6.8 Finishes and Coatings:

- All colors and architectural finishes to be determined.
- Concrete Abutments
 - Wrap around walls integrated with the structural form and cladding TBD.
- Structural Steel
 - Painted to SDDOT standard
- Traffic and Pedestrian Rails
 - Galvanized with stainless steel anchor bolts.
- Concrete Decks, Rails, and Medians
 - Concrete Surface Treatment – TBD

These and other materials used will be consistent with industry and SDDOT practices.

H.6.9 Bridge Railings, Parapets and Bridge Amenities:

- TBD –Various types of parapets, railings, and other bridge amenities will be presented for stakeholder and design team input. The preferred type(s) will be finalized as part of the type study process.
- Crash Test Criteria = TBD (TL-4, or TL-5)
- Vehicle Barrier Minimum Heights:
 - 32" for TL-4
 - 42" for TL-5
- Pedestrian Railing Minimum Heights:
 - 54" for pedestrian/bicycle w/ 6" diameter max opening (8" diameter above 27")

APPENDIX A.9 Previous Reports

US14/US83/SD34 Missouri River Bridge Replacement Study



SOUTH DAKOTA HISTORIC BRIDGE INVENTORY FORM

Survey Information

Site number
Survey date
Surveyor

Location Information

Structure number <input type="text" value="33-100-118"/> Local name <input type="text" value="Lt. Cmdr. John C. Waldron Memorial"/> County <input type="text" value="Hughes"/> Location <input type="text" value="HUGHES - STANLEY CO LINE"/> Street <input type="text" value="US014"/> Feature crossed <input type="text" value="Missouri River"/>	TWP <input type="text" value="5N/111N"/> RG <input type="text" value="31E/79W"/> SEC <input type="text" value="28/32"/> Q1 <input type="text" value="SE/SW"/> Q2 <input type="text" value="SE/SW"/> Map <input type="text" value="Pierre (1973)"/> UTM zone <input type="text" value="14"/> Easting <input type="text" value="390895"/> Northing <input type="text" value="4914019"/>
--	---

History/Significance

Year built **Altered**
Builder
Eligible
Criteria: A B C D

Statement of significance:

While this bridge retains integrity in most respects, integrity has been diminished by the addition of some modern guardrail. Nevertheless, the structure is a very long example of a multi-span variable depth steel girder bridge type. Bridge 33-100-118 is not National Register eligible at this time because it is less than 50 years old. In 2012, however, it will be considered eligible under criterion C as a good example of the steel girder type, provided that it has suffered no major alterations by that time.

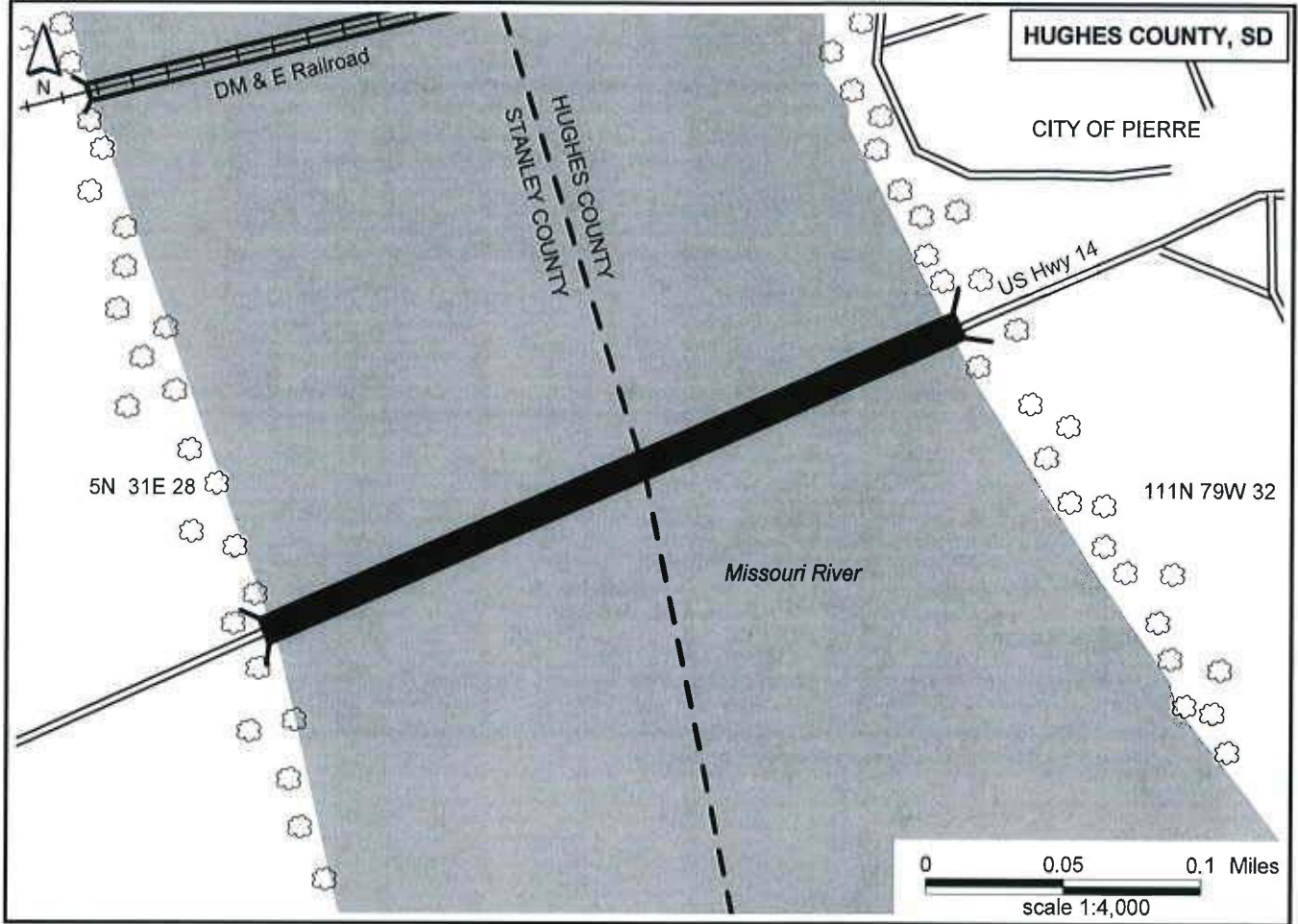
Description

Structural system <input type="text" value="n/a"/>	
Bridge type <input type="text" value="Girder"/>	Length <input type="text" value="1659"/>
Style <input type="text" value="N/A"/>	Number of spans <input type="text" value="10"/>
Material <input type="text" value="Steel"/>	Approach spans <input type="text" value="N/A"/>

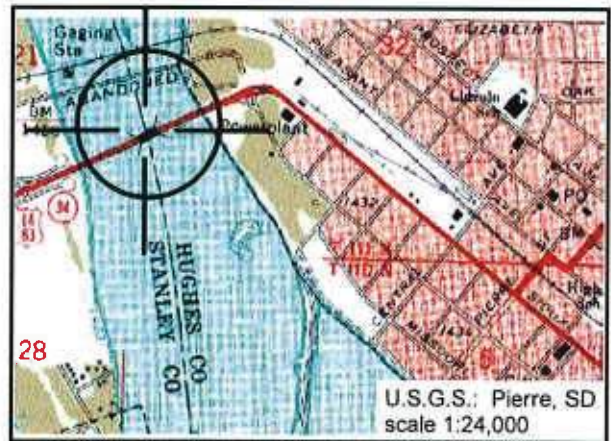
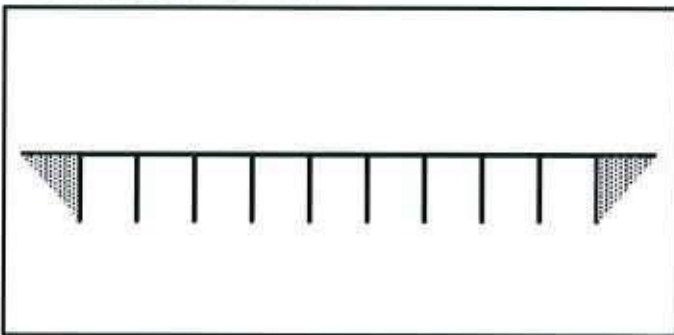
Physical description:

This structure is a ten span steel deck girder bridge that carries US Highway 14/83 over Lake Sharpe (Missouri River) at the western outskirts of Pierre. The superstructure consists of four variable depth continuous steel girders supporting a concrete deck. There is a concrete decked sidewalk, supported by cantilevered concrete posts, on the south side of the deck. Angle sections serve as bridging between the girders. Steel rails supported by metal posts flank the bridge. Modern precast concrete "Jersey rails" have been added to the median and to the outer traffic lanes. Abutments and backwalls are concrete. Intermediate piers are also concrete, each consisting of four round (in cross section) vertical posts with a solid cap. Rockers with anchor bolts on the piers allow for expansion and contraction of the steel superstructure. Other than the addition of the modern Jersey barriers, there have been no significant alterations to the structure.

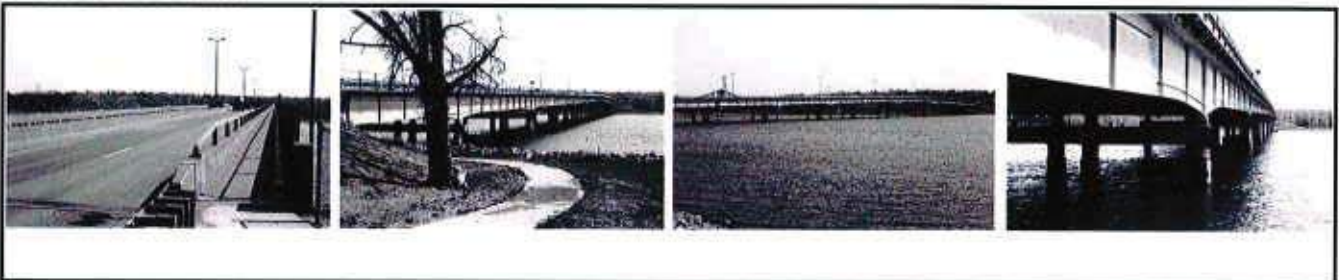
SITE MAP



ELEVATION DRAWING



CONTACT PRINTS



33-100-118

Printed: 10/18/2013 13:54:29

Pontis Database: Pontis DB Client

GENERAL BRIDGE DATA :

(8) STR NO : 33-100-118
 (7) FACILITY : US014
 (6) FEAT INTER : MISSOURI RV
 (9) LOCATION : HUGHES - STANLEY CO LINE
 INTERCHANGE :
 SECTION(S) : 31 32
 TOWNSHIP(S) : 111N
 RANGE(S) : 79W
 (2) REGION : Pierre
 (3) COUNTY : 33 HUGHES
 (21) CUSTODIAN : 1 State Highway Agency
 (22) OWNER : 1 State Highway Agency
 MAINT PROJ : 014-- -351
 (42A) SERV TYPE ON : 5 Highway-pedestrian
 (42B) SERV TYPE UND : 5 Waterway
 (103) TEMP STRUCTURE : Unknown (NBI)
 (99) BORDER BRIDGE STR NO : -1
 (98A) NEIGHBOR STATE : Not Applicable (P)
 (98B) PERCENT SHARE :

HIGHWAY CARRIED (NBI 5)

(5B) ROUTE PREFIX : 2 U.S. Numbered Hwy
 (5C) LEVEL OF SERVICE : 1 Mainline
 (5D) ROUTE NUMBER : 00014
 (5E) DIRECT SUFFIX : 0 N/A (NBI)
 MRM ENGLISH : 228.35

POSTED SPEED : 35 MPH
 SCHOOL BUS RT : MAIL RT :
 (104) NHS SYSTEM : 1 On the NHS
 FA ROUTE : 0014

(26) FUNC CLASS : 14 Urban Other Princ
 (28A) LANES : 4
 (102) DIRECTION TRAFFIC : 2 2-way traffic
 (105) FED LANDS HWY : 0 N/A (NBI)

(19) DETOUR : 9 mi
 (29) ADT TOTAL : 15900
 (30) YEAR OF ADT : 2011
 (109) % TRUCK : 5%

(53) MIN V CLR RT : 328.1 ft
 (53) MIN V CLR LT : 328.1 ft
 (10) MAX V CLR RT : 328.1 ft
 (10) MAX V CLR LT : 328.1 ft
 (47) HORIZ CLR RT : 26.5 ft
 (47) HORIZ CLR LT : 27.6 ft

GIS DATA

LATITUDE: 44.37208 LONGITUDE: -100.36674

DATE: 2/6/2004

COMMENT: FROM GIS AND DOQ ORTHO PHOTOS

GENERAL BRIDGE DATA

(27) YEAR BUILT : 1962 (106) RECONSTR : 0
 (49) STR LENGTH : 1,859.0 ft
 NBIS BRIDGE LENGTH : 1,646.0 ft
 (48) MAX SPAN LENGTH : 235.0 ft
 Main (43A) MATERIAL : 4 Steel Continuous
 Span (43B) DESIGN : 03 Girder-Floorbeam
 SD STR TYPE : X071
 (107) DECK STR TYPE : 1 Concrete-Cast-in-Place
 (52) DECK WIDTH : 66.5 ft
 (51) BRIDGE RDWY WIDTH : 56.2 ft
 (32) APPR RDWY WIDTH : 64.0 ft
 (50A) LT SIDEWK WIDTH : 0.0 ft
 (50B) RT SIDEWK WIDTH : 5.0 ft
 (34) SKEW : 0° SKEW DIR:
 (45) NO MAIN SPANS : 10
 (46) NO APPR SPANS : 0
 (31) DESIGN LOAD : 5 MS 18 (HS 20)
 (33) BRIDGE MEDIAN : 3 Closed Med w/Barriers
 (35) STR FLARED : 0 No flare

BOX CULVERT DATA :

BOX CULVERT SIZE : 0 X 0 X 0
 FILL HT OVER BOX : 0.0 ft
 LENGTH OF LONGEST CELL : 0.0 ft

RAIL DATA

(36) SAFETY FEAT : 1111
 BRIDGE RAIL 1 : 12
 RAIL TRANS 1 : 41
 APPR RAIL 1 : 20
 APPR RAIL TERM 1 : 40

NBI PROP WORK

(75A) WORK TYPE : 35 Rehabilitate-gen.
 (75B) WORK BY : 1 Contract
 (76) IMPROV LENGTH : 1,659.0 ft
 (94) BRIDGE IMPROV COST : \$ 200,000
 (95) RDWY IMPROV COST : \$ 1,000
 (96) TOTAL PROJECT COST : \$ 300,000
 (97) YEAR OF IMPROV COST : 2006
 (114) ADT FUTURE : 18364
 (115) YEAR OF ADT FUTURE : 2031

STEEL PAINT

UNDERCOAT : LEAD-BASED PAINT
 TOPCOAT : ALUMINUM LEAFING
 YEAR : 0000 COLOR : ALUMINUM-GRAY-SILVER

STATUS

SUFF RATE : 54.8
 FED SUFF RATE : 54.8
 FED SR DATE : MAR 2013
 DEFICIENCY :
 CANDIDATE :

DECK DATA

(108A) WEARING SURFACE : 4 Low Slump Concrete
 DECK PROTECTION : Low slump dense concrete (LSDC)
 OVERLAY THICKNESS : 1.97 in

DECK DELAM AREA : 2,500.0 sq ft
 DECK DELAM DATE : 07/2004

DECK SURVEY : 06/1989
 CHLORIDE :
 RESTEEL DEPTH :
 ELECTRO POTENT :

LOAD RATING DATA

(41) OPER STATUS : A Open, no restriction
 (66) INV HS20 : 24.0 tons HS 13.4
 (65) METHOD : 1 LF Load Factor (tons)
 (64) OP HS20 : 41.0 tons HS 22.8
 (63) METHOD : 1 LF Load Factor (Tons)
 TRUCK TYPE 3 : 32.0 tons
 TRUCK TYPE 3S2 : 55.1 tons
 TRUCK TYPE 3-2 : 61.7 tons
 BARS NO : 030005

HYDRAULICS

DRAINAGE AREA : 0.00 sq mi
 OBSERV HW ELEV : 0.0 ft
 YEAR : 0000

DESIGN FREQ : 0
 DESIGN FLOW : 0.0 cfs
 DESIGN VELOCITY : 0.00 fps
 DESIGN AREA : 0.0 sq ft

DESIGN YEAR : 0000
 DESIGN HW ELEV : ft
 100 YEAR FLOW : 0.0 cfts
 100 YR HW ELEV : ft
 V MAX : fps
 SCOUR SCREENING : 8 SCOUR RATING : 5
 TOPEKA SHINER :

RAIL PAINT

UNDERCOAT : LEAD-BASED PAINT
 TOPCOAT : ALUMINUM LEAFING
 YEAR : 0000 COLOR : ALUMINUM-GRAY-SILVER

PROJECT NUMBER : PCN : DATE DONE : PROGRAM IMPROVEMENTS

PROJECT NUMBER	PCN	DATE DONE	PROGRAM IMPROVEMENTS
F-030-1(02)	none	01/01/1961	YEAR: 2013
F-030-1(04)	none	01/01/1962	TYPE: 10 Bridge Projects
030-5-496	none	01/01/1969	ITEM NO :
F-0014(00)228	3351	01/01/1987	PCN : 03WM
F-0014(105)228	3289	01/01/1991	WORK: 60 Other
EM 0014(136)228	6243	01/01/2009	

GENERAL COMMENT : PLATE GIRDER 412' 418' 824' PARABOLIC
 RDWY WIDTH EBL 26.5 WBL 27.6 SEPARATED BY JERSEY BARRIER

REGION COMMENT : PAINT BRIDGE 1993, SW corner has ET-2000 along with new w-beam appr. rail at NW and SW corners.

FREE COMMENT : 1991-LSDC

INSPECTION TYPE	LAST INSPECTION DATE	REQUIRED	INSPECTION FREQUENCY	NEXT INSP DATE
NBI	07/16/2013		12 months	07/16/2014
FRACTURE CRITICAL	07/16/2013	Y	12 months	07/16/2014
UNDERWATER	07/25/2012	Y	60 months	09/12/2017
SPECIAL	NA	N	NA	NA
ELEMENT INSPECTION	07/16/2013		12 months	07/16/2014

INSPKEY : CTVA
 APPRAIS BY : SS
 APPRAIS DATE : 10/15/2013
 QA INSPECTOR :
 QA INSP DATE : 00/00/0000
 LAST INSPECTION BY : PAULN
 CONSULTANT CODE : COLLINS ENG

Pontis Database: Pontis DB Client

CONDITION RATINGS

(58) DECK : 5 (59) SUPER : 5 (60) SUB : 5 (62) CULVERT : N
 (61) CHANNEL : 6 Minor movement of channel
 APPROACH : 8 Concrete

APPRAISAL RATINGS

(67) STR APPR : 5 Deck cracks, cracked welds, girder rust
 (68) DECK GEOM : 5 Substd width
 (69) UNDERCLR : N
 (71) WATERWAY : 9
 (72) APPR ALIN : 5 Horiz curve east end
 (70) BR POST : 5 LFA

Elements	07/16/2013	Unit	ID	Env	Tot. Qty (English)	Units	Q 1	Q 2	Q 3	Q 4	Q 5	Notes
P Conc Deck/Rigid Ov		MAIN	22	3	110,324	(SF)	0	110,324	0	0	0	<p>PAULN inspect comments - No delem check at this inspection. Last yeer's check totaled 1384 sq. ft. just from the DL in the EBL from Abut 1 to Pler 7. That ends up being approx. 13 %. There are currently 4 small locations that show falling overlay within the DL of the EBLs. 7/16/13</p> <p>PAULN inspect comments - Two additional erees of overlay distress in EBL. Spen 1 near CL 27 ft. from Abut. 1, 2 x 3 & Spen 3 in outside wheel track of EB DL 30 ft beck of Pier 4 joint. 2 x 2. Delam survey completed in DL of EBLs from Abut 1 to Pler 7. 7/25/12</p> <p>PAULN inspect comments - No full delam check but spot checks indicate that delam is increasing. Not difficult to find delamination along wheel paths. Two areas of distress on overlay in EBLs one near yellow line 30 ft. from Abut. 1 & the other near the white line 30 ft. back of Pier 4 jt. 9/14/11</p> <p>PAULN inspect comments - No repairs required on deck surface. No formel dealm survey done. 5/28/10</p> <p>PAULN inspect comments - An additional area of distress on surface in EBL near Abut 1. Partiel depth patch was placed. No significant change in remainder of deck. 6/25/09</p> <p>PAULN inspect comments - Area in EBL near Abut 1 showing distress above area of crecking & efflor visible on underside. Partiel depth patch was plected prior to head to heed traffic during rehab work. Remelnder of overlay appears in good condition. 5/29/08</p> <p>PAULN inspect comments - Overlay is in overall good condition. 7/9/07</p> <p>PAULN inspect comments - No formal delem check done this inspection. Surface of overlay has little obvious deterioration. Some light spelling on the tops of the abutment backwalls. 7/13/06</p> <p>Random areas of mainly small delam. areas throughout the deck. Outside lanes checked in both sets of lanes.</p>
Paint Str Opn Girder		MAIN	107	2	6,492	(LF)	122	2,210	3,910	250	0	<p>PAULN inspect comments - No significant change in paint. 7/16/13</p> <p>PAULN inspect comments - Little change in paint. More freckia rust showing through newer paint. 7/25/12</p> <p>PAULN inspect comments - Some freckie rust starting to show through recently repainted areas along girdars. 5/28/10</p> <p>PAULN inspect comments - The bottom portions of the web and bottom flenge on the inside of G2, G3 & G4 have been cleaned and painted between the bolted splices in the positive momant ragions end through the pier erees with open joints eiimineting most of the erees showing section loss.</p> <p>PAULN inspect comments - Surface rust continues to expand. Large majority of interior sida of G2 & G3 heve heavy frackle to mod. surfece rust end soma section loss through spans meking inspection of bottom fillat welds difficult. 7/9/07</p> <p>PAULN inspect comments - Slight increasa in rust coveraga. 7/13/06</p> <p>PAULN inspection comments - Rust erees continua to grow slowly along with flaking areas. 7/1/04</p> <p>PAULN elament inspection comments - Slight increases in corrosion throughout girders.</p> <p>Date 2003-04-28 -</p> <p>PAULN element inspection comments - Much of the interior sides of G2 end G3 hava sections of modarata to heavy rusting with light section loss occuring. There are also areas to a lasser extent in the same condition on the exterior girdars. Estimated length of at least 1/4 of total amount of girder length.</p> <p>Data 2002-05-14 -</p> <p>-> Light to moderate spot rusting throughout most of the girdar lengths. Numarous erees whera paint hes feiled end section loss is occuring. FATIGUE CRACKS THAT HAVE BEEN DRILLED & FATIGUE CRACKS</p>

Elements	07/16/2013	Unit	ID	Env	Tot. Qty (English)	Units	Q 1	Q 2	Q 3	Q 4	Q 5	Notes
Paint Stl Opn Girder	MAIN	107	3		144	(LF)	85	24	20	15	0	PAULN inspection comments - Several areas of light section loss adjacent to open joints. Holes in girder webs of G2 & G3 at Abut. 11. 7/16/13 PAULN inspection comments - Small areas of SR on most girders at stepped locations within stiffeners. Heavy SR along several horiz. stiffeners between stepped girder sections & bearing stiffeners. SR rust also appearing along top flanges adjacent to open jts. 9/14/11 PAULN inspection comments - Some surface rust showing through repainted areas on hangers. 5/20/10 PAULN inspection comments - Most of girder ends near open joints are in good condition. 7/1/04 Date 2003-04-28 - PAULN element inspection comments - Similar to previous inspection. Date 2002-05-14 - Previous comments > Girder ends at interior open joints have spot rusting in some locations. Girder ends at the abutments have areas of heavy rusting and some section loss. Remainder of girder ends are in very good condition.
Paint Stl Stringer	MAIN	113	2		6,492	(LF)	3,220	3,192	40	40	0	PAULN inspect comments - Stringers overall good. Only areas with advanced corrosion are adjacent to open joints. Small crack found at 90 degree cope on the south stringer in Span 10 west side of FB 1. 7/16/13 PAULN inspect comments - Stringers adjacent to open joints have light SL. 9/14/11 PAULN inspect comments - Crack tip in stringer drilled out. Stringers adjacent to Pier 4 on the Span 3 side have heavy SR on the top of the bottom flange. 5/28/10 PAULN inspect comments - North stringer at FB 1 Span 8 has a crack in the cope at the west end. 6/25/09 PAULN inspect comments - Stringer paint in good condition. 7/9/07 PAULN element inspection comments - Stringers not adjacent to open joints are in good condition with mainly freckle rust. 7/13/06 Date 2003-04-28 - PAULN element inspection comments - Similar to previous inspection. Only lite freckle rust on the edges of the bottom flanges for the most part. Date 2002-05-14 - Previous comments > Stringers are in good condition with light spot and freckle rusting at random locations.
Paint Stl Stringer	MAIN	113	3		144	(LF)	52	56	16	20	0	PAULN inspect comments - Stringers overall good. Only areas with advanced corrosion are adjacent to open joints. 7/16/13 PAULN inspect comments - Stringers adjacent to open joints have light SL. 9/14/11 PAULN inspect comments - Crack tip in stringer drilled out. Stringers adjacent to Pier 4 on the Span 3 side have heavy SR on the top of the bottom flange. 5/28/10 PAULN inspect comments - Stringers within 4 ft. of open joints have been cleaned and repainted. 6/25/09 PAULN inspect comments - Stringers in Bay 1 near open joint at Pier 7 have 30 ft. of light section loss. 5/29/08 PAULN element inspection comments - Moderate to heavy corrosion on several stringer ends under open joints. 7/13/06 Date 2003-04-28 - PAULN element inspection comments - Date 2002-05-14 - Previous comments > Stringers within the 2 meter limit of an open joint have spot and freckle rust fairly widespread.
Paint Stl Floor Beam	MAIN	152	2		4,078	(LF)	755	2,903	420	0	0	PAULN inspect comments - Two cracks found in the bottom fillet wald of FB 8 Span 9 Bay 1. Cracks are approx. 6 inches apart located approx. 15 inches from cantarina. Floorbeams generally in good condition. Generally light freckle rust. Some heavier rust adjacent to open joints. 7/16/13 PAULN element inspection comments - Span 3 Floorbeam adjacent to Pier 4 has SR along top flange throughout. 5/28/10 PAULN element inspection comments - Floorbeams in overall good condition. Some areas of surface rust from leakage through the deck. 7/13/06 Date 2003-04-28 - PAULN element inspection comments - Mainly lite freckle rusting on floorbeams. There is some random locations of surface rusting. Date 2002-05-14 - Previous comments > Most of the floorbeams have some freckle rust with random areas of surface rusting. No significant change from previous inspection.
Paint Stl Floor Beam	MAIN	152	3		289	(LF)	188	43	45	13	0	PAULN inspect comments - Areas of light SL on FBs adjacent to open joints. 9/14/11 PAULN inspect comments - Span 3 Floorbeam adjacent to Pier 4 has SR along top flange throughout. 5/28/10 PAULN inspect comments - Floorbeams within 4 ft. of open joints have been cleaned and repainted. 6/25/09 PAULN inspect comments - Areas of section loss to floorbeams at abutments. 7/9/07 PAULN element inspection comments - The last FB in Span 6 has 11 ft. of section loss. 7/13/06 Date 2003-04-28 - PAULN element inspection comments - The floorbeams near the open joints are in good condition. Date 2002-05-14 - Previous comments > Paint on floorbeams is fairly good. Light spot rusting at random locations

Elements	Unit	ID	Env	Tot. Qty (English)	Units	Q 1	Q 2	Q 3	Q 4	Q 5	Notes
R/Conc Column	MAIN	205	2	36	(EA)	30	6	0	0	0	<p>PAULN inspect comments - Columns are in overall good condition. 7/18/13</p> <p>PAULN inspect comments - Repaired columns continue to look good. 7/25/12</p> <p>PAULN inspect comments - Columns are in good condition. No problems found on repaired columns. 9/14/11</p> <p>PAULN inspect comments - HL vert cracks occurring in new Pier 10 columns mainly in the middle of the columns. 5/28/10</p> <p>PAULN inspect comments - Rehab work summer of '09 repaired nearly all column deterioration. Pier 10 completely rebuilt while others had delem repaired and were fiber wrapped. 6/25/09</p> <p>Collins Engineering 9-6-2008; inspected 32 of columns reted 31 in CS 1 and 1 in CS2 - Did not inspect Pier 4 since under construction</p> <p>PAULN inspect comments - Columns are scheduled for repair starting 7/08.</p> <p>PAULN inspect comments - No noticeable change in column deterioration. 7/09/07</p> <p>PAULN inspect comments - CTL performed an indepth inspection of substructure units in the Fall of '04. A report submitted to the DOT showed 13 columns with various delamination and 8 with exposed resteel. Further testing revealed that many columns had high permeability, high carbonation and chloride retes and shallow cover. 7/13/06</p> <p>PAULN element inspection comments - Ten columns now found to have moderate scaling to delamination with spalling and exposed and corroding resteel. Most of the heavy corrosion appears to be on the stirrups but there are a couple of columns that have corroding vertical bars. CTL will in in depth investigation of piers this fall. 7/1/04</p> <p>COLLINSENG element inspection comments - Date 2003-09-30 -</p> <p>PAULN element inspection comments - Date 2003-04-28 -</p>
R/Conc Abutment	MAIN	215	3	141	(LF)	111	8	22	0	0	<p>PAULN inspect comments - Spelled areas on the top of Abut. 11 backwall in WBLs. Mod. to heavy scaling on the seat edge of Abut. 11 with stirrups & main bars exposed. Eight spalls along top of Abut 11 backwall in Bay 3. 7/16/13</p> <p>PAULN inspect comments - Minor to mod. scaling for approx. 20 ft along Abut. 11 seat with several erees of resteel exposed. Several spells with exposed resteel near the top of Abut. 11 backwall in Bay 3. 9/14/11</p> <p>PAULN inspect comments - Some minor spalling in Bay 1 of Abut 1. 5/28/10</p> <p>PAULN inspect comments - Abut 11 has several small spells with exposed resteel in the upper portion of the backwall. 5/29/08</p> <p>PAULN inspect comments - Moderate scaling at three locations on Abut 11 seat totelling 12 ft. 7/13/06</p> <p>PAULN element inspection comments - Rendom HL to narrow vertical cracking in the backwalls. 7/1/04 PAULN element inspection comments - Date 2003-04-28 -</p> <p>PAULN element inspection comments - Similar to previous inspection. Date 2002-05-14 -</p> <p>Previous comments > Abutment No. 1 seat has 3 meters of heavy scaling, up to 6 inches deep. No resteel exposed. HAIRLINE CRACKS IN CAPS AND COLUMNS</p>
R/C Sub Pile Cap/Ftg	MAIN	220	2	8	(EA)	8	0	0	0	0	<p>CollinsEng - 9-6-2008; Exposed footings end piles (2 piers) in generally good condition with no significant defects. Previous comments > Footings visible were all in good condition. HAIRLINE CRACKS IN CAPS AND COLUMNS</p>
R/Conc Cap	MAIN	234	2	448	(LF)	407	40	1	0	0	<p>PAULN inspect comments - NW corner of Pier 2 cap has heavy scaling & exposed resteel. 7/16/13</p> <p>PAULN inspect comments - Repaired cap areas look good. 7/25/12</p> <p>PAULN inspect comments - Some minor deterioration on unrepaired caps. No problems found on repaired areas. 9/14/11</p> <p>PAULN inspect comments - Repaired areas of caps look good. 5/28/10</p> <p>PAULN inspect comments - Most of the cap deterioration has been repaired. Concrete repaired with some caps getting epoxy fiber wrap, also. 6/25/09</p> <p>PAULN inspect comments - Cap repair to begin 7/08.</p> <p>PAULN inspect comments - CTL detected delamination on several of the pier caps along with some spalling and exposed resteel. 7/13/06</p> <p>PAULN element inspection comments - Several cap ends have scaling and deterioration. Several of the caps have narrow to medium transv. cracks on the interior portion of the caps. 7/1/04 PAULN element inspection comments - Date 2003-04-28 -</p> <p>PAULN element inspection comments - Similar to previous inspection. Date 2002-05-14 -</p> <p>Previous comments > Pier cap #3 has an area of scaling with exposed resteel. Hairline to narrow cracking throughout caps. A few areas have medium size cracks. HAIRLINE CRACKS IN CAPS AND COLUMNS</p>

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Elements	07/16/2013	Unit	ID	Env	Tot. Qty	Units	Q 1	Q 2	Q 3	Q 4	Q 5	Notes
					(English)							
R/Conc Cap	MAIN	234	3	128	(LF)	108	20	0	0	0	0	PAULN inspect comments - Repaired cap areas look good. 7/25/12 PAULN inspect comments - Some minor deterioration on unrepaired caps. No problems found on repaired areas. 9/14/11 PAULN inspect comments - Repaired areas of caps look good. 5/28/10 PAULN inspect comments - Most of the cap deterioration has been repaired. Concrete repaired with some caps getting epoxy fiber wrap, also. 6/25/09 PAULN inspect comments - Cap repair to begin 7/08. PAULN element inspection comments - Several cap ends have moderate deterioration with exposed resteel along with narrow to medium cracking on the interior portions. 7/1/04 PAULN element inspection comments - Date 2003-04-28 - PAULN element inspection comments - Similar to previous inspection. Date 2002-05-14 - Previous comments > Several caps with up to medium size cracking on portions of cap length. Caps at Pier No. 4 and 7 have areas of scaling 3/4 to 2 in. deep with exposed reinforcing steel.
Open Expansion Joint	MAIN	304	3	239	(LF)	36	121	82	0	0	0	PAULN inspect comments - Shallow spalling along Pier 4 jt. in WBLs shows little change. Overall jts. are performing. 7/16/13 PAULN inspect comments - Spalling along P4 jt. similar to previous. 7/25/12 PAULN inspect comments - Small spall adjacent to Abut. 11 in WBL & shallow spalling along Pier 4 jt. in WBLs. 9/14/2011 PAULN inspect comments - Finger joints continue to function. Tight fingers at Abut 1 and some misalignment at other joints. Corrosion continues below deck surface on assemblies. 6/25/09 PAULN inspect comments - Corrosion continues to remove section from finger joints. Areas of spalling on the underside of the deck adjacent to armor assemblies. 7/9/07 PAULN inspect comments - Abut joints are tight at 60 degrees +. Some spalling at the tops of the abutment backwalls adjacent to the joints. 7/13/06 PAULN element inspection comments - Corrosion continues on finger joints. 7/13/06 Date 2003-04-28 - PAULN element inspection comments - There is heavy section loss on many of the knee braces and the armor assembly under the fingers of these joints. Some are completely corroded away. Date 2002-05-14 - Previous comments > The fingers are in good condition for the most part. The support plates below have areas of heavy rust and section loss. There are several plates that have rusted entirely. Some of the armor assembly plates have significant section loss, also.
Moveable Bearing	MAIN	311	2	24	(EA)	23	1	0	0	0	0	PAULN inspect comments - Environment 2 moveable bearings have little corrosion. 7/16/13 PAULN inspect comments - G2 at Pier 3 is locked in expansion at 78 degrees. 9/14/11 PAULN inspect comments - No apparent movement in the rocker bearings at Pier 6 & 10. 5/28/10 PAULN inspect comments - No apparent movement in G2 or G3 rockers at Pier 10 since last painted. G2 bearing at Pier 3 has limited expansion capabilities remaining. 7/09/07 PAULN inspect comments - The G3 rocker at Pier 6 appears to have not moved since it was last painted. The paint over run between the bottom of the rocker and the bearing plate is not cracked. 7/13/06 PAULN inspection comments - Bearings are in good condition. Only light spot rusting. 7/1/04 PAULN element inspection comments - Date 2003-04-28 - PAULN element inspection comments - Date 2002-05-14 -
Moveable Bearing	MAIN	311	3	16	(EA)	10	6	0	0	0	0	PAULN inspect comments - Only bearings with mod. corrosion at the the abutments. 7/16/13 PAULN element inspection comments - Several abutment bearings have mod. to heavy corrosion. 7/1/04 PAULN element inspection comments - Date 2003-04-28 - PAULN element inspection comments - Date 2002-05-14 - Previous comments > Bearings at abutments have moderate to heavy corrosion.
Fixed Bearing	MAIN	313	2	12	(EA)	12	0	0	0	0	0	PAULN inspect comments - Fixed bearings in good overall condition. 7/13/06 PAULN element inspection comments - Fixed bearings at piers look good. Only light spot rusting. 7/1/04 PAULN element inspection comments - Similar to previous inspection. Date 2002-05-14 - Previous comments > Fixed bearings at Pier Nos. 2, 5 & 9. Good condition.

33-100-118

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Elements	07/16/2013	Unit	ID	Env	Tot. Qty (English)	Units	Q 1	Q 2	Q 3	Q 4	Q 5	Notes
Conc Bridge Railing	MAIN	331	3		4,977	(LF)	4,977	0	0	0	0	<p>PAULN inspect comments - A large crack has developed 1 ft. + or - from the end of the centerline barrier adjacent to the expansion joint at Abut. 11. Crack is approx. 1/4 inch wide at the top. 7/16/13</p> <p>PAULN element inspection comments - Conc barrier is in good condition. 7/13/06</p> <p>Date 2003-04-28 -</p> <p>PAULN element inspection comments - Only HL vertical cracking along concrete bridge railing.</p> <p>Date 2002-05-14 -</p> <p>Previous comments > Barrier is in good condition. Some random hairline to narrow vertical cracks are present.</p>
Other Bridge Railing	MAIN	333	3		1,660	(LF)	1,496	164	0	0	0	<p>PAULN inspect comments - Overall good condition. 7/16/13</p> <p>PAULN element inspection comments - Random areas of spot rust. 7/13/06</p> <p>Date 2003-04-28 -</p> <p>PAULN element inspection comments - There is some light rusting on original rail elements. Chainlink fence has been hooked in three locations during snow removal operations. Date 2002-05-14 -</p> <p>Previous comments > Light rusting on the original elements. Three locations where the chainlink has been hooked during snow removal.</p>
Steel Fatigue SmFlag	MAIN	356	2		1	(EA)	0	1	0	0	0	<p>PAULN inspect comments - Several new cracks found this inspection. See Fracture Critical report. 7/16/13</p> <p>PAULN inspect comments - A few new cracks found this inspection. See Fracture Critical report. 9/14/11</p> <p>PAULN inspect comments - Some additional crack welds found at stiffeners & a welded web splice. 5/28/10</p> <p>PAULN inspect comments - Fatigue retrofit completed summer of '09. Type B & C retrofits to diaphragm stiffeners along with bolted splices at cover plate terminations and welded web splices at high stress areas. 6/25/09</p> <p>PAULN inspect comments - Additional cracks found mainly at the ends of stiffeners. One crack found near the weld termination at the bolted splice near FB 7 on the inside of G2 Span 2. Fillet weld ground flush with base metal. Cracks still visible in web material. Plan is to cope area out with current rehab project. 5/29/08</p> <p>PAULN inspect comments - Additional cracks found this inspection. A few old cracks showed slight growth. Cracks bared at 4 locations. 7/09/07</p> <p>PAULN inspect comments - Continue to see additional cracks mainly at the tops of vertical stiffeners, bearing stiffeners and diaphragm stiffeners. Several previous crack indications were declared No Crack by HDR personnel. Many of those still indicate crack with use of mag part. 7/13/06</p> <p>PAULN element inspection comments - Numerous additional cracks in girders found. Several locations cored due to cracks in the flange to web fillet welds. 7/1/04</p> <p>Previous comments > < none ></p>
Deck Cracking SmFlag	MAIN	358	2		1	(EA)	0	1	0	0	0	<p>PAULN inspect comments - Cracking is still mainly HL to narrow with isolated larger cracks of varying directions. Four potential patch areas within the outside lane of the EBLs between Abut 1 & Pier 7. 7/16/13</p> <p>PAULN inspect comments - Random HL to narrow transv & long cracking throughout. Delam detected along many of the cracks. Two areas of distressed overlay in EBL one near yellow line 30 ft. from Abut. 1 & the other near the white line 30 ft. back of Pier 4 jt. 9/14/11</p> <p>PAULN element inspection comments - No significant change in deck cracking observed. 7/1/04</p> <p>PAULN element inspection comments -</p> <p>Date 2003-04-28 -</p> <p>PAULN element inspection comments - There are random transverse and longitudinal cracks in all spans. Most of the cracks are HL in size with a small portion in the narrow to medium range. There are some cracks in the wide range in Span No. 3. Many of the cracks have been previously sealed with epoxy. Some epoxy is wearing out and disappearing.</p> <p>Date 2002-05-14 -</p> <p>Previous comments > All cracks that are fairly visible have been sealed with epoxy.</p>

Elements	07/16/2013	Unit	ID	Env	Tot. Qty (English)	Units	Q 1	Q 2	Q 3	Q 4	Q 5	Notes
Soffit Smart Flag	MAIN	359	2	1	(EA)	0	1	0	0	0	0	<p>PAULN inspect comments - Continued deterioration on overhangs. Areas of full depth distress in Span 1 Bay 2 & 3 between end and FB 2. Large area of distress in Span 8 Bay 2 from FB 1 to FB 3. 7/16/13</p> <p>PAULN inspect comments - Several small areas of heavy map cracking throughout underside and adjacent to deck joints. Many transv cracks allowing leakage through deck creating areas of corrosion on the top flange. Heavy spalling and corroded resteel continues on the overhangs. 9/14/11</p> <p>PAULN inspect comments - No additional areas of deterioration found on underside of deck. 5/28/10</p> <p>PAULN inspect comments - An additional deck patch placed above the distressed area in Span 1 Bay 3. Most other areas that appear distressed are adjacent to finger joints. 6/25/09</p> <p>PAULN inspect comments - Random areas of spalling concrete and exposed resteel mainly adjacent to open deck joints. 7/09/07</p> <p>PAULN inspect comments - Broken and delaminated area on the underside of the deck 6 ft east of Span 8, in Bay between G2 and stringer, 3 x 3. There is distressed concrete with some spalling adjacent to the Pier 7 finger joint on both sides. Cracking and efflor. on the underside between FB 9 & 10 Bay 3 Span 8. 7/13/06</p> <p>PAULN element inspection comments - Removed numerous loose areas of concrete along deck edges to prevent falling on boaters. Underside of deck is in fairly good condition. 7/1/04 PAULN element inspection comments - Date 2003-04-28 -</p> <p>PAULN element inspection comments - The underside of the deck near the edges continues to deteriorate and lose section. The exposed resteel along this area has heavy rusting and heavy section loss in many locations. There is an area within Span No. 1, between Abutment No. 1 and floorbeam 2, that has wide sized cracking in block pattern Date 2002-05-14 -</p>
Scour Smart Flag	MAIN	361	2	1	(EA)	0	1	0	0	0	0	<p>PAULN inspect comments - Underwater inspection performed last year shows areas of scour have filled in to various degrees. 7/16/13</p> <p>PAULN inspect comments - Weekly monitoring of scour summer of '11 due to flood conditions. Undermining of the full footing was indicated on Pier Nos. 2, 8 & 9. Most of the other footings had partial undermining to footing exposure. Scour to 15 ft + or - below the bottom of Pier 9 was the largest amount found. 9/14/11</p> <p>Collins Engineering - 9-6-2008; Localized scour depressions at Piers 5 thru 7</p> <p>Previous comments > Pier No. 3 and No. 9 both have undermining of the footings. The footing of Pier No. 9 has 5 ft. of exposed piling at the upstream end tapering to zero at the upstream 1/4 points. The underwater inspection done in September '98 coded this situation as e 3.</p>
Section Loss SmFlag	MAIN	363	2	1	(EA)	0	1	0	0	0	0	<p>PAULN inspect comments - Corrosion emerging from section loss areas that were repainted near Pier 4 & 7. 7/16/13</p> <p>PAULN inspect comments - G2 & G3 at Abut. 11 bumper locations within web reinforcements have holes completely through the web. 9/14/11</p> <p>PAULN inspect comments - Nearly all areas of section loss on the girders end elements at open joints have been cleaned and painted. Any remaining section loss is light. 5/25/09</p> <p>PAULN element inspection comments - Many areas on the interior sides of G2 and G3 have moderate rusting with little section loss. Random areas on remainder of girders have similar condition. 7/1/04 PAULN element inspection comments - Date 2003-04-28 -</p> <p>PAULN element inspection comments - Mainly little section loss is still present mostly on the lower flange of the interior girders end under open joints. Date 2002-05-14 -</p> <p>Previous comments > Girder ends near abutments and random locations throughout the girders have rusting with section loss. The knee braces under the fingers of the expansion joints have heavy section loss throughout the expansion joints.</p>
# Elements												

UNDERWATER BRIDGE INSPECTION REPORT



NBI Item 60 Rating: 6
NBI Item 61 Rating: 8
NBI Item 113 Rating: 5

Bridge Number: 33-100-118
Inspection Date: 9/12/2012
Division: Statewide
River: Missouri River

Engineer of Record: David Reser, 6209
Team Leader: David Reser, 6209
Substructures Inspected: Piers 2 thru 10
Team Members:
ARY, DRR, KRR, MPC, MDD

Signature/Seal

12/18/12

Summary of Scour and Channel Conditions:

There has been up to 18-feet of general channel degradation between Bents 6 and 9 since bridge construction. Additionally, there has been significant local scour at Bents 6 thru 9 since 2008, including up to 11-feet of local scour at Bent 8 since the 2008 underwater inspection.

Summary of Structural Conditions:

The inspected substructure units are in satisfactory condition. There are no significant structural defects present below the high waterline. Scour has exposed the steel H-piles under the footings at Piers 3 and 6 thru 9. Refer to Photos 1 and 2 for overall views of the bridge and substructure configuration.

Summary Evaluation of Previous Corrective Actions:

The pier wall and cap at Pier 10 was reconstructed in 2009. Additional concrete repairs were performed above the waterline on the remaining piers. The repairs at Pier 10 are performing well.

Summary of Repair Recommendations:

No repairs are required at this time.



Route: US 14
Inventory Direction: West to East
County: Hughes
Location: Pierre
Bridge Length: 1659 FT
Superstructure Type: Steel Girder
Substructure Type: CIP Concrete Columns on Footings
Foundation Type: Footing w/ Steel H-Piles
Total Substructure Units: 11
Substructure Units in Water: 9
Deepost Water Depth: 30 FT
Water Velocity: 2 FPS
Underwater Visibility: 6 FT
Water Temperature: 69 °F

Attachments Included:

- A - Drawings (Pages A-1 through A-13)
- B - PONTIS Table (Page B-1)
- C - Location Map (Page C-1)



Infrastructure Engineers, Inc.
Corporate Headquarters
2121 Old Hickory Tree Road
St. Cloud, FL 34772
1-888-451-6822

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APPENDIX B

Tier 1 Evaluation Matrices

Table A1 (Part 1 of 2)

SDDOT: US14/US83/SD34 Missouri River Bridge Study

Phase 1: BridgeTypical Section Scoring Matrix

Date: February 4, 2014

Typical Section Alternate ID	Type	Description	Number of 12' Lanes	Outside Shoulder Width (ft)	Inside Shoulder Width (ft)	Median Width (ft)	South Path/Trail Width (ft)	North Path/Trail Width (ft)	Slopes	Overall Width (ft)	Single, Dual or Triple Decks	Number of Railings	Number of Parapets	Traffic Lighting Location(s)	Approximate Bridge Area (sft) (Overall Width x 1600 ft)	Approximate Bridge Cost (\$M) Based on \$200/sft	Typical Section Graphic	CSS / Environment					Cost Effectiveness		Maintenance & Inspection			Traffic Impacts					TOTALS	
																		Social Impact	Section 41 / 61 (Park) Impact	Cultural / Historical Impact	Economic Impact	Noise Impact	Initial Cost	Lifecycle Cost	Snow Removal	Lane Closure Availability	Accessibility for Inspection	Level of Service (2025)	Level of Service (2045)	Level of Service (2125)	Pedestrian Accessibility	Bicycle Accommodation		
Weighting																		Category	15					20		15			50					100%
Individual																		1 to 5 Score	5	3	2	2	3	15	5	5	5	5	10	25	5	5	5	100%
1	Do Nothing	Bridge Remains As-is	4	1.25 ft & 1.83 ft	1.25 ft & 1.83 ft	2	5	0	1.5% off centered	66.5 ft	Single	2	3	Center Median	106,400 sft	N/A		Weighted Score	2.0	3.0	1.6	0.8	2.4	15.0	2.0	1.0	2.0	3.0	6.0	5.0	1.0	1.0	1.0	46.8
Non-Weighted Score																		17					7		6			7					11.8	
2	2 Lanes, 1 path	2 lanes, 1 large trail, large shoulders, no median	2	14	0	0	12	0	2% centered	68.00	Single	1	2	Traffic Barrier Each Side	108,800	\$21.8		1 to 5 Score	1	4	2	1	4	5	4	5	2	4	1	1	1	3	3	51.0
Non-Weighted Score																		12					9		11			9					11.0	
3A	2 Lanes, 2 paths	2 lanes, 2 small trails, large shoulders, no median	2	14	0	0	6	6	2% centered	68.00	Single	2	2	Traffic Barrier Each Side	108,800	\$21.8		1 to 5 Score	1	4	2	1	4	5	4	4	2	4	1	1	1	3	3	50.0
Non-Weighted Score																		12					9		10			9					10.8	
3B	2 Lanes, 2 paths	2 lanes, 2 large trails, large shoulders, no median	2	14	0	0	12	12	2% centered	80.00	Single	2	2	Traffic Barrier Each Side	128,000	\$25.6		1 to 5 Score	2	4	2	1	4	5	4	5	2	4	1	1	1	5	5	56.0
Non-Weighted Score																		13					9		11			13					11.5	
4A	4 lanes, 1 path	4 lanes, 1 large trail, small shoulders, no median	4	8	0	0	12	0	2% centered	80.00	Single	1	2	Traffic Barrier Each Side	128,000	\$25.6		1 to 5 Score	3	4	3	3	4	5	4	4	5	3	4	3	2	2	3	71.2
Non-Weighted Score																		17					9		12			14					13.8	
4B	4 lanes, 1 path	4 lanes, 1 large trail, large shoulders, no median	4	14	0	0	12	0	2% centered	92.00	Single	1	2	Traffic Barrier Each Side	147,200	\$29.4		1 to 5 Score	3	4	3	3	4	4	3	5	5	4	5	4	3	3	3	78.2
Non-Weighted Score																		17					7		14			18					13.8	
4C	4 lanes, 1 path	4 lanes, 1 large trail, small shoulders, median present	4	8	4	3	12	0	2% centered	95.00	Dual	1	4	Center Median or Traffic Barriers Each Side	152,000	\$30.4		1 to 5 Score	3	4	3	3	4	4	3	3	4	3	4	3	2	2	3	65.2
Non-Weighted Score																		17					7		10			14					12.8	
4D	4 lanes, 1 path	4 lanes, 1 large trail, small shoulders, median curb present	4	8	4	4	12	0	2% centered	92.00	Dual	1	2	Traffic Barrier Each Side	147,200	\$29.4		1 to 5 Score	3	4	3	3	4	4	3	3	4	3	4	3	2	2	3	65.2
Non-Weighted Score																		17					7		10			14					12.8	
5A	4 lanes, 2 paths	4 lanes, 2 small trails, large shoulders, no median	4	14	0	0	6	6	2% centered	92.00	Single	2	2	Traffic Barrier Each Side	147,200	\$29.4		1 to 5 Score	3	4	3	3	4	4	3	4	3	3	5	4	3	3	3	74.2
Non-Weighted Score																		17					7		10			18					12.8	
5B	4 lanes, 2 paths	4 lanes, 1 large trail, 1 small trail, large and small shoulders, no median	4	10	0	0	12	6	2% centered	90.00	Single	2	2	Traffic Barrier Each Side	144,000	\$28.8		1 to 5 Score	5	4	4	4	4	4	3	4	3	4	5	4	3	4	4	80.0
Non-Weighted Score																		21					7		11			20					15.0	

Table A1 (Part 2 of 2)

SDDOT: US14/US83/SD34 Missouri River Bridge Study

Phase 1: BridgeTypical Section Scoring Matrix

Date: February 4, 2014

Typical Section Alternate ID	Type	Description	Number of 12' Lanes	Outside Shoulder Width (ft)	Inside Shoulder Width (ft)	Median Width (ft)	South Path/Trail Width (ft)	North Path/Trail Width (ft)	Slopes	Overall Width (ft)	Single, Dual or Triple Decks	Number of Railings	Number of Parapets	Traffic Lighting Location(s)	Approximate Bridge Area (sqft) (Overall Width x 1600 ft)	Approximate Bridge Cost (\$M) Based on \$200/sft	Typical Section Graphic	CSS / Environment					Cost Effectiveness		Maintenance & Inspection			Traffic Impacts					TOTALS		
																		Social Impact	Section 4(f) / 6(f) (Park) Impact	Cultural / Historical Impact	Economic Impact	Noise Impact	Initial Cost	Lifecycle Cost	Snow Removal	Lane Closure Availability	Accessibility for Inspection	Level of Service (2025)	Level of Service (2045)	Level of Service (2125)	Pedestrian Accessibility	Bicycle Accommodation			
Weighting																		Category	15					20		15			50					100%	
																		Individual	5	3	2	2	3	15	5	5	5	5	10	25	5	5	5	100%	
5C	4 lanes, 2 paths	4 lanes, 2 large trails, small shoulders, no median	4	8	0	0	12	12	2% centered	92.00	Single	2	2	Traffic Barrier Each Side	147,200	\$29.4		1 to 5 Score	5	4	4	3	4	4	3	4	3	4	4	4	3	2	5	4	72.6
																		Weighted Score	5.0	2.4	1.6	1.2	2.4	12.0	3.0	4.0	3.0	4.0	8.0	15.0	2.0	5.0	4.0		
																		Non-Weighted Score	20					7		11			18					14.5	
5D	4 lanes, 2 paths	4 lanes, 2 small trails, small shoulders, no median	4	8	0	0	6	6	2% centered	80.00	Single	2	2	Traffic Barrier Each Side	128,000	\$25.6		1 to 5 Score	3	4	3	3	4	5	4	3	3	4	4	3	2	3	2	69.2	
																		Weighted Score	3.0	2.4	1.2	1.2	2.4	15.0	4.0	3.0	3.0	4.0	8.0	15.0	2.0	3.0	2.0		
																		Non-Weighted Score	17					9		10			14					13.3	
5E	4 lanes, 2 paths	4 lanes, 2 small trails, small shoulders, median present	4	8	4	3	6	6	2% centered	95.00	Dual	2	4	Center Median or Traffic Barriers Each Side	152,000	\$30.4		1 to 5 Score	4	4	3	3	4	4	3	2	4	4	4	3	2	3	2	66.2	
																		Weighted Score	4.0	2.4	1.2	1.2	2.4	12.0	3.0	2.0	4.0	4.0	8.0	15.0	2.0	3.0	2.0		
																		Non-Weighted Score	18					7		10			14					13.3	
5F	4 lanes, 2 paths	4 lanes, 2 large trails, small shoulders, median present	4	8	4	3	12	12	2% centered	107.00	Dual	2	4	Center Median or Traffic Barriers Each Side	171,200	\$34.2		1 to 5 Score	5	3	5	5	4	3	2	3	4	4	4	3	2	5	4	69.2	
																		Weighted Score	5.0	1.8	2.0	2.0	2.4	9.0	2.0	3.0	4.0	4.0	8.0	15.0	2.0	5.0	4.0		
																		Non-Weighted Score	22					5		11			18					15.0	
5G	4 lanes, 2 paths	4 lanes, 2 large trails, large shoulders, median present	4	14	4	3	12	12	2% centered	119.00	Dual	2	4	Center Median or Traffic Barriers Each Side	190,400	\$38.1		1 to 5 Score	5	2	4	3	3	2	1	4	4	3	5	4	3	5	5	71.8	
																		Weighted Score	5.0	1.2	1.6	1.2	1.8	6.0	1.0	4.0	4.0	3.0	10.0	20.0	3.0	5.0	5.0		
																		Non-Weighted Score	17					3		11			22					12.0	
6	6 lanes, 1 path	6 lanes, small shoulders, 1 large trail, center median present	6	8	4	3	12	0	2% centered	119.00	Dual	2	4	Center Median or Traffic Barriers Each Side	190,400	\$38.1		1 to 5 Score	3	2	2	3	2	2	1	3	5	3	5	5	5	3	2	70.4	
																		Weighted Score	3.0	1.2	0.8	1.2	1.2	6.0	1.0	3.0	5.0	3.0	10.0	25.0	5.0	3.0	2.0		
																		Non-Weighted Score	12					3		11			20					9.5	
7A	6 lanes, 2 paths	6 lanes, small shoulders, 2 small trails, center median present	6	8	4	3	6	6	2% centered	119.00	Dual	2	4	Center Median or Traffic Barriers Each Side	190,400	\$38.1		1 to 5 Score	3	2	2	3	2	2	1	2	5	3	5	5	5	3	2	69.4	
																		Weighted Score	3.0	1.2	0.8	1.2	1.2	6.0	1.0	2.0	5.0	3.0	10.0	25.0	5.0	3.0	2.0		
																		Non-Weighted Score	12					3		10			20					9.3	
7B	6 lanes, 2 paths	6 lanes, small shoulders, 2 large trails, center median present	6	8	4	3	12	12	2% centered	131.00	Dual	2	4	Center Median or Traffic Barriers Each Side	209,600	\$41.9		1 to 5 Score	4	1	1	3	1	1	1	3	4	2	5	5	5	5	4	68.8	
																		Weighted Score	4.0	0.6	0.4	1.2	0.6	3.0	1.0	3.0	4.0	2.0	10.0	25.0	5.0	5.0	4.0		
																		Non-Weighted Score	10					2		9			24					7.8	

Table A2 (Part 1 of 2)

SDDOT: US14/US83/SD34 Missouri River Bridge Study

Phase 1: Bridge Category Scoring Matrix

Date: #####


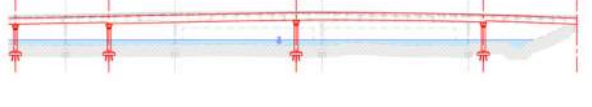





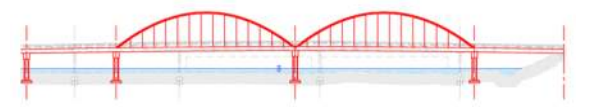
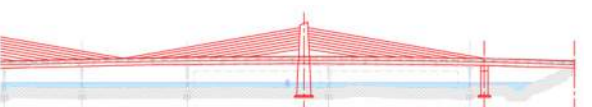
Alternate ID	Type	Description	Main Span(s)	Horizontal Clearance	Vertical Clearance	Estimated Initial Cost (\$M) Based on 80 ft x 1600 ft	Side Elevation	Category	Aesthetics		CSS / Environmental					Cost Effectiveness			Maintenance & Inspection				Structural Redundancy			TOTALS		
									Fits the Site / Compatible with RR Bridge	Continuity of Form & Function	Social Impact	Section 41 / 61 (Park) Impact	Navigational / Waterway Impact	Cultural / Historical Impact	Economic Impact	Fish & Wildlife Impact	Initial Cost	Lifecycle Cost	Risk of Cost Growth	Scheduled Maintenance	Durability of Critical Items	Deck Replacement	Accessibility for Inspection	Inspection Effort	Multiple Load Paths		Continuity	Blast Resistance & Security
Weighting								15	5	3	5	2	5	2	3	15	10	5	5	3	3	4	6	6	3	100%		
1	Do Nothing	Bridge Remains As-is	2 @ 235 ft	210 ft	28.7 ft	N/A		1 to 5 Score	4	3	2	4	3	3	4	5	2	3	2	1	1	4	1	1	2	1	57.0	
								Weighted Score	8.0	3.0	1.2	4.0	1.2	3.0	1.2	2.4	15.0	4.0	3.0	2.0	0.6	1.0	2.4	0.8	1.2	2.4	0.6	57.0
								Non-Weighted Score	7		19					10			9					4			9.8	
2	Steel Plate Girder - Parallel Flange	Multiple girders - parallel flanges.	2 @ 200-250 ft	190-240 ft	20-30 ft	\$23.2		1 to 5 Score	4	4	4	4	3	4	4	3	5	4	5	4	4	4	5	4	5	5	3	85.4
								Weighted Score	8.0	4.0	2.4	4.0	1.2	4.0	1.6	1.8	15.0	8.0	5.0	4.0	2.4	4.0	3.0	3.2	6.0	6.0	1.8	85.4
								Non-Weighted Score	8		22					14			21					13			15.6	
2A	Steel Plate Girder - Haunched Flange	Multiple girders - haunched flanges.	2 @ 200-250 ft	190-240 ft	20-30 ft	\$23.2		1 to 5 Score	4	4	4	4	3	4	4	3	5	4	5	4	4	4	5	4	5	5	3	85.4
								Weighted Score	8.0	4.0	2.4	4.0	1.2	4.0	1.6	1.8	15.0	8.0	5.0	4.0	2.4	4.0	3.0	3.2	6.0	6.0	1.8	85.4
								Non-Weighted Score	8		22					14			21					13			15.6	
3	Spliced Prestressed Concrete Girder	Multiple girders - haunched flanges.	2 @ 200-250 ft	190-240 ft	20-30 ft	\$25.2		1 to 5 Score	4	3	4	4	3	4	4	3	5	5	4	4	5	4	4	4	5	5	3	85.4
								Weighted Score	8.0	3.0	2.4	4.0	1.2	4.0	1.6	1.8	15.0	10.0	4.0	4.0	3.0	4.0	2.4	3.2	6.0	6.0	1.8	85.4
								Non-Weighted Score	7		22					14			21					13			15.4	
4	Steel Box Girder	Two decks - CIP with traveller. Haunched girder.	2 @ 200-250 ft	190-240 ft	20-30 ft	\$26.2		1 to 5 Score	4	4	4	4	3	4	3	3	4	4	4	4	4	4	3	3	4	4	3	76.6
								Weighted Score	8.0	4.0	2.4	4.0	1.2	4.0	1.2	1.8	12.0	8.0	4.0	4.0	2.4	4.0	1.8	2.4	4.8	4.8	1.8	76.6
								Non-Weighted Score	8		21					12			18					11			14.0	
5	Concrete Box Girder	Two decks - precast segmental. Haunched girder.	2 @ 200-250 ft	190-240 ft	20-30 ft	\$27.2		1 to 5 Score	4	4	4	4	3	4	3	3	3	5	4	4	5	4	3	3	4	4	3	76.2
								Weighted Score	8.0	4.0	2.4	4.0	1.2	4.0	1.2	1.8	9.0	10.0	4.0	4.0	3.0	4.0	1.8	2.4	4.8	4.8	1.8	76.2
								Non-Weighted Score	8		21					12			19					11			14.2	
6	Steel Truss	One deck - CIP with traveller.	2 @ 250-300 ft	240-290 ft	20-30 ft	\$33.2		1 to 5 Score	2	3	3	4	4	4	3	3	2	2	3	2	3	4	3	1	2	2	2	50.8
								Weighted Score	4.0	3.0	1.8	4.0	1.6	4.0	1.2	1.8	6.0	4.0	3.0	2.0	1.8	4.0	1.8	0.8	2.4	2.4	1.2	50.8
								Non-Weighted Score	5		21					7			13					6			10.4	
7	Concrete Arch	Two inclined / basket handle ribs.	2 @ 225-300 ft	215-290 ft	20-30 ft	\$33.2		1 to 5 Score	3	3	4	4	4	4	3	3	2	3	3	3	4	4	3	3	3	2	3	60.8
								Weighted Score	6.0	3.0	2.4	4.0	1.6	4.0	1.6	1.8	6.0	6.0	3.0	3.0	2.4	4.0	1.8	2.4	3.6	2.4	1.8	60.8
								Non-Weighted Score	6		23					8			17					8			12.4	
8	Extradosed	Three leg pylons.	1 @ 500 ft and 2 @ 250 ft	490 ft	20-30 ft	\$47.2		1 to 5 Score	2	3	4	4	5	3	4	2	1	2	2	2	3	3	2	2	4	3	2	49.4
								Weighted Score	4.0	3.0	2.4	4.0	2.0	3.0	1.6	1.2	3.0	4.0	2.0	2.0	1.8	3.0	1.2	1.6	4.8	3.6	1.2	49.4
								Non-Weighted Score	5		22					5			12					9			10.6	

Table A2 (Part 2 of 2)

SDDOT: US14/US83/SD34 Missouri River Bridge Study

Phase 1: Bridge Category Scoring Matrix

Date: #####

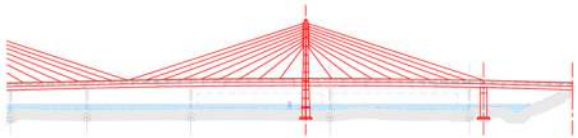
Alternate ID	Type	Description	Main Span(s)	Horizontal Clearance	Vertical Clearance	Estimated Initial Cost (\$M) Based on 80 ft x 1600 ft	Side Elevation	Aesthetics		CSS / Environmental						Cost Effectiveness			Maintenance & Inspection				Structural Redundancy			TOTALS		
								Fits the Site / Compatible with RR Bridge	Continuity of Form & Function	Social Impact	Section 41 / 61 (Park) Impact	Navigational / Waterway Impact	Cultural / Historical Impact	Economic Impact	Fish & Wildlife Impact	Initial Cost	Lifecycle Cost	Risk of Cost Growth	Scheduled Maintenance	Durability of Critical Items	Deck Replacement	Accessibility for Inspection	Inspection Effort	Multiple Load Paths	Continuity		Blast Resistance & Security	
							Weighting	Category	15		20						30			20				15			100%	
								Individual	10	5	3	5	2	5	2	3	15	10	5	5	3	5	3	4	6	6	3	100%
9	Cable Stay	Conventional edge girder with two tower legs.	1 @ 500 ft and 2 @ 250 ft	490 ft	20-30 ft	\$47.2		1 to 5 Score	1	3	3	4	5	3	3	2	1	2	3	3	1	2	4	3	2			
								Weighted Score	2.0	3.0	1.8	4.0	2.0	3.0	1.2	1.2	3.0	4.0	1.0	2.0	1.8	3.0	0.6	1.6	4.8	3.6	1.2	44.8
								Non-Weighted Score	4		20						4			11				9			9.6	

Table A3: Tier 1 Bridge Alternative Locations (Part 1 of 5)





Alt. ID	Location/Alignment	Description	Plan View
E1	Do Nothing	Bridge Remains As is	
E2	Existing Alignment	New bridge is constructed on the existing alignment	
N1	Proposed Alignment to North of Existing (adjacent)	New bridge is constructed just to the north of the existing alignment, eliminating S-curve on west approach.	
N2	Proposed Alignment to North of Existing (100' north)	New bridge is constructed to the north of the existing alignment, eliminating S-curve on west approach and widening curve on east approach.	

Table A3: Tier 1 Bridge Alternative Locations (Part 2 of 5)

<p>N3</p>	<p>Proposed Alignment to North of Existing (200' north parallel)</p>		
<p>N4</p>	<p>Proposed Alignment to North of Existing (clipping NE corner of existing bridge)</p>	<p>New bridge is constructed just to the north of the existing alignment, overlapping existing bridge on the east and eliminating S-curve on west approach.</p>	
<p>N5</p>	<p>Proposed Alignment to North of Existing (200' north non-parallel)</p>	<p>New bridge is constructed well to the north of the existing alignment, eliminating S-curve on west and drastically widening curve on east.</p>	
<p>N6</p>	<p>Proposed Alignment to North of Existing (adjacent non-parallel)</p>	<p>New bridge is constructed just to the north of the existing alignment, eliminating S-curve on west approach and widening curve on east approach.</p>	

Table A3: Tier 1 Bridge Alternative Locations (Part 3 of 5)

N7	Proposed Alignment to North of Existing (adjacent and over existing)	New bridge is two separate superstructures - WB built just to the north of existing and EB built over existing alignment	
S1	Proposed Alignment to South of Existing (adjacent and clipping SW corner of existing)	New bridge is to the south of existing alignment - west end clips existing bridge.	
S2	Proposed Alignment to South of Existing (James Street)	New bridge is to the south of existing alignment - east end tranforms James Street.	
S3	Proposed Alignment to South of Existing (James St and Dakota Ave)	New bridge is to the south of existing alignment - east end tranforms James Street (WB) and Dakota Ave Street (EB).	

Table A3: Tier 1 Bridge Alternative Locations (Part 4 of 5)

S4	Proposed Alignment to On existing alignment (WB) and South of existing (EB) (clipping SW corner of existing bridge)	New bridge is two separate superstructures (bifercated). WB lies over existing bridge alignment and EB to the south of existing alignment (sharpening this curve).	
S5	Proposed Alignment to South of Existing (Overlapping south half of existing bridge)	New bridge is built slightly to the south of the existing bridge. Southern side of existing bridge is overlapped.	
S6	Proposed Alignment to South of Existing (Overlapping south half of existing bridge)	New bridge is built slightly to the south of the existing bridge. Southern side of existing bridge is overlapped and west approach is straightened.	
S7	Proposed Alignment to South of Existing (adjacent and over existing)	New bridge is two separate superstructures - EB built to the south of existing and WB built over existing alignment	

Table A3: Tier 1 Bridge Alternative Locations (Part 5 of 5)

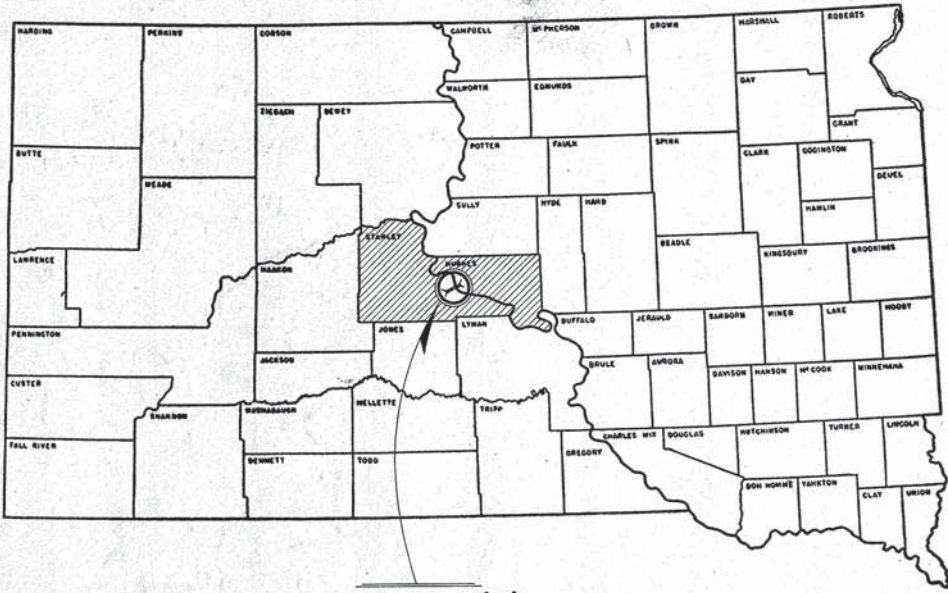
<p>M1</p>	<p>Proposed WB Alignment to North of Existing and EB to South of Existing Alignment - Connecting to Dakota (6-lanes)</p>	<p>New bridge is two separate superstructures - EB built to the south of existing and WB built over existing alignment</p>	
<p>M2</p>	<p>Proposed WB Alignment on Existing and EB to South of Existing Alignment - modified western approach.</p>	<p>New bridge is two separate superstructures (bifercated). WB lies over existing bridge and EB to the south of existing. Similar to 3D except western approach moves southerly.</p>	

APPENDIX C
Existing US14 Missouri River Bridge Plans
(Abbreviated)

FED. ROAD DIST. NO.	STATE OF	PROJECT NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
5	S. D.			1	25

STATE OF SOUTH DAKOTA
DEPARTMENT OF HIGHWAYS

PLANS FOR PROPOSED
**FEDERAL AID PROJECT
NO. F 030-1(4)**
U.S. TRUNK HIGHWAY NO. 14 & 83
**HUGHES COUNTY
SUPERSTRUCTURE**



F030-1(4)

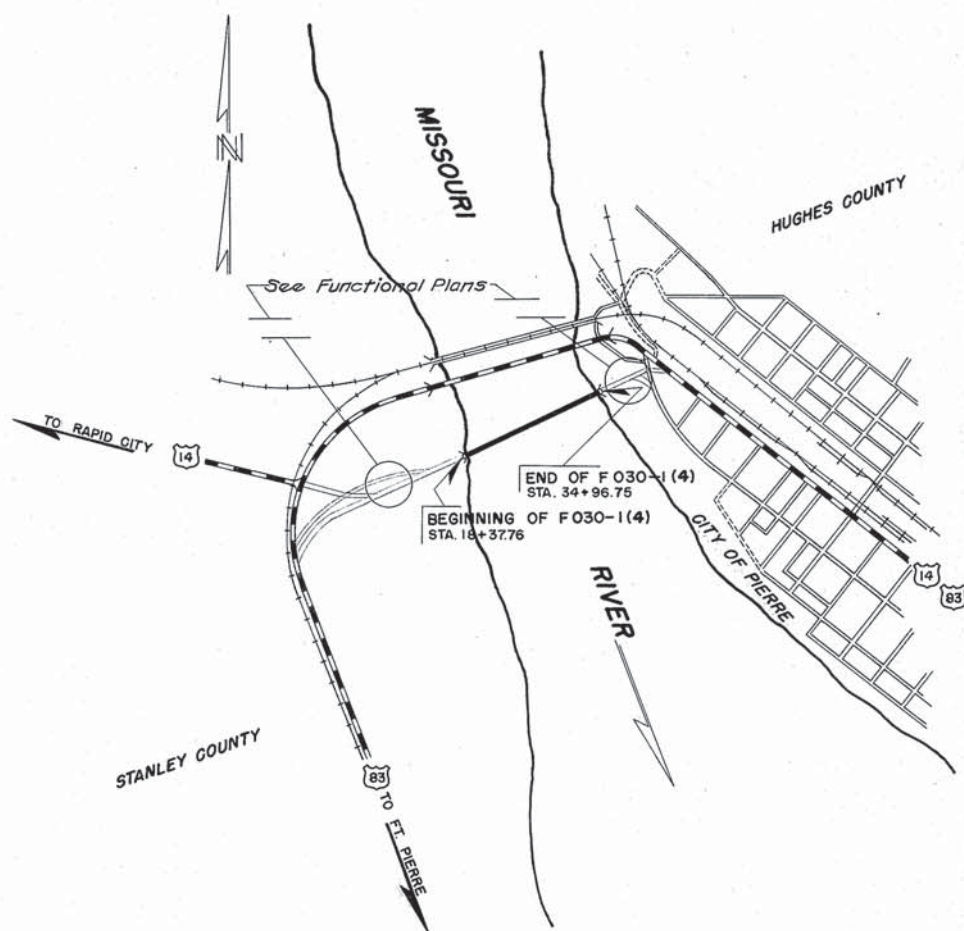
-X031-
INDEX OF SHEETS

SHEET NO. 1 - TITLE SHEET AND LAYOUT MAP.
SHEET NO. 2 - PLAN AND PROFILE - WEST APPROACH.
SHEET NO. 3 - PLAN AND PROFILE - EAST APPROACH.

SUBSTRUCTURE DRAWINGS
SHEETS NO. 4 AND 5 - GENERAL DRAWING.
SHEET NO. 6 - ESTIMATE OF SUBSTRUCTURE QUANTITIES.
SHEETS NO. 7 AND 8 - DETAILS OF SILLS NO. 1 AND NO. 11.
SHEETS NO. 9 AND 10 - DETAILS OF PIER NO. 2.
SHEETS NO. 11 AND 12 - DETAILS OF PIER NO. 3.
SHEETS NO. 13 AND 14 - DETAILS OF PIER NO. 4.
SHEETS NO. 15 AND 16 - DETAILS OF PIER NO. 5.
SHEETS NO. 17 AND 18 - DETAILS OF PIER NO. 6.
SHEETS NO. 19 AND 20 - DETAILS OF PIER NO. 7.
SHEETS NO. 21 AND 22 - DETAILS OF PIER NO. 8.
SHEETS NO. 23 AND 24 - DETAILS OF PIER NO. 9.
SHEETS NO. 25 AND 26 - DETAILS OF PIER NO. 10.

SUPERSTRUCTURE DRAWINGS

SHEET NOS.	PROJ. PLANS	BRIDGE PLANS	DESCRIPTION
4 AND 5	4 AND 5	4 AND 5	GENERAL DRAWING.
6	6	27	ESTIMATE OF SUPERSTRUCTURE QUANTITIES AND NOTES.
7-10	7-10	28-31	GIRDER LAYOUT AND DETAILS.
11	11	32	CROSS FRAME DETAILS.
12	12	33	LAYOUT AND DETAILS OF LATERALS.
13	13	34	DETAILS OF EXPANSION DEVICES.
14	14	35	DETAILS OF WIND TRANSFER AND EXPANSION DEVICES.
15	15	36	SHOE DETAILS.
16	16	37	SLIDING BEARINGS AND SHOE DETAILS.
17	17	38	ERECTION DATA AND DEFLECTION DIAGRAMS.
18	18	39	BEARING ELEVATIONS AND DETAILS.
19	19	40	LAYOUT OF SLAB PANELS AND RAIL POST SPACING.
20 AND 21	20 AND 21	41 AND 42	ROADWAY SLAB DETAILS.
22	22	43	REINFORCING SCHEDULE.
23 AND 24	23 AND 24	44 AND 45	RAILING DETAILS.
25			Informational Sign



LEGEND

STATE AND NATIONAL LINE	---
COUNTY LINE	----
SECTION LINE	-----
QUARTER LINE	-----
SIXTEENTH LINE	-----
CENTER LINE OF SURVEY	-----
RIGHT OF WAY LINE	-----
FENCE LINE	-----
GUARD RAIL	-----
TRAVELED WAY	-----
RAILROADS	-----
MARSH	-----
TREES	-----
TELEPHONE & TELEGRAPH LINES	-----
POWER LINES	-----

SCALES

LAYOUT.	1 INCHES = 1 MILE
PLAN.	1 INCH = 100 FT.
PROFILE	{ HORIZONTAL 1 INCH = 100 FT. VERTICAL 1 INCH = 10 FT.
CROSS SECTIONS	{ HORIZONTAL 1 INCH = 10 FT. VERTICAL 1 INCH = 5 FT.

GROSS LENGTH	1659.0	FEET	0.314	MILES
LENGTH OF EXCEPTIONS	0	FEET	0	MILES
NET LENGTH	1659.0	FEET	0.314	MILES
LENGTH OF GRADING	0	FEET	0	MILES
LENGTH OF BRIDGES	1659.0	FEET	0.314	MILES

APPROVED _____ DATE _____

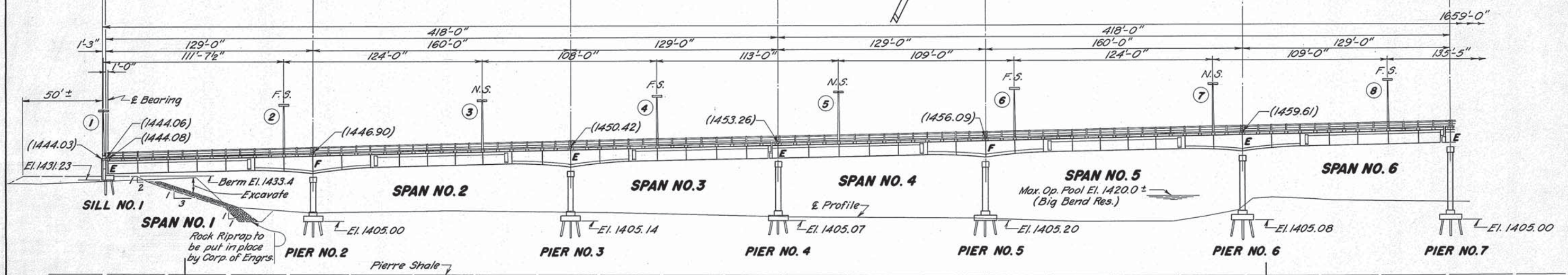
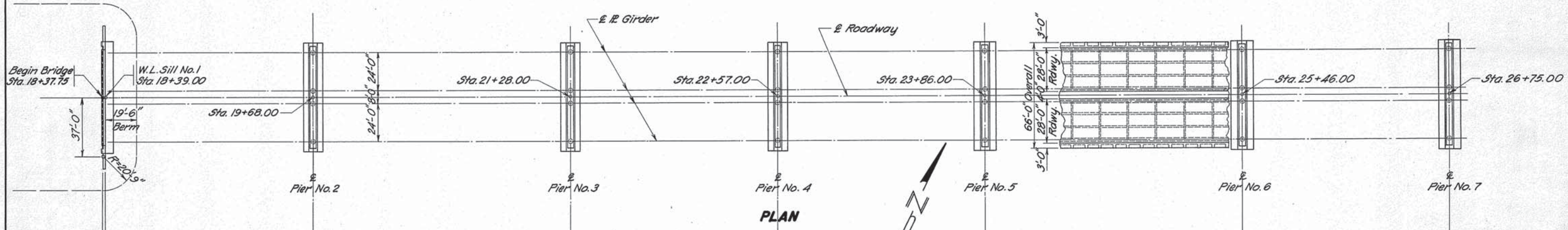
HIGHWAY ENGINEER, SOUTH DAKOTA DEPARTMENT OF HIGHWAYS

DEPARTMENT OF COMMERCE
BUREAU OF PUBLIC ROADS

APPROVED: _____

DIVISION ENGINEER _____ DATE _____

FED. ROAD DIST. NO.	STATE	FISCAL YEAR	SHEET NO.	TOTAL
5	S.D.	F200-1(4)	4	25



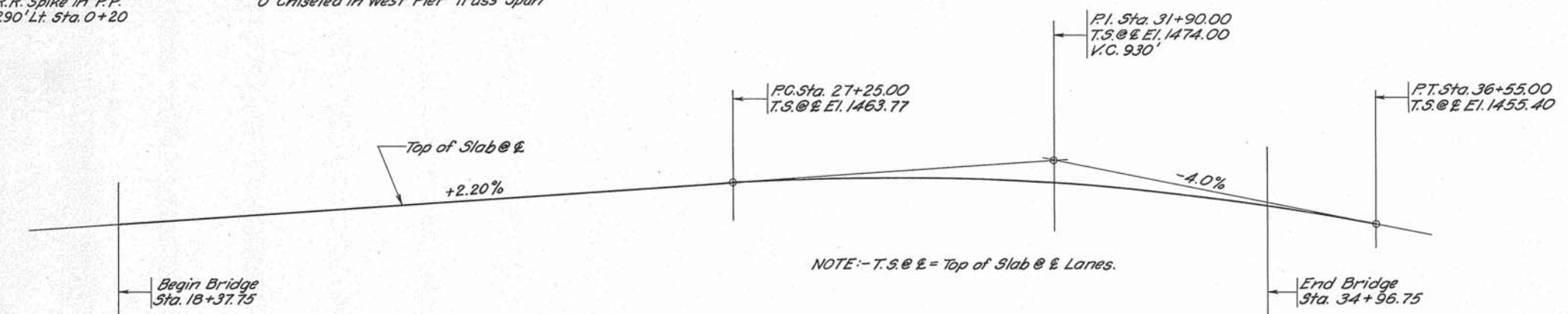
Test Hole No. 2-1
38' Lt. Sta. 18+88
*1370

Test Hole No. 7-1
E Sta. 25+62
*1368

- GENERAL NOTES-**
- Design Loading: H20-516-44.
 - Longitudinal elements of the slab shall conform to the vertical curve.
 - All rail posts shall be built vertical.
 - Concrete Stresses; $f_c = 1600$
 $f_t = 4000$

B.M. No. 1A - El. 1433.32
R.R. Spike in P.P.
290' Lt. Sta. 0+20

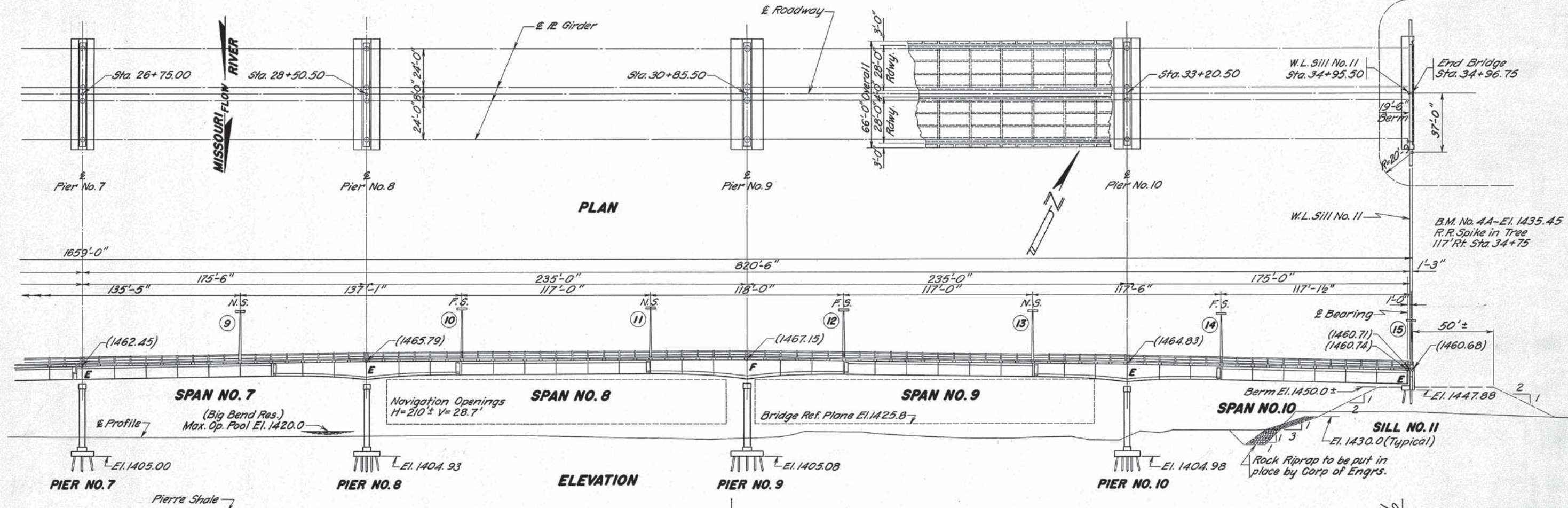
B.M. No. 3 - El. 1432.63
O Chiseled in West Pier Truss Spar



GENERAL DRAWING
FOR
1659'-0" BRIDGE OVER MISSOURI RIVER
TWO 28'-0" ROADWAYS 4'-0" MEDIAN
STA. 18+37.75 TO 34+96.75 F 030-1(4)
ON U.S. HWYS. 14 & 83 HUGHES COUNTY
SOUTH DAKOTA H20-S16-44
DEPARTMENT OF HIGHWAYS

-X031-

DESIGNED BY F.W.J.	DRAWN BY D.J.S.	CHECKED BY E.K.	APPROVED R. R. Seuss BRIDGE ENGINEER
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DESCRIPTION OF MATERIALS AND LOCATION OF CHANGES IN STRATA	Elev.	BLOWS PER FOOT			
		50	100	150	200
River Sands and Gravels	1432.1				
	1422.1				
	1412.1				
	1402.1				
	1392.1				
	1382.1				
*Pierre Shale	1372.1				

Used 2 1/2" Drill Rod with 170" hammer / 30' free fall

Boring No. 12-2 Top of Hole El. 1432.1 22' Lt. @ Sta. 34+90. Typical Test Hole for Strata Changes.

TEST HOLE NOTE—
 Test hole data shown for Boring No. 12-2 (at left) is typical with slight variations for all test holes. All holes show the same material varying slightly as to depth of each, and blow count required for penetration.

LEGEND
 (1462.45) = Top of Slab @ Curb Elevation
 W.L. = Working Line
 F = Fixed Bearing
 E = Expansion Bearing
 * = Pierre Shale Elevation
 N.S. = Near Side
 F.S. = Far Side

SPECIFICATION NOTE—
 Use Standard Specifications for Roads and Bridges approved as Standard November 3, 1957 and Required Provisions Federal-Aid-Contracts Primary Highways dated May 27, 1959 and Supplemental Specifications as included in the Proposal.

GENERAL DRAWING FOR
1659'-0" BRIDGE OVER MISSOURI RIVER
 TWO 28'-0" ROADWAYS 4'-0" MEDIAN
 STA. 18+37.75 TO 34+96.75 F 030-1(4)
 ON U.S. HWYS. 14 & 83 HUGHES COUNTY
 SOUTH DAKOTA H20-S16-44
 DEPARTMENT OF HIGHWAYS
 OCT. 1960 (5) OF (45)

DESIGNED BY R. V. J.	DRAWN BY D. S.	CHECKED BY E. K.	APPROVED J. B. Scurr BRIDGE ENGINEER
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ESTIMATE OF SUPERSTRUCTURE QUANTITIES		
ITEM	UNIT	QUANTITY
Structural Steel	Lb.	3,660,000 <i>3,609,640</i>
Cast Steel	Lb.	90,000 <i>95,275</i> *
Reinforcing Steel	Lb.	652,700 <i>619,659</i> *
Concrete Class "A"	Cu. Yds.	2,456 <i>24,642</i>
Railing	Lin. Ft.	3,312 ✓
Steel Lighting Pole (Regular)	No.	4 ✓
Reinforced Steel Lighting Pole	No.	13 ✓
Lighting Transmission System	Lump Sum	

* curb modification

F.E. 1-17-63 R.O.J.

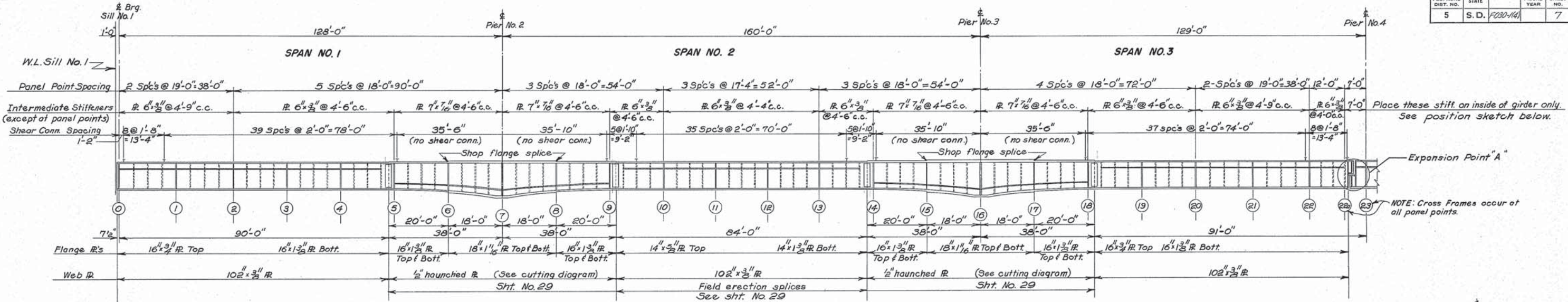
QUANTITY NOTE

- STRUCTURAL STEEL** - includes
 (1) 2,392,000 pounds A7 Steel
 (2) 1,268,000 pounds A242 Steel
- CONCRETE CLASS "A"** - includes
 (1) 3.5 Cu. Yds. Grout
- RAILING** - includes
 (1) All Railing parts except Reinf. Lighting Poles.
- STEEL LIGHTING POLE (Regular)**
 (1) At sills for lighting only - and not a part of Railing.
- REINFORCED STEEL LIGHTING POLE** - includes
 (1) Tubular reinforcing and weldments.
- LIGHTING TRANSMISSION SYSTEM** - includes
 (1) All material and installation of electrical transmission line for energizing lighting poles.

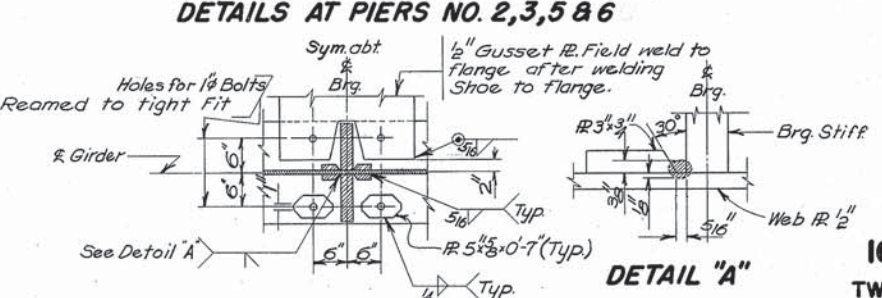
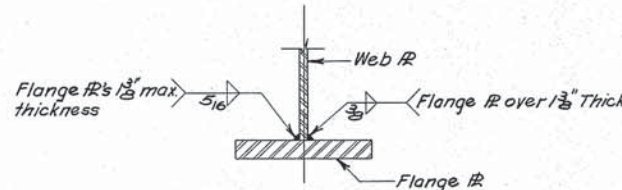
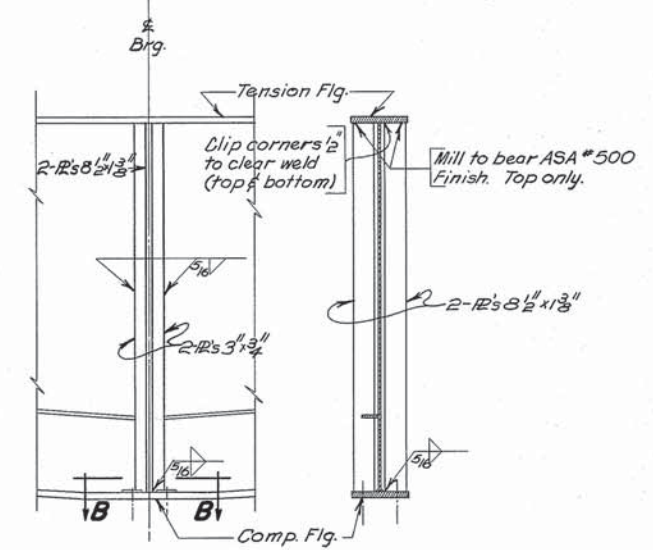
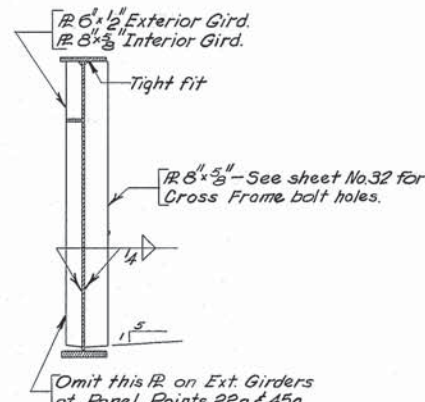
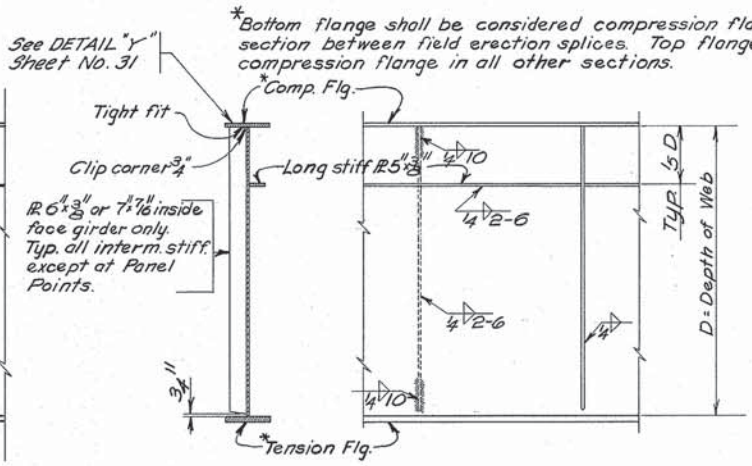
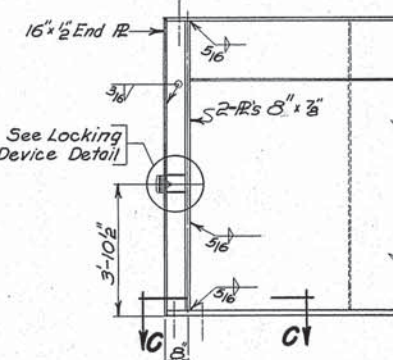
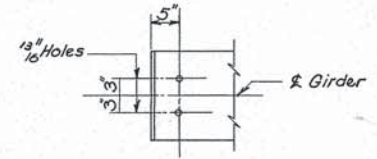
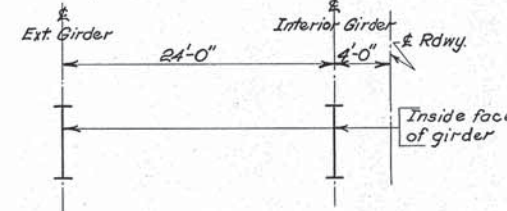
ESTIMATE OF SUPERSTRUCTURE
 QUANTITIES AND NOTES
 FOR
1659'-0" BRIDGE OVER MISSOURI RIVER
 TWO 28'-0" ROADWAYS 4'-0" MEDIAN
 STA. 18+37.75 TO 34+96.75 F 030-1(4)
 ON HWYS. 14 & 83 HUGHES COUNTY
 SOUTH DAKOTA H20-S16-44
 DEPARTMENT OF HIGHWAYS
 OCT. 1960 (27) OF (45)

DESIGNED BY	DRAWN BY	CHECKED BY	APPROVED
	E.K.	E.K.	<i>H. H. Seuss</i> BRIDGE ENGINEER

FED. ROAD DIST. NO.	STATE	FISCAL YEAR	SHEET NO.	TOTAL
5	S. D.	F030-1(4)	7	25



SUPERSTRUCTURE NOTES —
 All dimensions shown are horizontal or vertical.
 All stiffeners at Panel Points, bearing stiffeners, erection splices and girder ends, including ends at Expansion Points "A" and "B" shall be vertical.



NOTE: See sht. No. 32 & 33 for details of Gusset IR's and Cross Frames, except as shown on this sheet.

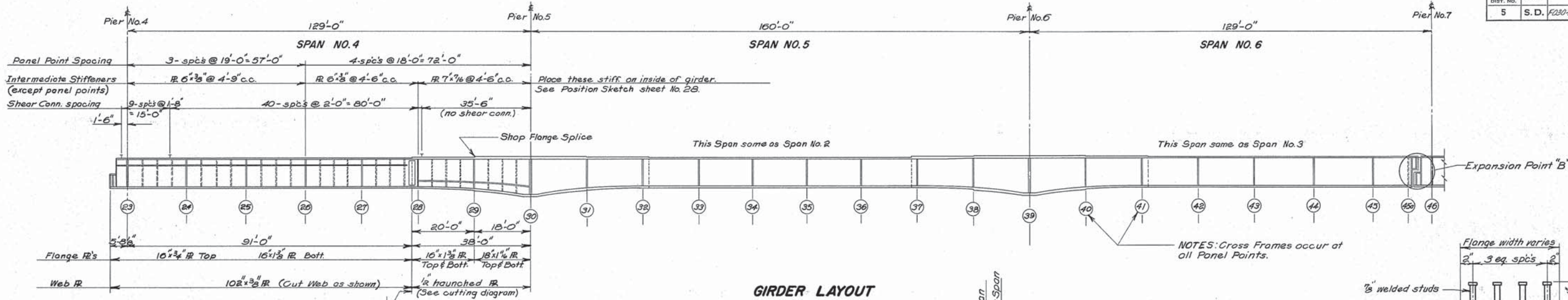
GIRDER LAYOUT AND DETAILS FOR 1659'-0" BRIDGE OVER MISSOURI RIVER

TWO 28'-0" ROADWAYS 4'-0" MEDIAN
 STA. 18+37.75 TO 34+96.75 F 030-1(4)
 ON U.S. HWYS. 14 & 83 HUGHES COUNTY
 SOUTH DAKOTA H20-S16-44

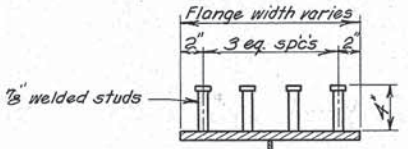
DEPARTMENT OF HIGHWAYS
 OCT. 1960 28 OF 45

DESIGNED BY K.G.W.	DRAWN BY K.C.W.	CHECKED BY E.K.	APPROVED T. by G.A.
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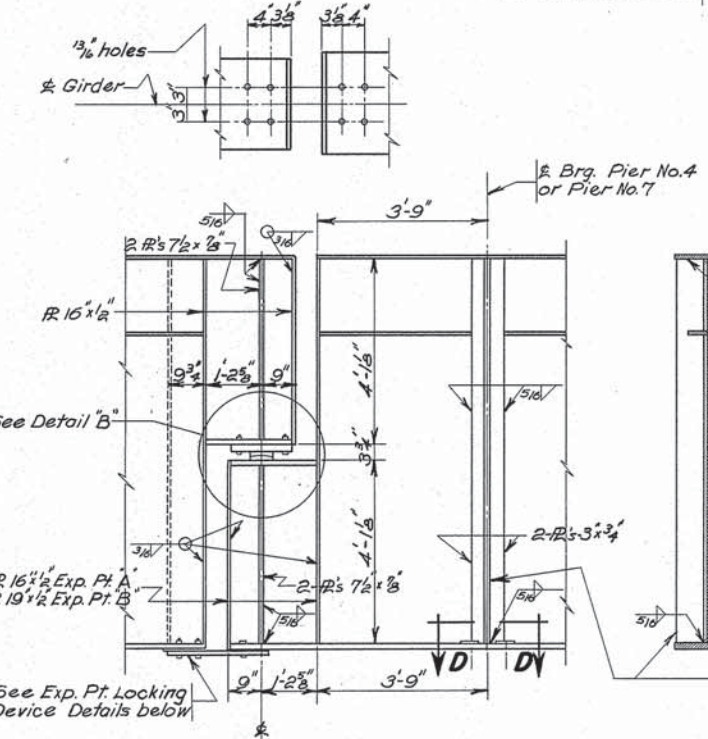
FED. ROAD DIST. NO.	STATE	FISCAL YEAR	SHEET NO.	TOTAL
5	S. D.	F230-148	8	25



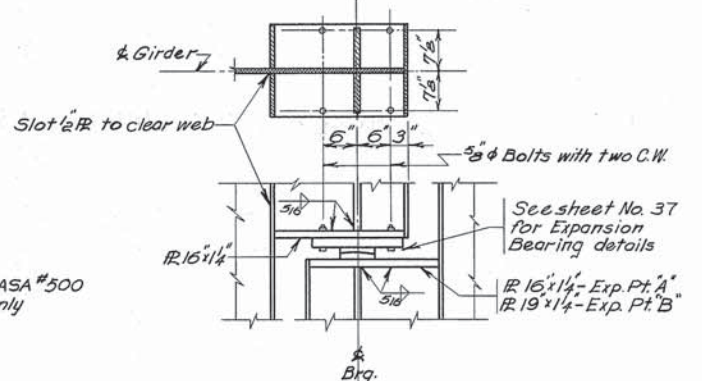
GIRDER LAYOUT



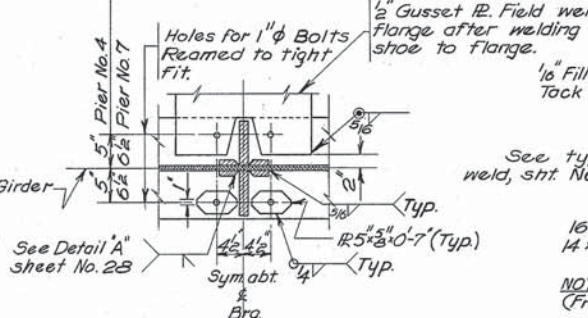
SHEAR CONNECTOR DETAILS
(For all Girders)



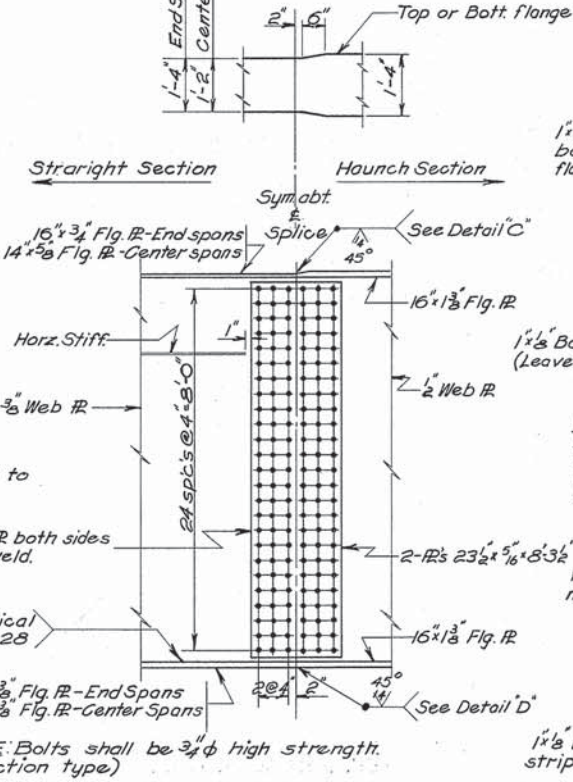
DETAILS AT EXP. POINTS "A" & "B" AND PIERS NO. 4 & 7



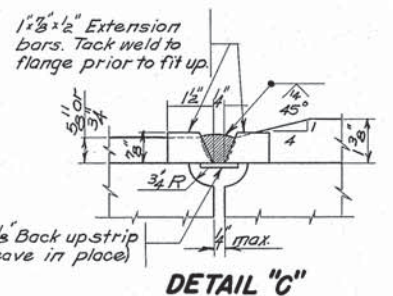
DETAIL "B"



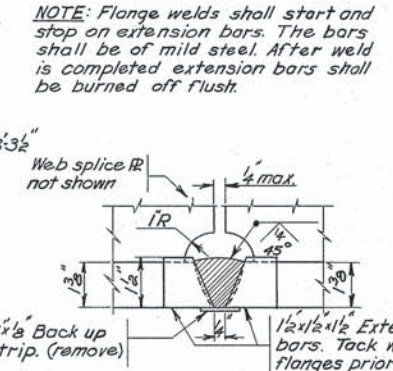
SEC. D-D



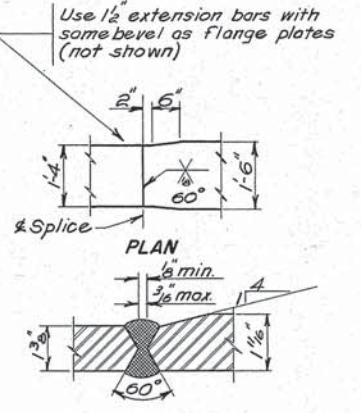
TYPICAL FIELD ERECTION SPLICE
(3 SPAN UNITS)



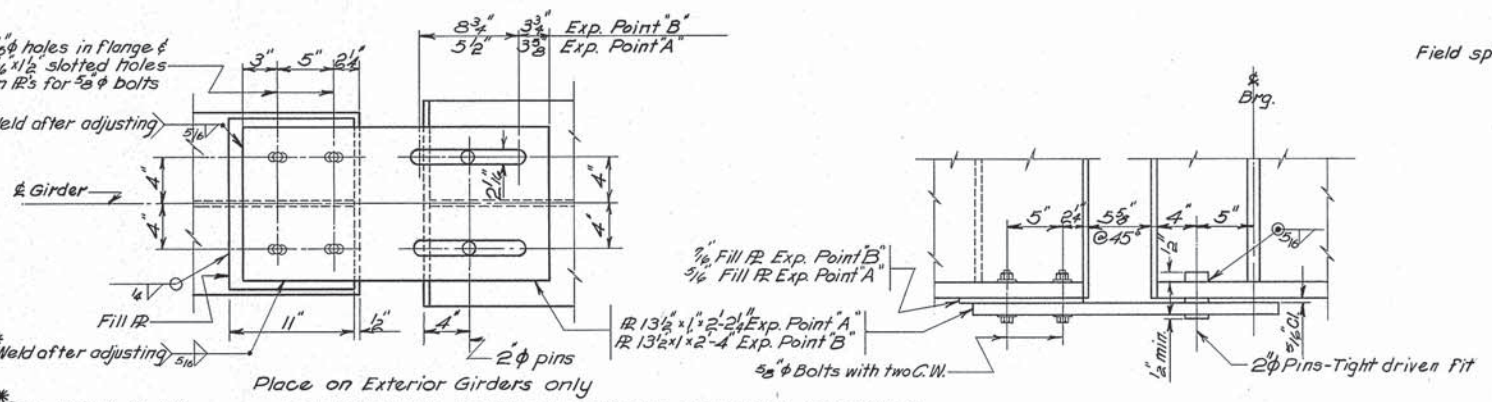
DETAIL "C"



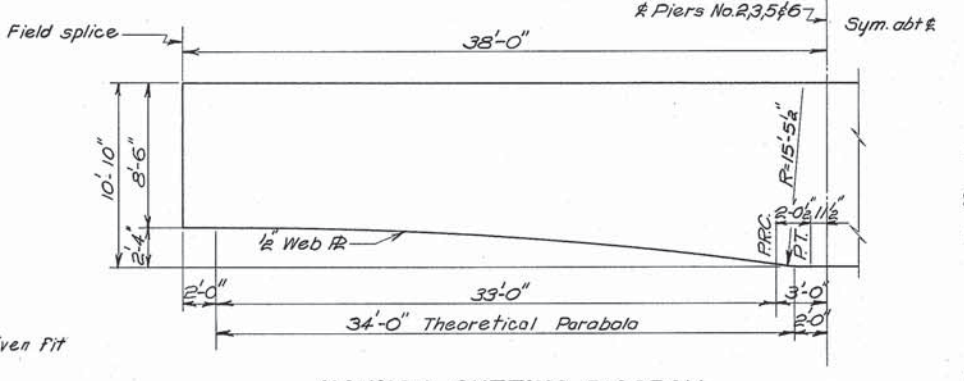
DETAIL "D"



SECTION THRU WELD SHOP FLANGE SPLICE



EXPANSION POINT LOCKING DEVICE DETAILS



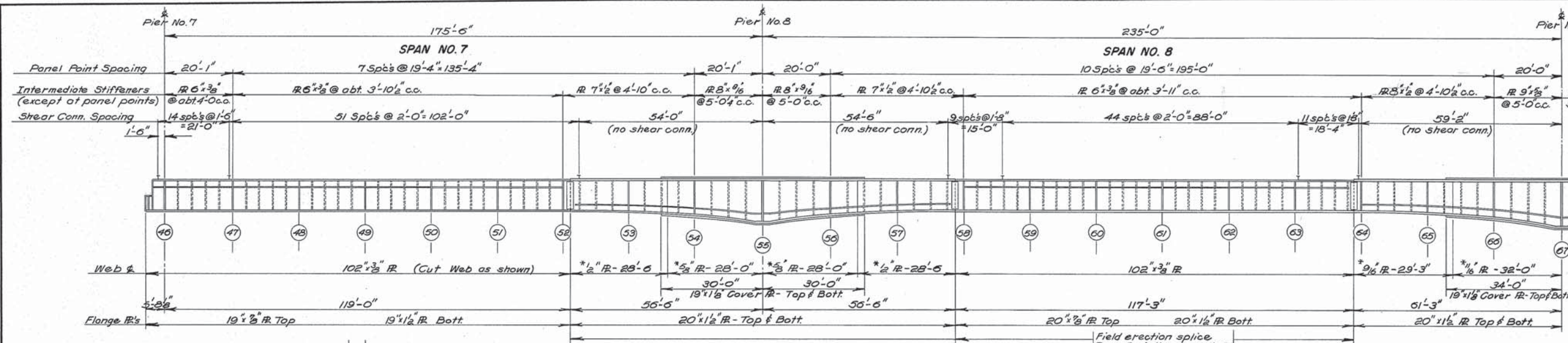
HAUNCH CUTTING DIAGRAM
(At Piers No. 2, 3, 5 & 6)

GIRDER LAYOUT AND DETAILS
FOR
1659'-0" BRIDGE OVER MISSOURI RIVER
TWO 28'-0" ROADWAYS 4'-0" MEDIAN
STA. 18+37.75 TO 34+96.75 F 030-1(4)
ON U.S. HWYS. 14 & 83 HUGHES COUNTY
SOUTH DAKOTA H20-S16-44
DEPARTMENT OF HIGHWAYS

DESIGNED BY A.C.W.	DRAWN BY H.C.W.	CHECKED BY E.K.	APPROVED K.P. Deuss BRIDGE ENGINEER
-----------------------	--------------------	--------------------	---

OCT. 1960 29 OF 45

FED. ROAD DIST. NO.	STATE	FISCAL YEAR	SHEET NO.	TOTAL
5	S. D.	F200-1(4)	9	25



Place these stiff on inside of girder. See Position sketch, sheet No. 28

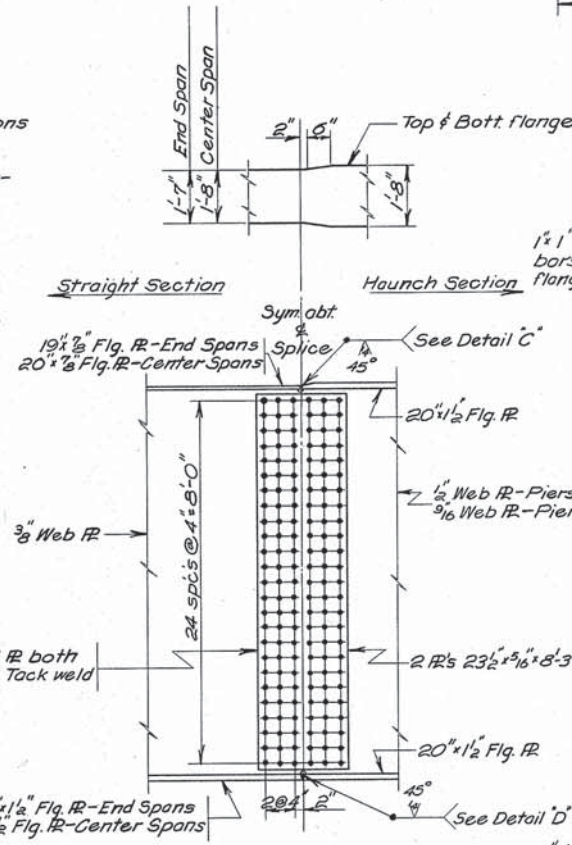
NOTE: Cross Frames occur at all panel points

* Haunched Web R. See cutting diagram

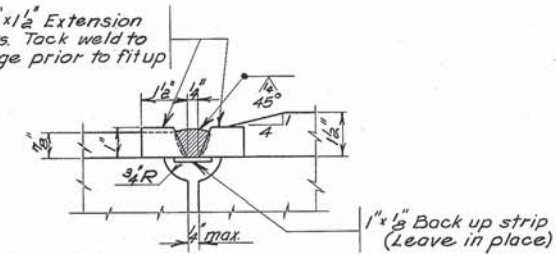
FIELD GIRDER SPLICE

All material and procedure for bolting field web splices shall conform to tentative specifications for Structural Joints Using ASTM A325 Bolts, dated March 1960 and endorsed by AISC and Industrial Fasteners Institute.

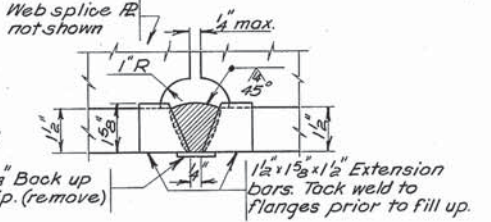
Flange shall be welded before bolting web. However, sufficient bolts may be used to position and fix girders during welding. Any residual stress in web and flange due to welding shall be relieved by releasing any tension in bolts and adjusting bolts in holes.



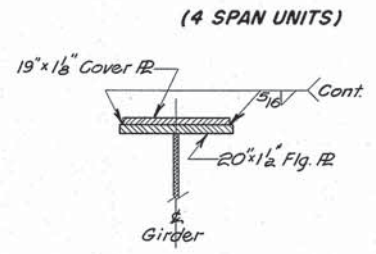
DETAIL "C"



DETAIL "D"

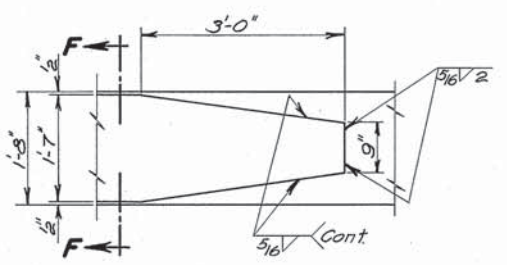


TYPICAL FIELD ERECTION SPLICE

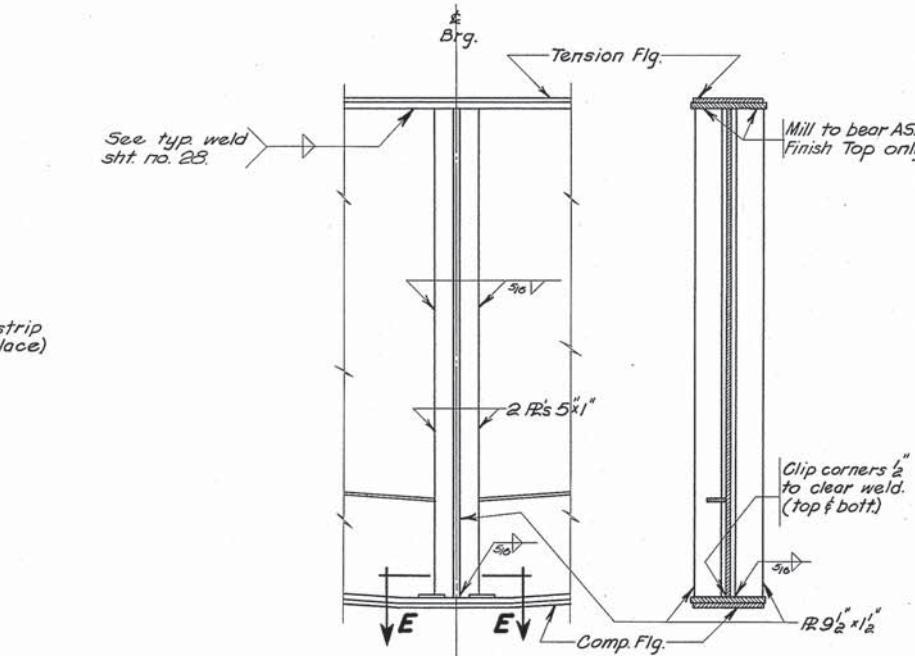


SEC. F-F

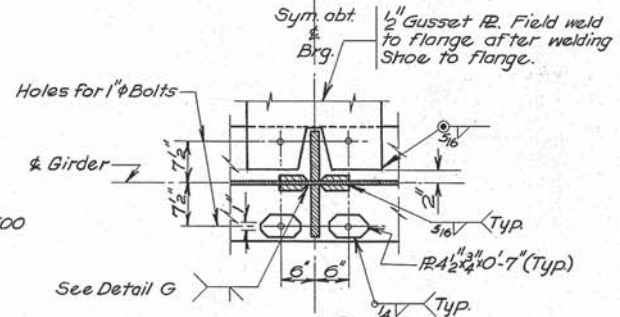
COVER PLATE DETAIL



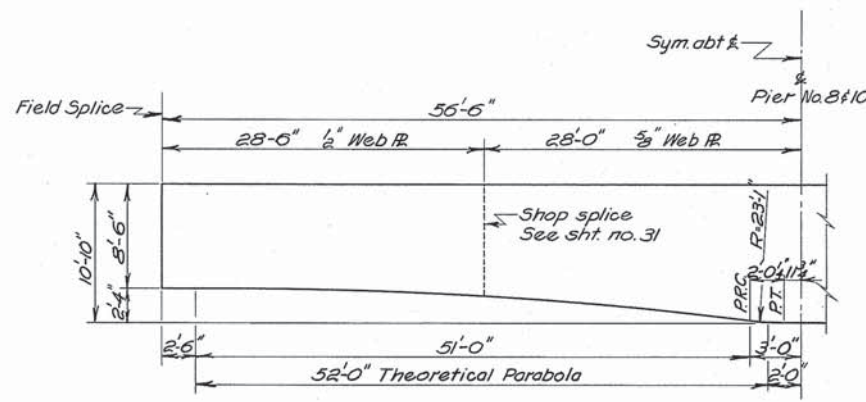
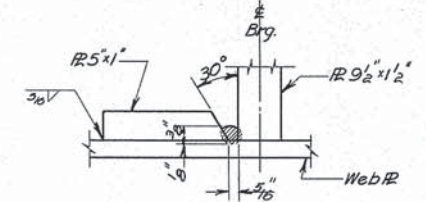
DETAILS AT PIERS NO. 8, 9 & 10



SEC. E-E



DETAIL "G"



HAUNCH CUTTING DIAGRAM

(At Piers No. 8 & 10)

GIRDER LAYOUT AND DETAILS FOR

1659'-0" BRIDGE OVER MISSOURI RIVER

TWO 28'-0" ROADWAYS 4'-0" MEDIAN

STA. 18+37.75 TO 34+96.75 F 030-1(4)

ON U.S. HWYS. 14 & 83 HUGHES COUNTY

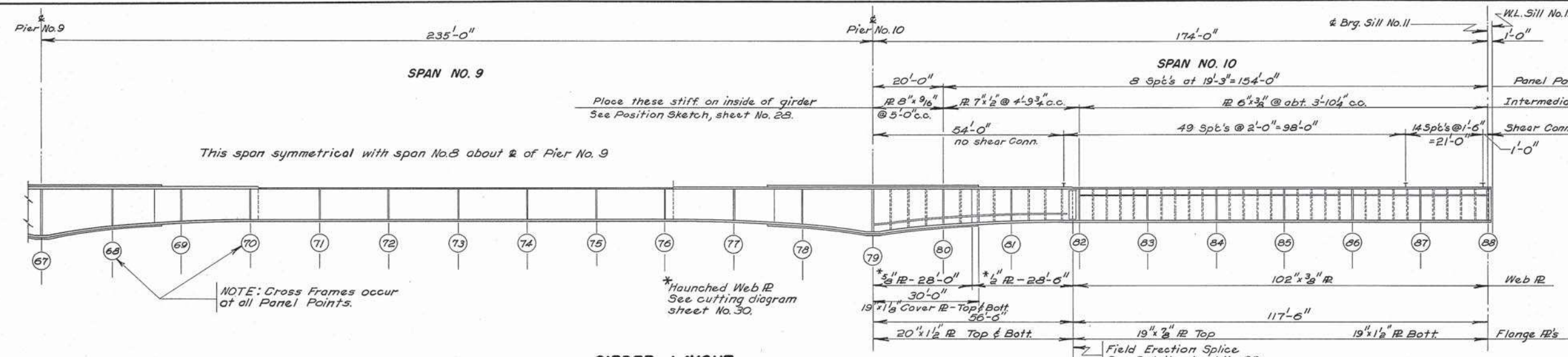
SOUTH DAKOTA H20-S16-44

DEPARTMENT OF HIGHWAYS

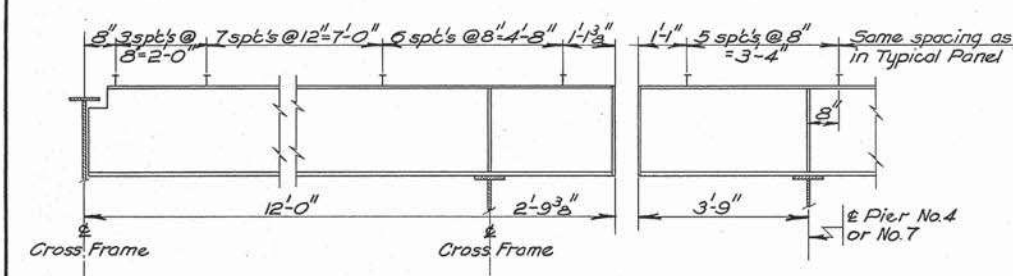
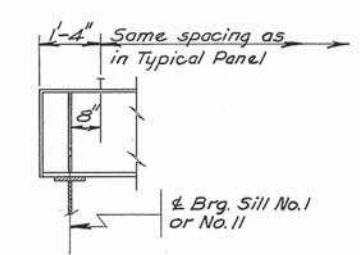
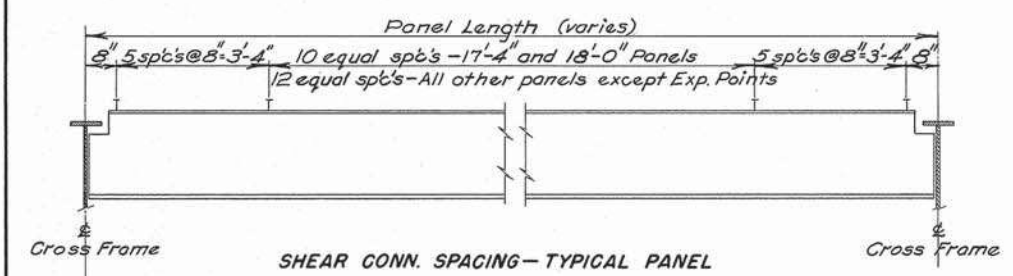
OCT. 1960

30 OF 45

DESIGNED BY R. W. J. F. A. C. W.	DRAWN BY K. C. W.	CHECKED BY E. K.	APPROVED BRIDGE ENGINEER
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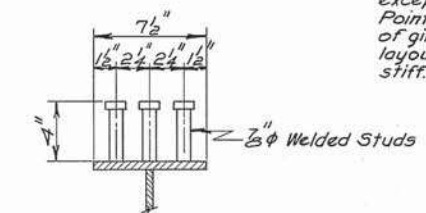


GIRDER LAYOUT

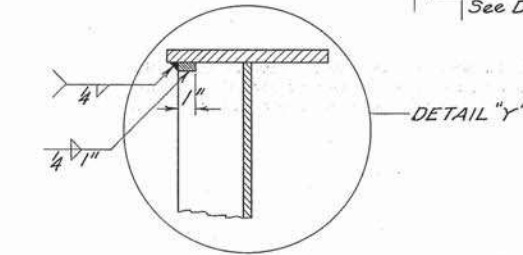


SHEAR CONN. SPACING—PANEL AT EXP. POINTS

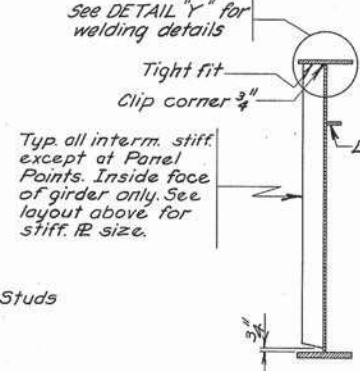
SHEAR CONNECTOR DETAILS FOR STRINGERS



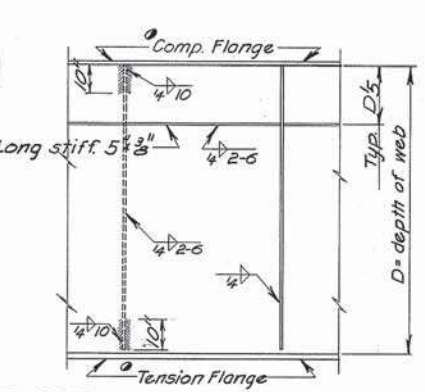
TRANSVERSE SPACING (Typ. for all stringers)



Bottom flange shall be considered compression flange at haunched section between field erection splices. Top flange will be considered compression flange in all other sections.

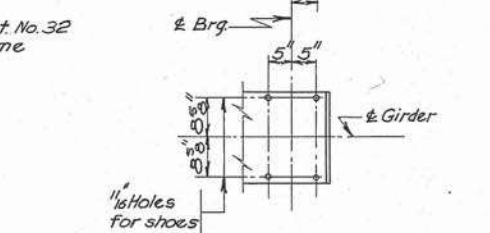
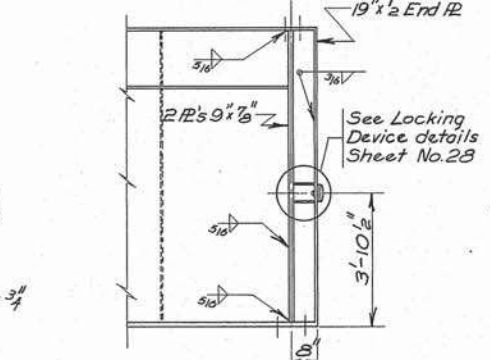
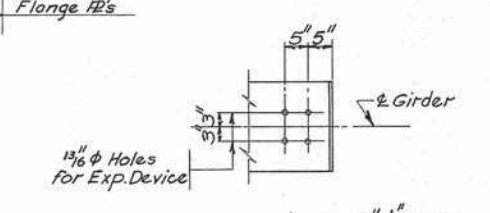


ALL INTERMEDIATE STIFF. EXCEPT AT PANEL POINTS

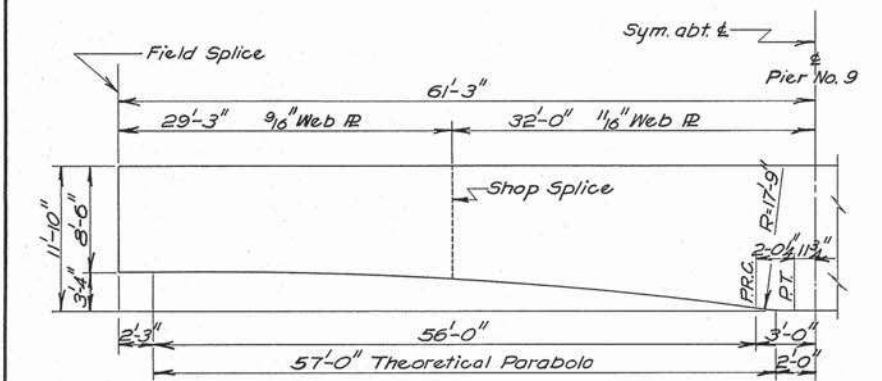


INTERMEDIATE STIFF. AT PANEL POINTS

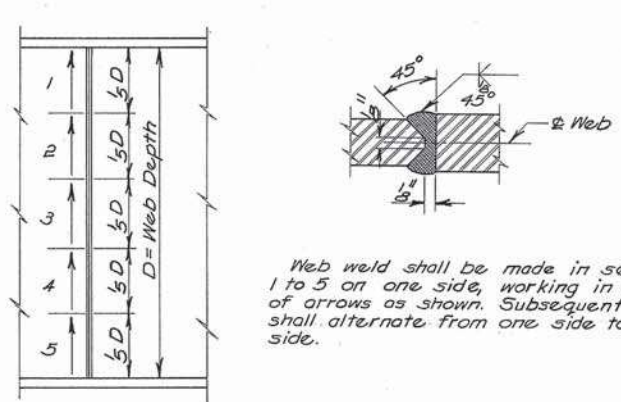
STIFFENER DETAILS (For 4 Span Unit)



DETAILS AT SILLS NO. 11

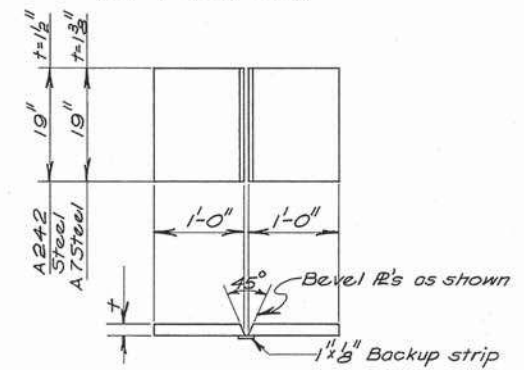


HAUNCH CUTTING DIAGRAM (At Pier No. 9)



SHOP WEB SPLICE DETAILS

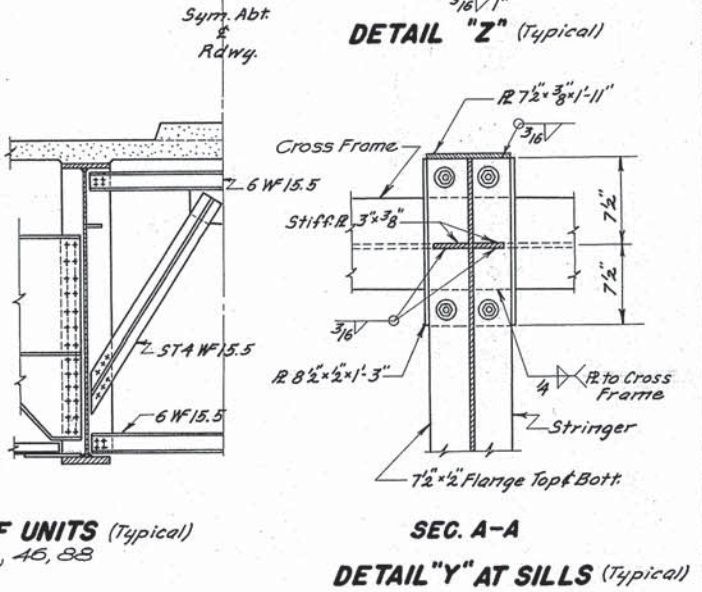
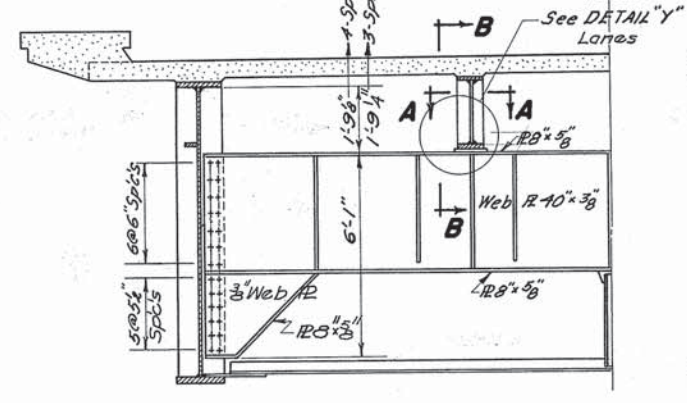
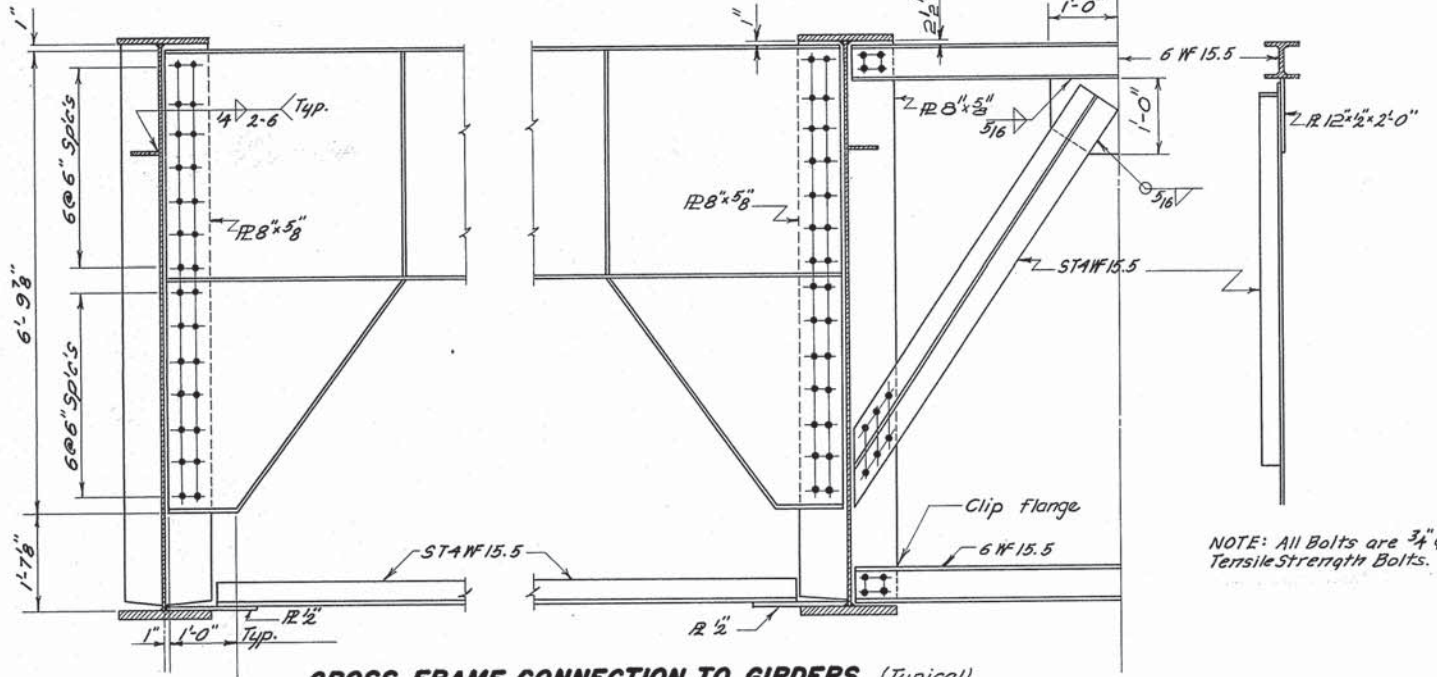
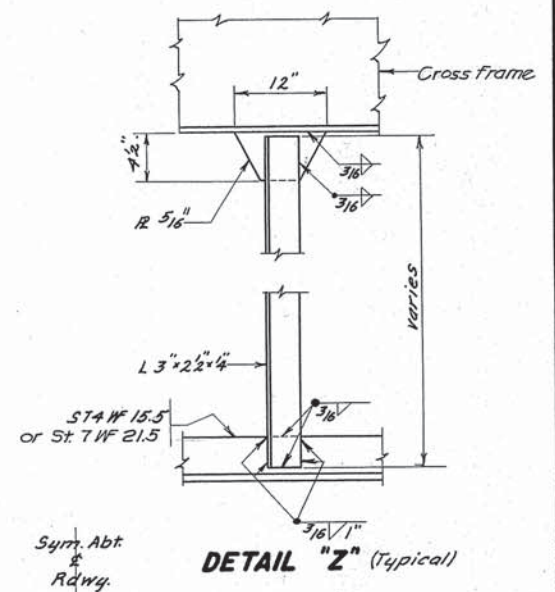
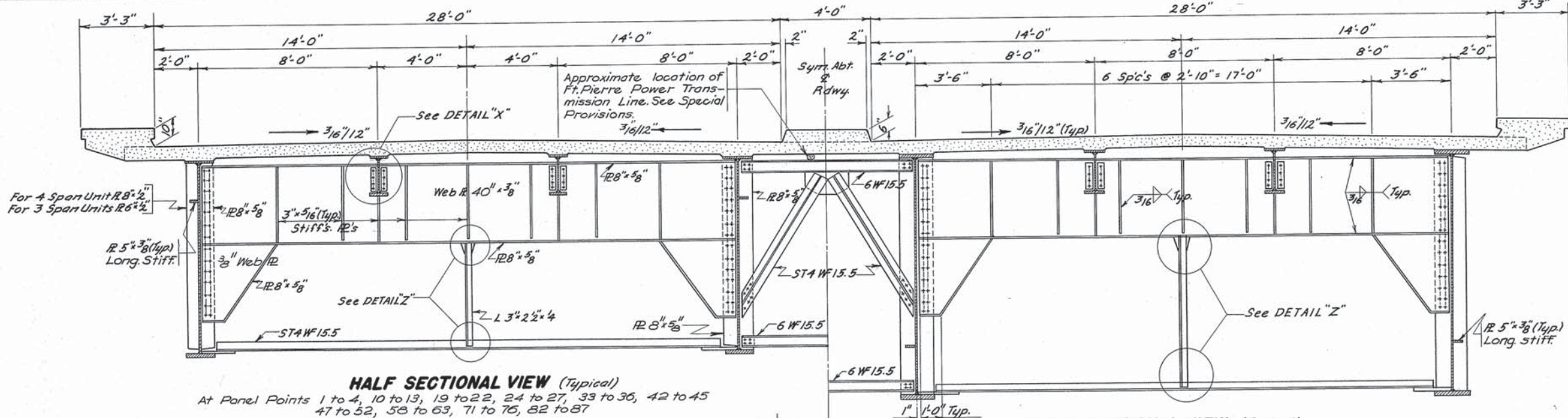
Web weld shall be made in sequence 1 to 5 on one side, working in direction of arrows as shown. Subsequent passes shall alternate from one side to opposite side.



MATERIAL FOR MAKING TEST WELDS FOR OPERATOR QUALIFICATIONS
Provide 8 sets of each plate size as shown above.

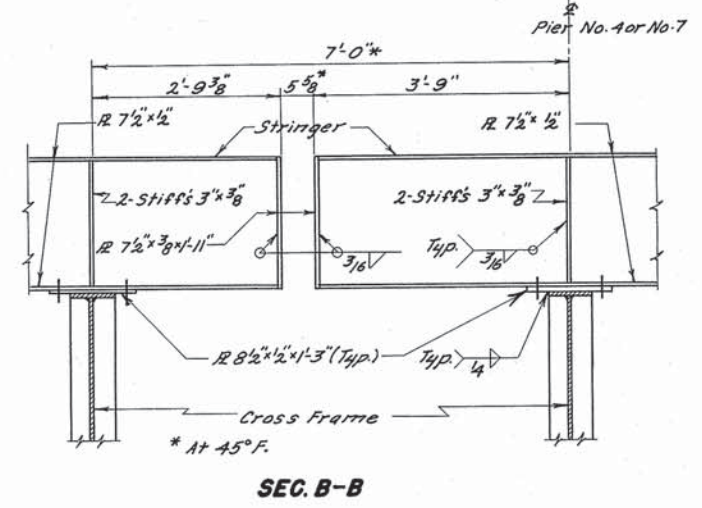
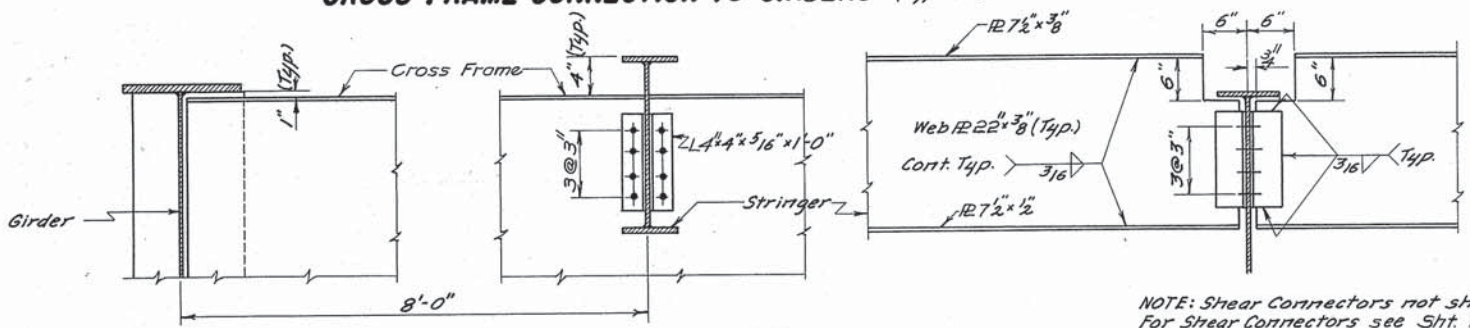
GIRDER LAYOUT AND DETAILS FOR 1659'-0" BRIDGE OVER MISSOURI RIVER
 TWO 28'-0" ROADWAYS 4'-0" MEDIAN
 STA. 18+37.75 TO 34+96.75 F 030-1(4)
 ON U.S. HWYS. 14 & 83 HUGHES COUNTY
 SOUTH DAKOTA H20-S16-44
 DEPARTMENT OF HIGHWAYS
 OCT. 1960 31 OF 45

DESIGNED BY R.W.T. & K.O.W.	DRAWN BY K.O.W.	CHECKED BY E. K.	APPROVED [Signature] BRIDGE ENGINEER
--------------------------------	--------------------	---------------------	--



CROSS FRAME AT ENDS OF UNITS (Typical)
At Panel Points 0, 22a, 23, 45a, 46, 88

NOTE: All Bolts are 3/4" φ High Tensile Strength Bolts.

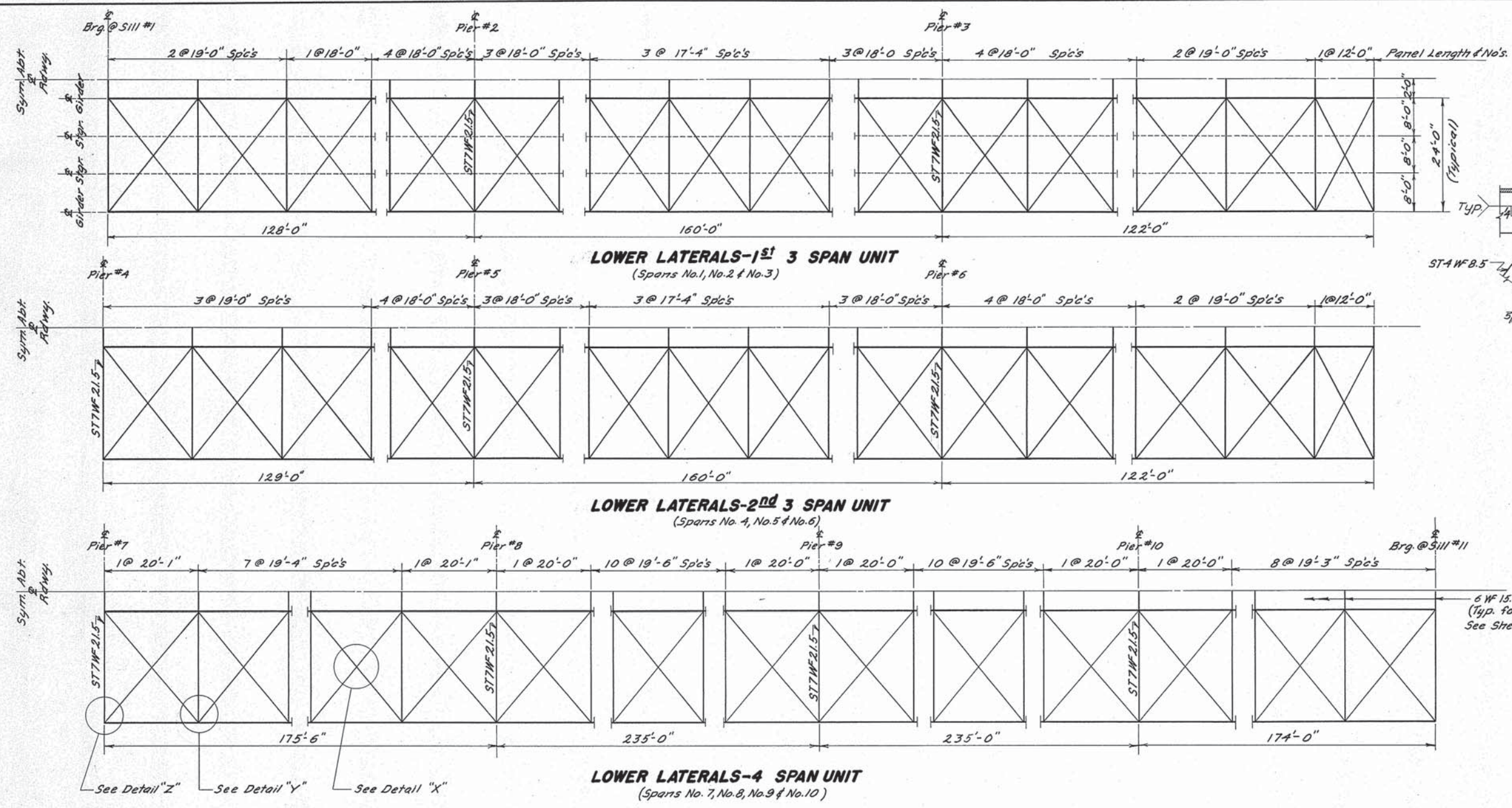


CROSS FRAME DETAILS FOR
1659'-0" BRIDGE OVER MISSOURI RIVER
TWO 28'-0" ROADWAYS 4'-0" MEDIAN
STA. 18+37.75 TO 34+96.75 F 030-1(4)
ON U.S. HWYS. 14 & 83 HUGHES COUNTY
SOUTH DAKOTA H20-S16-44

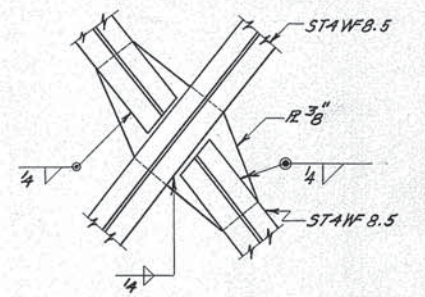
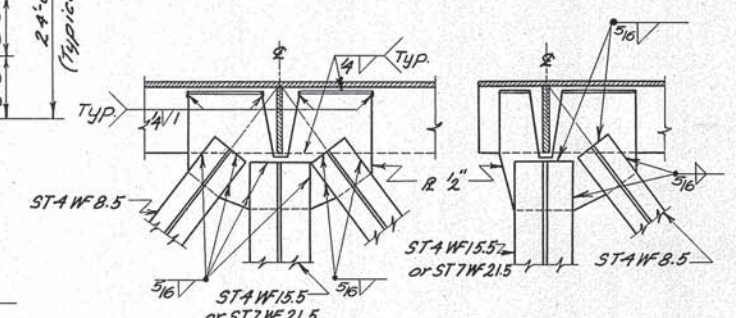
DEPARTMENT OF HIGHWAYS
OCT. 1960 32 OF 45

DESIGNED BY E.K.	DRAWN BY E.K.	CHECKED BY H.C.W.	APPROVED F.P. Seaver BRIDGE ENGINEER
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FED. ROAD DIST. NO.	STATE	FISCAL YEAR	SHEET NO.	TOTAL
5	S. D.	F030-1(4)	12	25

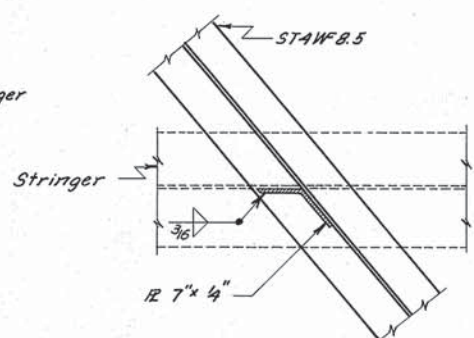
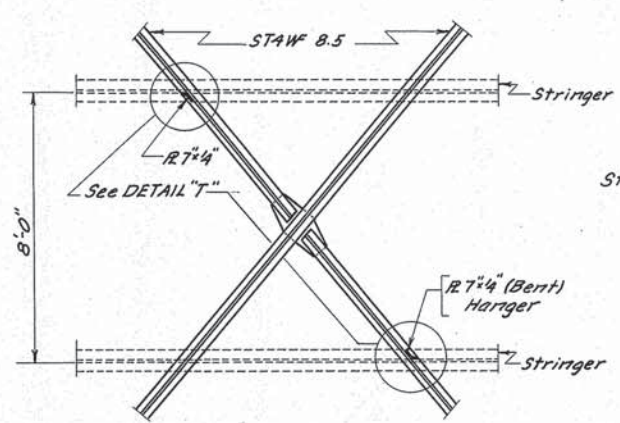
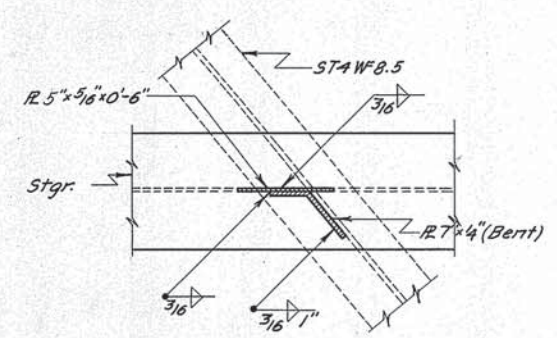


NOTE: Gusset plates for diagonal bracing shall be welded to girder flanges prior to welding flange to web.

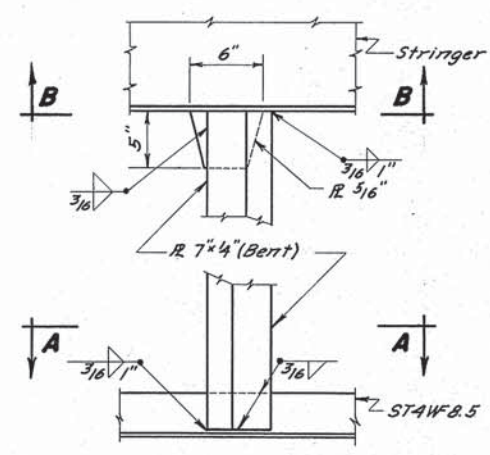


6 WF 15.5 (Typ. for all) See Sheet No. 32

NOTE: All diagonals shall be ST4WF8.5. All cross struts shall be ST4WF15.5 except as shown. The diagonals in haunched sections shall be shop bent at ends to conform to slope of gusset plates.



DETAIL "T"



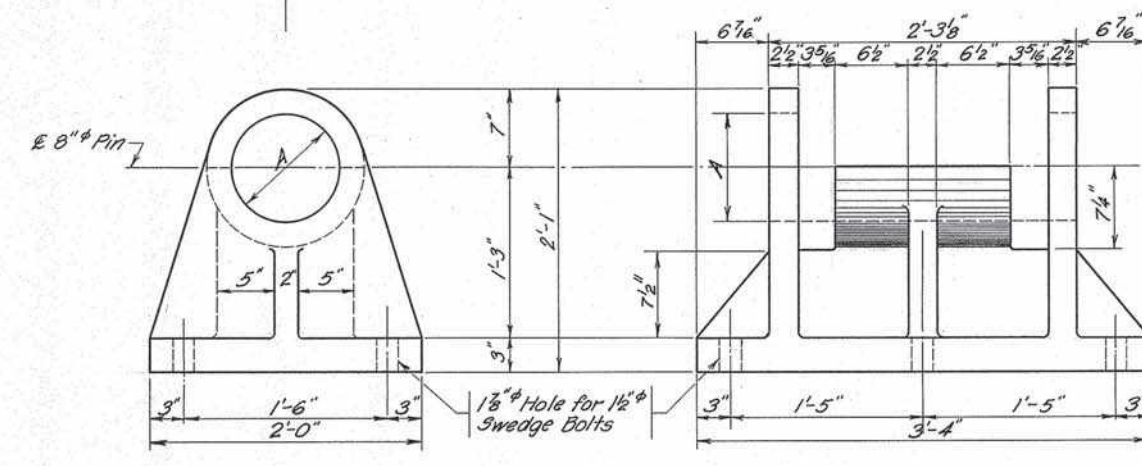
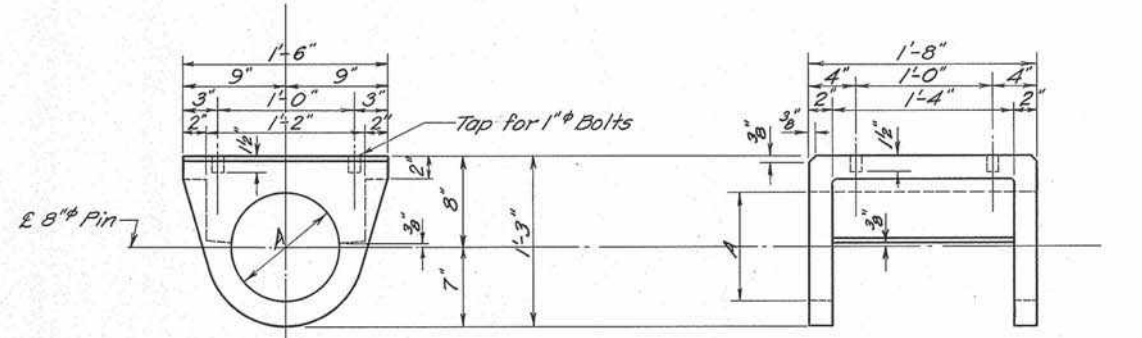
LAYOUT AND DETAILS OF LATERALS FOR

1659'-0" BRIDGE OVER MISSOURI RIVER
TWO 28'-0" ROADWAYS 4'-0" MEDIAN
STA. 18+37.75 TO 34+96.75 F 030-1(4)
ON U.S. HWYS. 14 & 83 HUGHES COUNTY

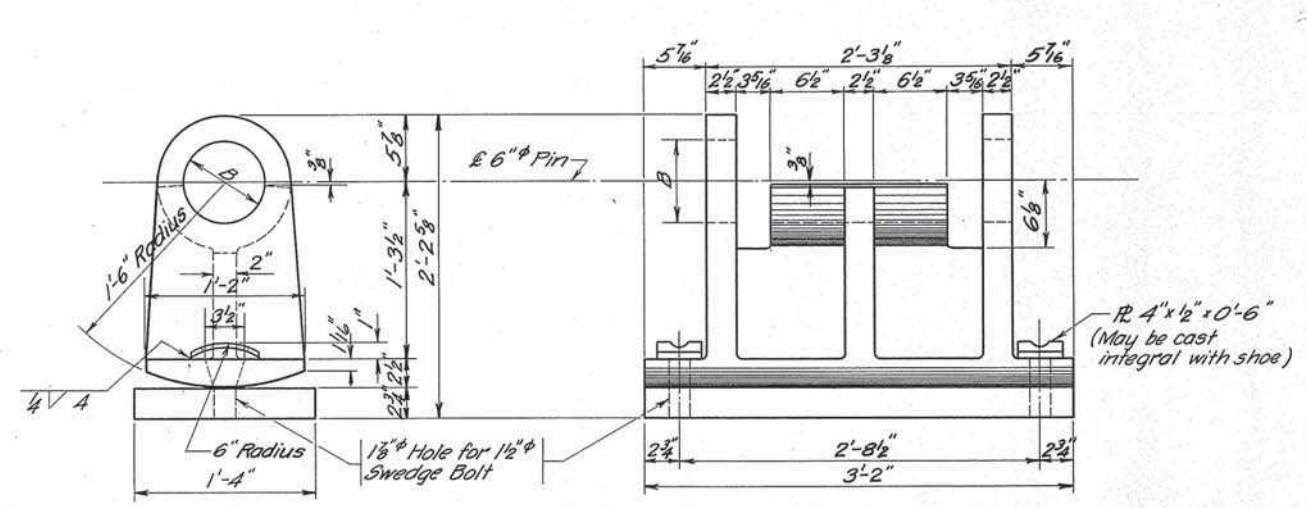
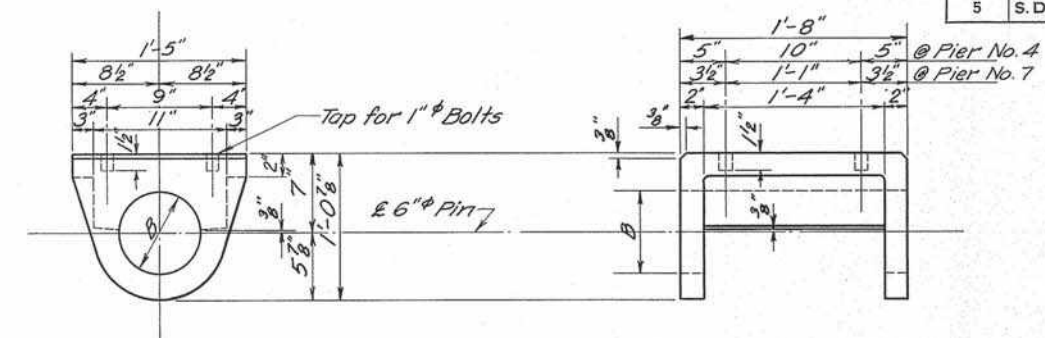
SOUTH DAKOTA H20-S16-44
DEPARTMENT OF HIGHWAYS

OCT. 1960 (33 OF 45)

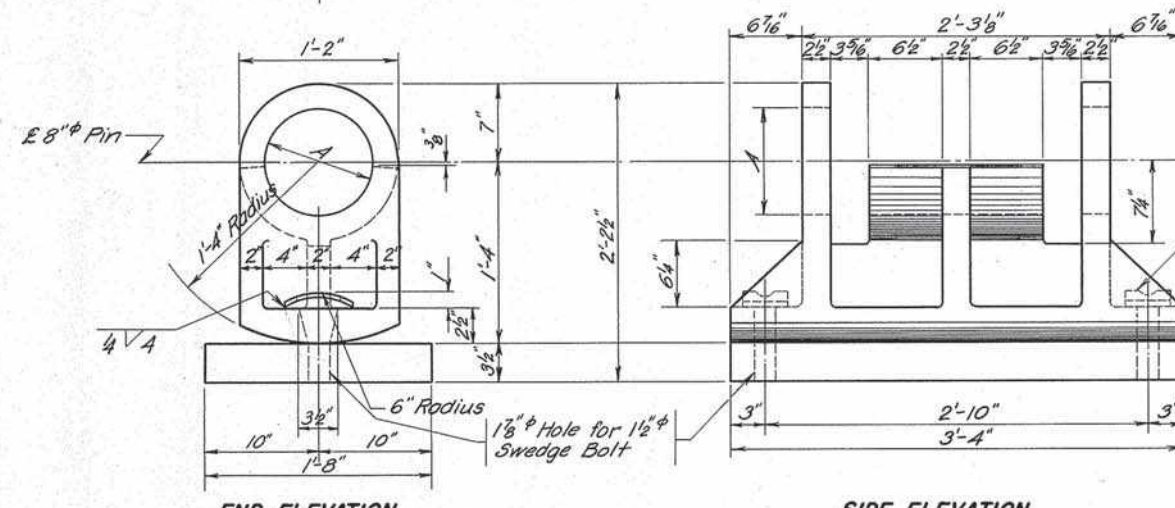
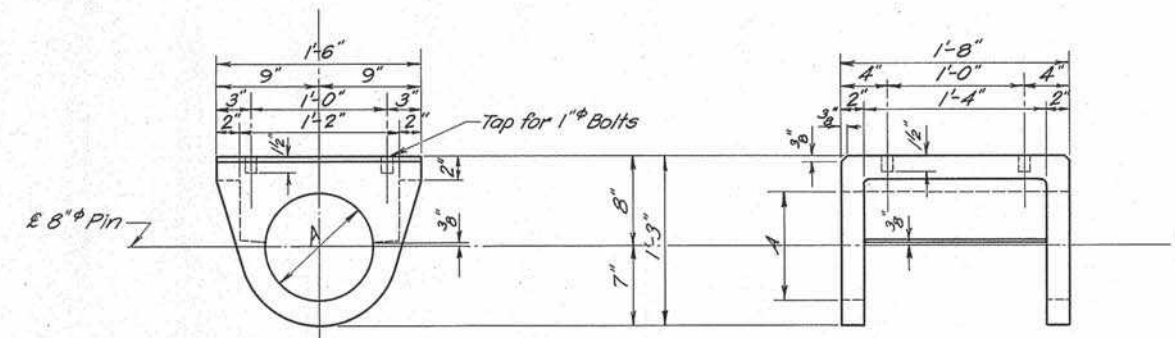
DESIGNED BY E.K.	DRAWN BY E.K. TRACED BY M.C.A.	CHECKED BY H.C.W.	APPROVED A. R. BEARS BRIDGE ENGINEER
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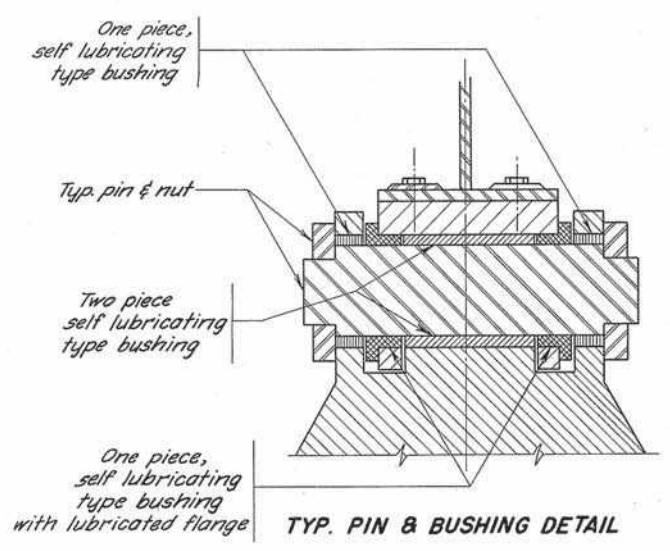
END ELEVATION SIDE ELEVATION
FIXED SHOE FOR PIERS NO. 2 & 5



END ELEVATION SIDE ELEVATION
ROCKER SHOE FOR PIERS NO. 4 & 7



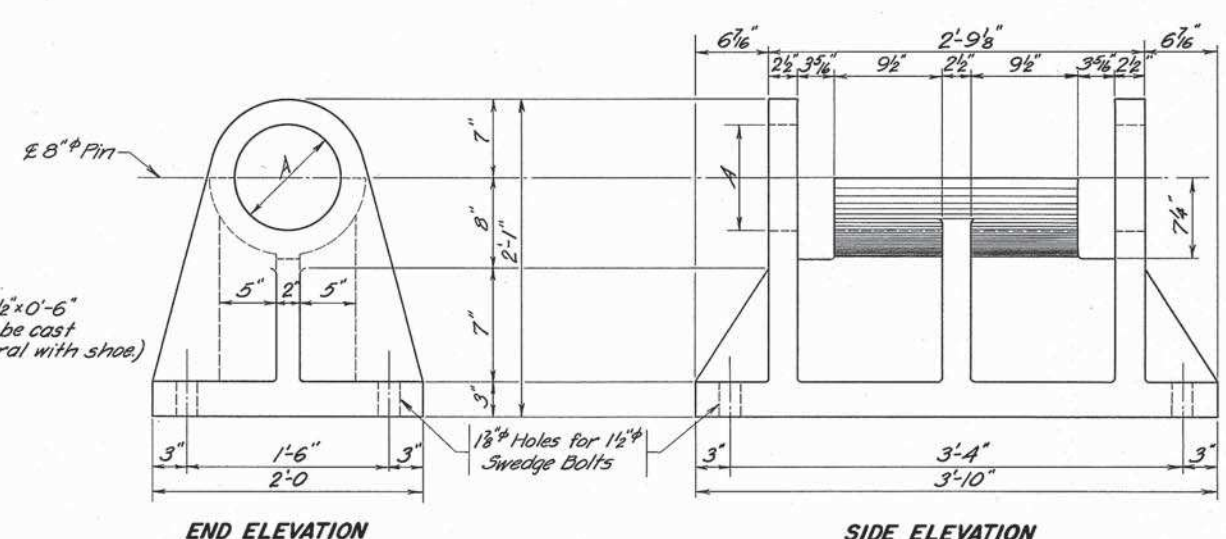
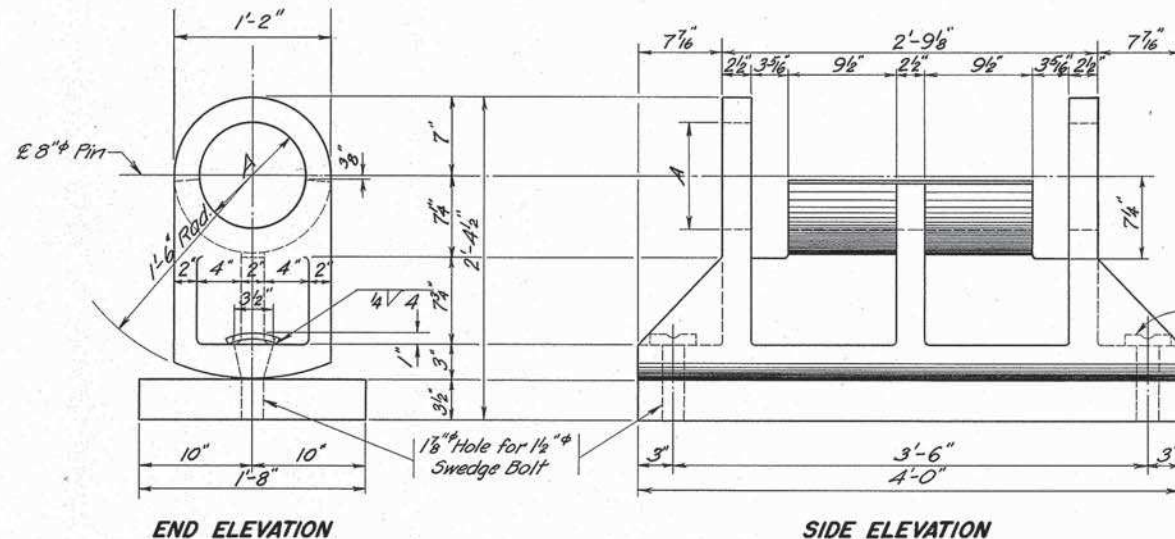
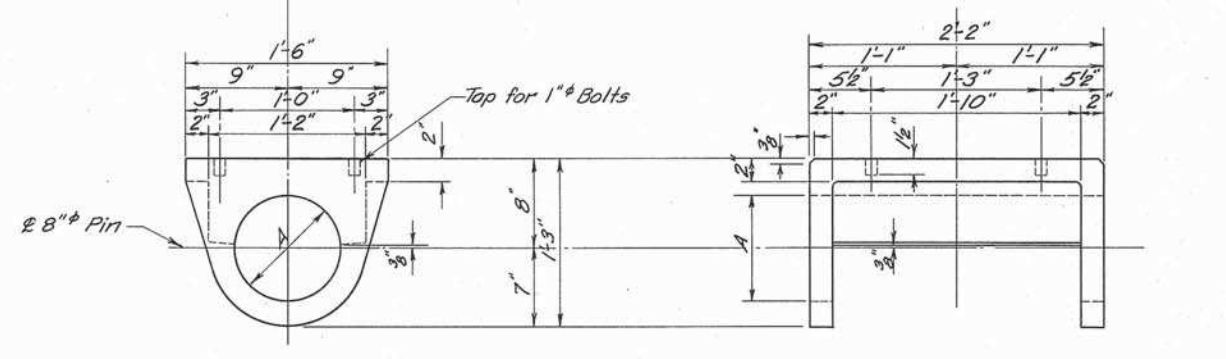
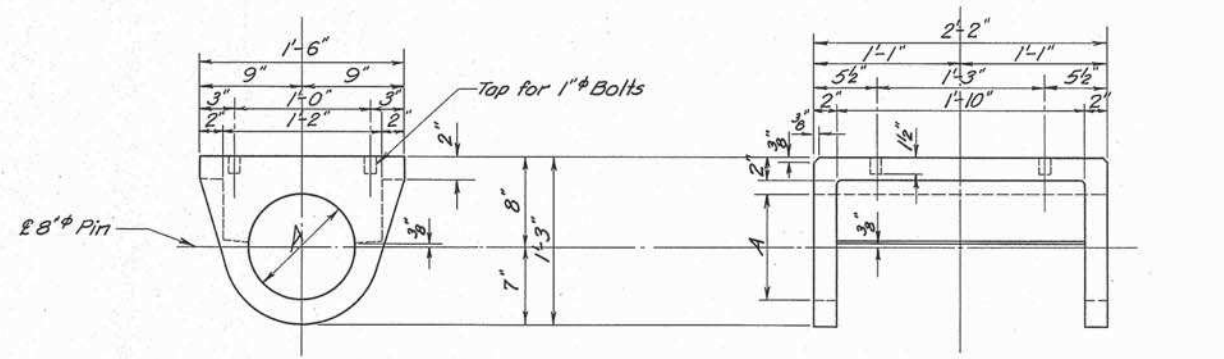
END ELEVATION SIDE ELEVATION
ROCKER SHOE FOR PIERS NO. 3 & 6



TYP. PIN & BUSHING DETAIL

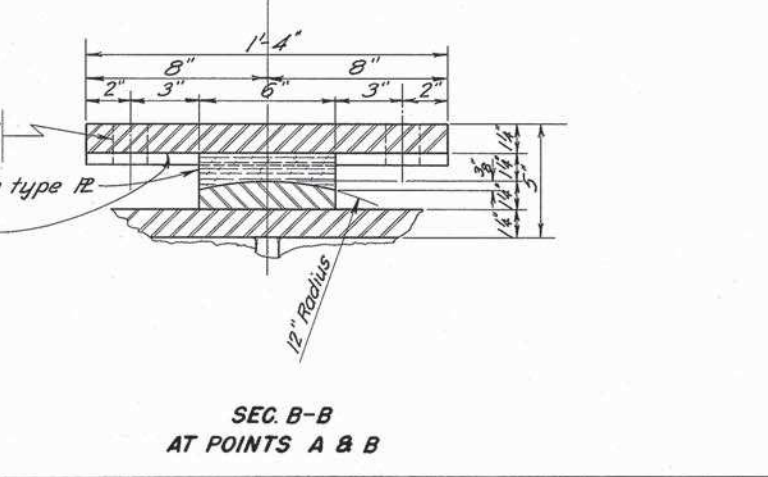
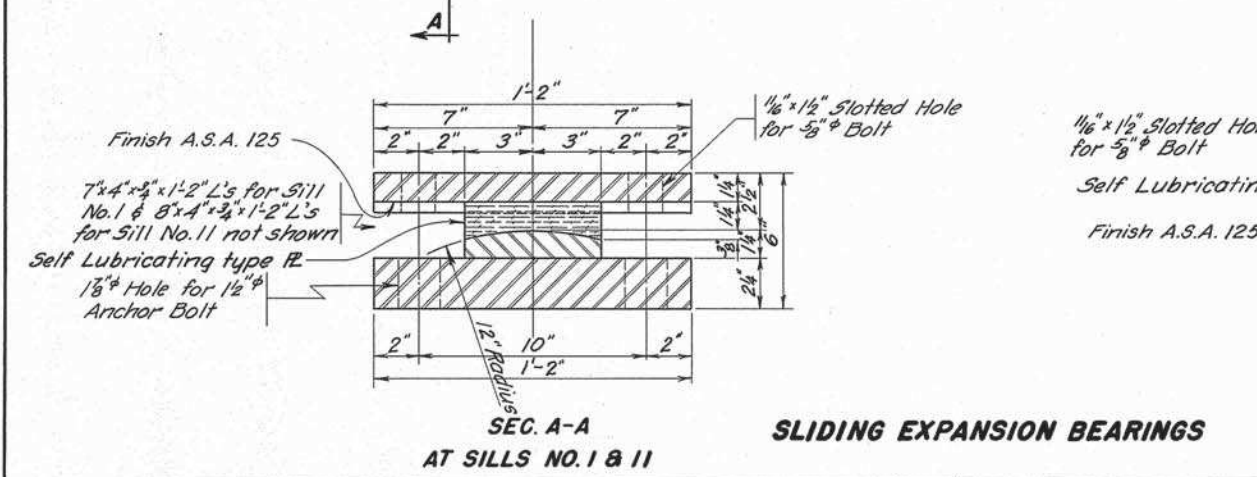
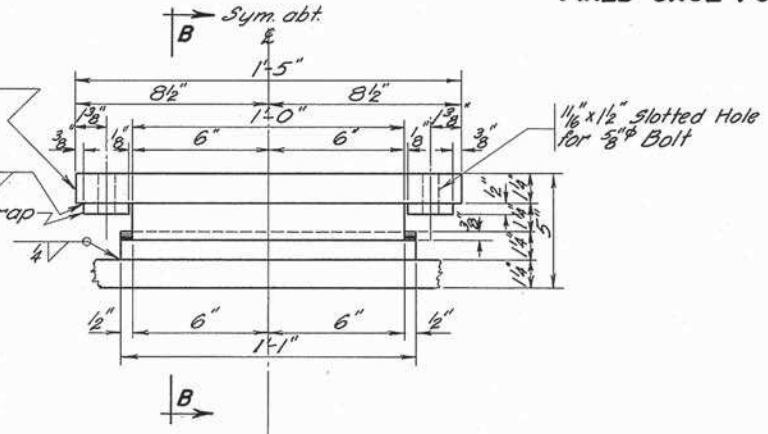
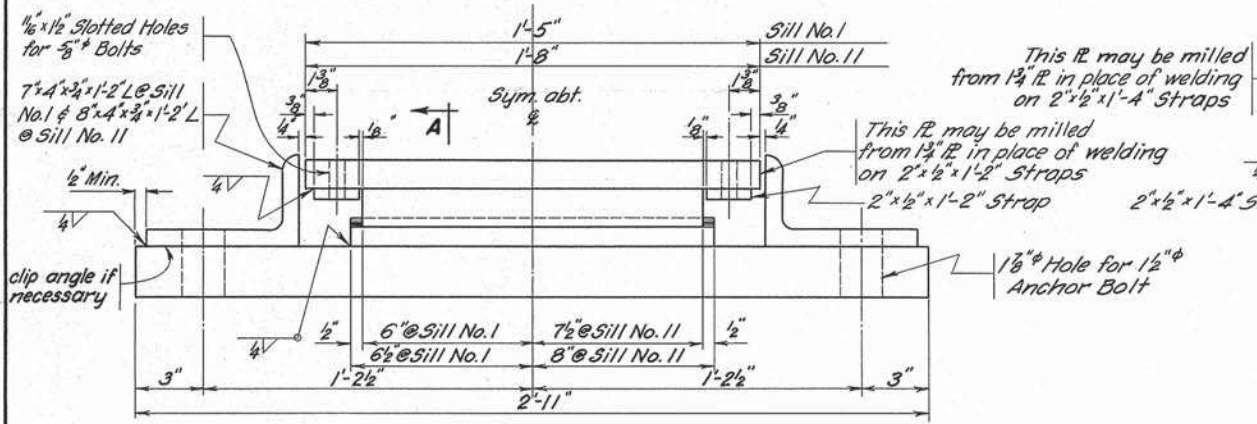
SHOE DETAILS FOR
1659'-0" BRIDGE OVER MISSOURI RIVER
TWO 28'-0" ROADWAYS 4'-0" MEDIAN
STA. 18+37.75 TO 34+96.75 F 030-1(4)
ON U.S. HWYS. 14 & 83 HUGHES COUNTY
SOUTH DAKOTA H20-S16-44
DEPARTMENT OF HIGHWAYS
OCT. 1960 36 OF 45

DESIGNED BY R.W.J.	DRAWN BY D.B.	CHECKED BY E.K.	APPROVED [Signature] BRIDGE ENGINEER
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ROCKER SHOE FOR PIERS NO. 8 & 10

FIXED SHOE FOR PIER NO. 9

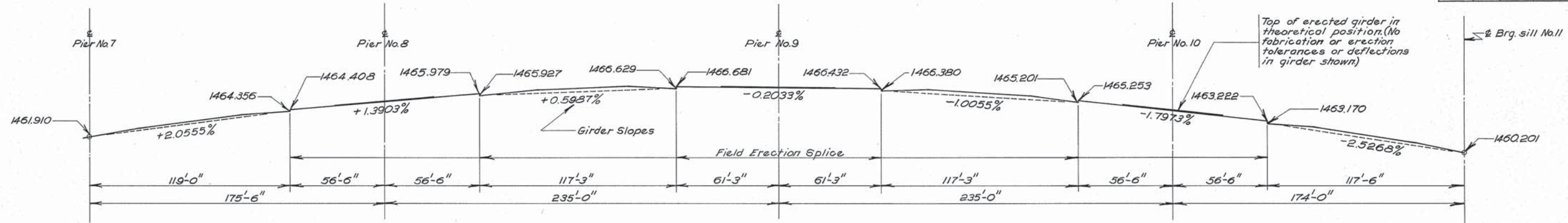


SEC. A-A SLIDING EXPANSION BEARINGS AT SILLS NO. 1 & 11

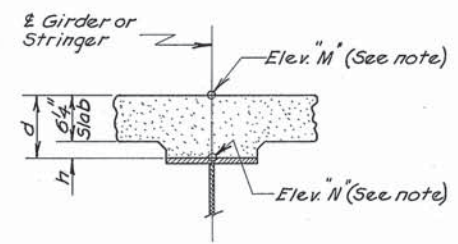
SEC. B-B AT POINTS A & B

SLIDING BEARINGS AND SHOE DETAILS
FOR
1659'-0" BRIDGE OVER MISSOURI RIVER
TWO 28'-0" ROADWAYS 4'-0" MEDIAN
STA. 18+37.75 TO 34+96.75 F 030-1(4)
ON U.S. HWYS. 14 & 83 HUGHES COUNTY
SOUTH DAKOTA H20-S16-44
DEPARTMENT OF HIGHWAYS
OCT. 1960 37 OF 45

DESIGNED BY R.W.T.	DRAWN BY D.L.S.	CHECKED BY E.K.	APPROVED A. R. Leary BRIDGE ENGINEER
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ERECTION ELEVATIONS FOR GIRDERS
(4 Span Unit, Spans #7, #8, #9 & #10)



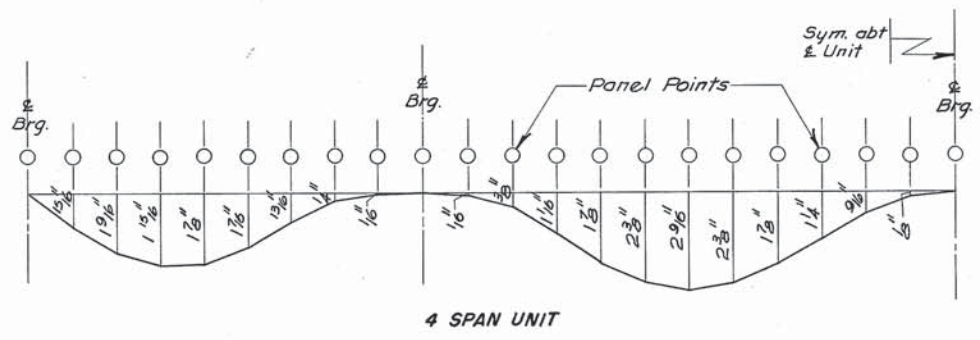
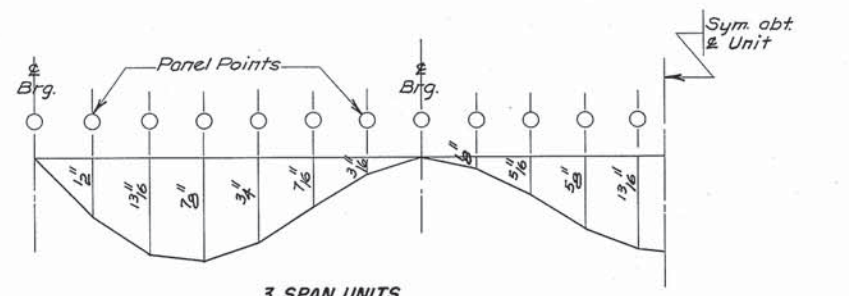
SLAB FORM ELEVATIONS			
Panel Point @ Girder	Elev. M	Panel Point @ Stringer	Elev. N
# Brq. sill #1	1444.113	1444.238	# Brq. Pier #7 1462.83
1	1444.572	1444.697	47 1463.002
2	1445.016	1445.141	48 1463.480
3	1445.417	1445.542	49 1463.934
4	1445.803	1445.928	50 1464.330
5	1446.173	1446.298	51 1464.671
6	1446.548	1446.673	52 1464.970
# Brq. Pier #2	1446.929	1447.054	53 1465.250
8	1447.335	1447.460	54 1465.537
9	1447.747	1447.872	# Brq. Pier #8 1465.819
10	1448.169	1448.294	56 1466.083
11	1448.566	1448.691	57 1466.336
12	1448.947	1449.072	58 1466.595
13	1449.313	1449.438	59 1466.840
14	1449.683	1449.808	60 1467.032
15	1450.063	1450.188	61 1467.174
# Brq. Pier #3	1450.049	1450.574	62 1467.259
17	1450.860	1450.985	63 1467.292
18	1451.277	1451.402	64 1467.290
19	1451.699	1451.824	65 1467.257
20	1452.105	1452.240	66 1467.219
21	1452.518	1452.643	# Brq. Pier #9 1467.182
22	1452.910	1453.035	68 1467.138
# Brq. Pier #4	1453.287	1453.412	69 1467.096
24	1453.746	1453.871	70 1467.050
25	1454.190	1454.315	71 1466.973
26	1454.613	1454.738	72 1466.860
27	1454.999	1455.124	73 1466.696
28	1455.369	1455.494	74 1466.475
29	1455.744	1455.869	75 1466.203
# Brq. Pier #5	1456.125	1456.250	76 1465.880
31	1456.531	1456.656	77 1465.541
32	1456.943	1457.068	78 1465.209
33	1457.365	1457.490	# Brq. Pier #10 1464.863
34	1457.762	1457.887	80 1464.501
35	1458.143	1458.268	81 1464.138
36	1458.509	1458.634	82 1463.781
37	1458.879	1459.004	83 1463.405
38	1459.259	1459.384	84 1462.989
# Brq. Pier #6	1459.645	1459.770	85 1462.516
40	1460.056	1460.181	86 1461.983
41	1460.473	1460.598	87 1461.404
42	1460.895	1461.020	# Brq. sill #11 1460.774
43	1461.301	1461.426	
44	1461.714	1461.839	
45	1462.106	1462.231	

NOTE
To determine the depth of concrete "d" in feet over the girders or stringers at Panel points subtract Elev. "N" from Elev. "M" taken from the table at left. Elev. "M" is the elevation of the top of slab form before any concrete has been poured. This elevation includes correction for deflection due to all D.L. above girders. Elev. "N" is a field measured elevation taken on top of all girders and stringers at panel points. This elevation must be taken after all erection is completed, but prior to placing any of the concrete. Girders shall not be supported by construction shoring while elevations are taken. See example below.

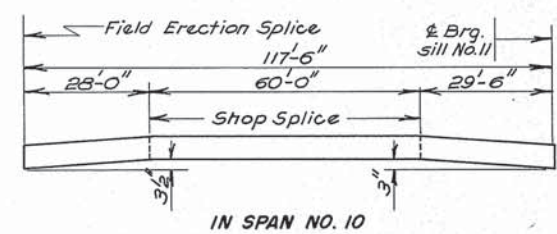
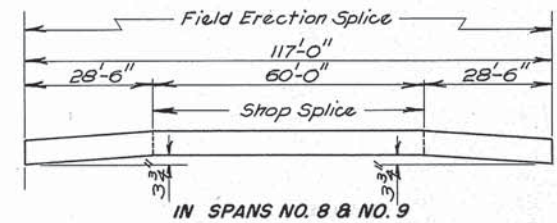
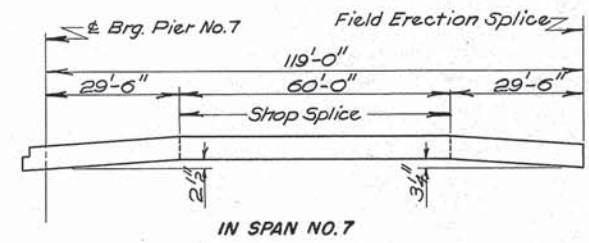
EXAMPLE: Compute depth of concrete over girder at panel point 74.
Elev. "M" (from table) ----- 1466.697
- Elev. "N" (field measured) 1466.049
= d ----- 0.648
= 6 1/2" Slab ----- 0.521
= h (haunch) ----- 0.127

When "d" is less than 0.521' this indicates the flange will be imbedded in the slab. If "d" is less than 0.50' contact Bridge Division before setting slab forms.

STRINGER DEFLECTION
Stringer deflection due to D.L. of concrete is less than 1/8" and need not be considered in construction.



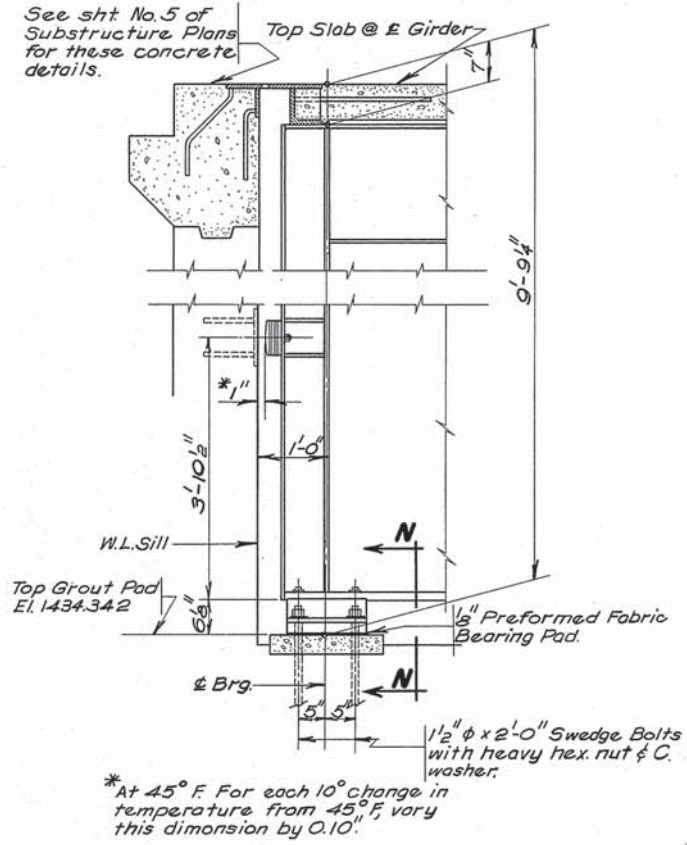
D.L. DEFLECTION DIAGRAMS
For D.L. of Slab, Curb & Railing only. (1650 #/1 per Girder)



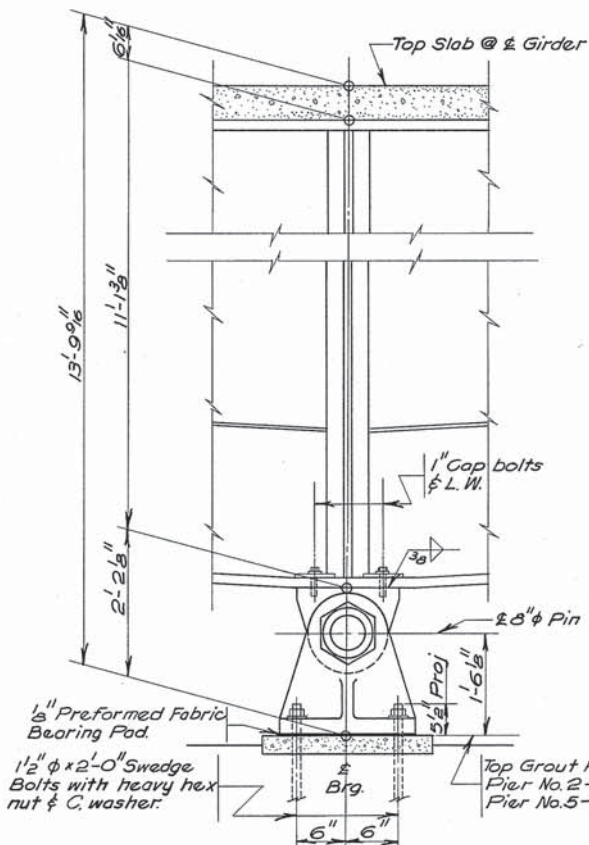
CAMBER DIAGRAMS
Camber girders in 4-Span unit as shown

ERECTION DATA & DEFLECTION DIAGRAMS
FOR
1659'-0" BRIDGE OVER MISSOURI RIVER
TWO 28'-0" ROADWAYS 4'-0" MEDIAN
STA. 18+37.75 TO 34+96.75 F 030-1(4)
ON U.S. HWYS. 14 & 83 HUGHES COUNTY
SOUTH DAKOTA H20-S16-44

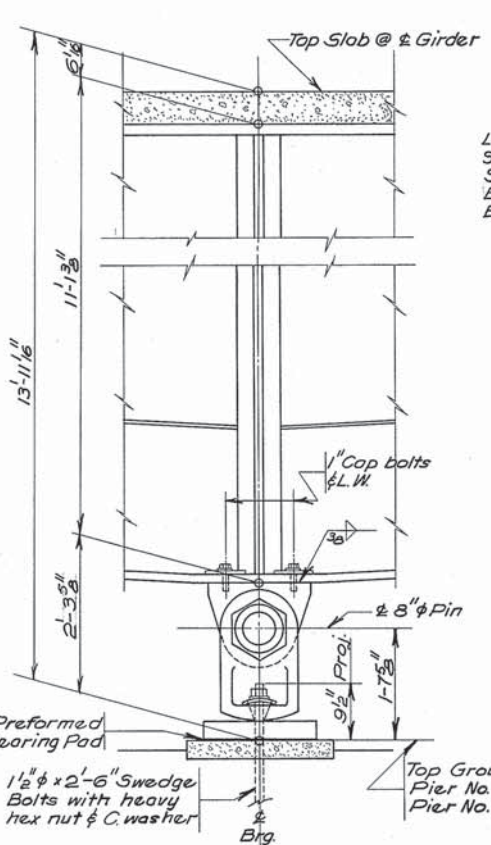
OCT. 1960 38 OF 45
DESIGNED BY H.C.W. DRAWN BY H.C.W. Tr. by G.A. CHECKED BY E.K. APPROVED [Signature] BRIDGE ENGINEER



SILL NO. 1



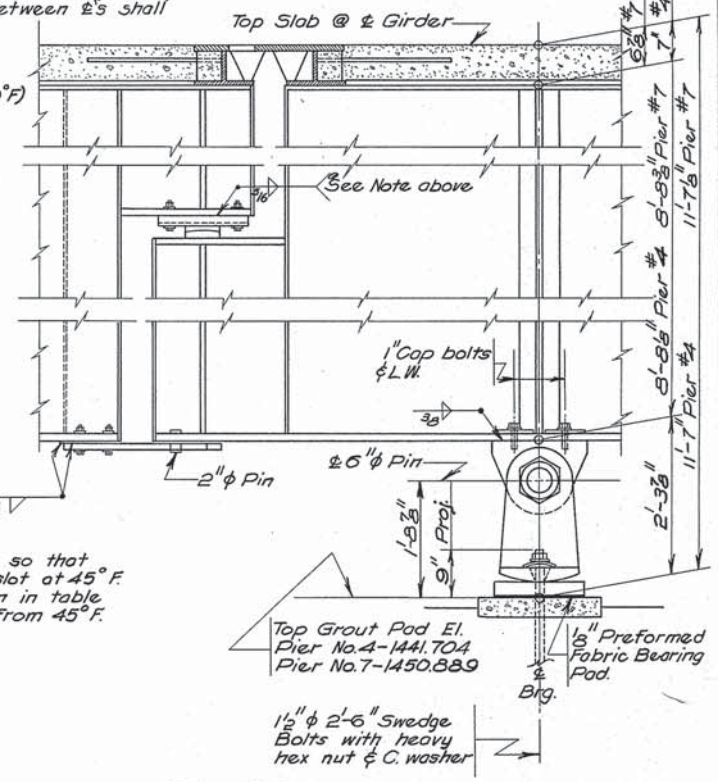
PIERS NO. 2 & NO. 5



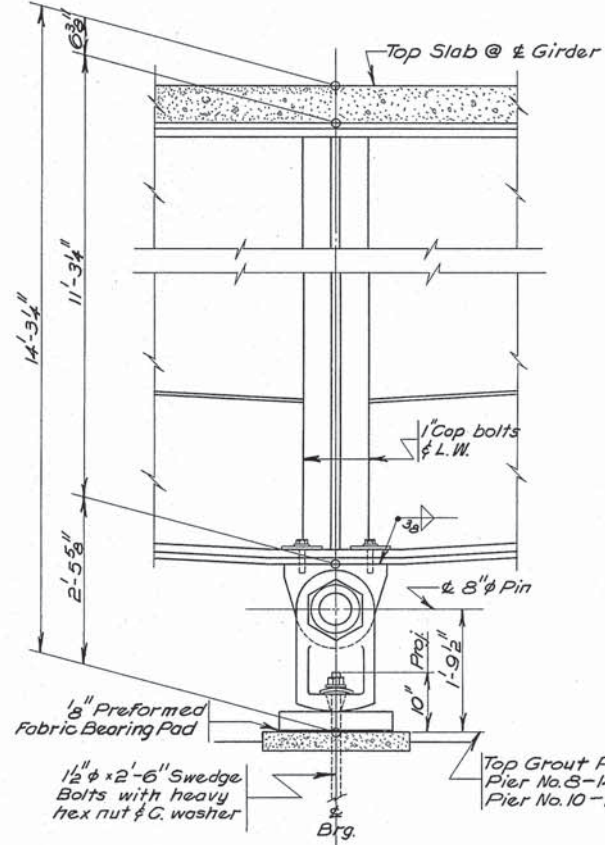
PIERS NO. 3 & NO. 6

NOTE: Adjust R before welding. Vertical & of plate and Lub. Brg. shall coincide at 45° F. For each 10° variation in temp. from 45° adjust top plate so that the distance between & s shall be as shown below.

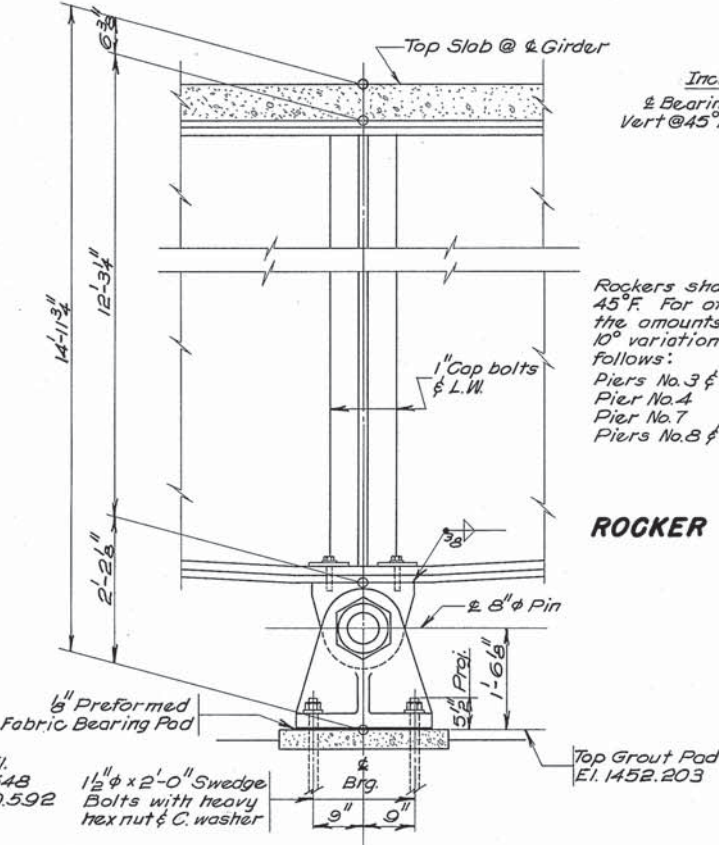
LOCATION	CORRECTION (10° F)
Sill No. 1	0.100"
Exp. Point "A"	0.320"
Exp. Point "B"	0.546"



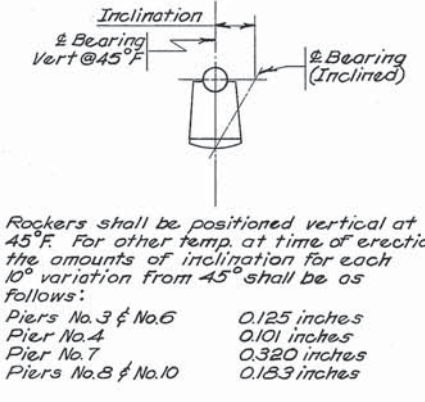
EXP. POINTS "A" & "B" AND PIERS NO. 4 & NO. 7



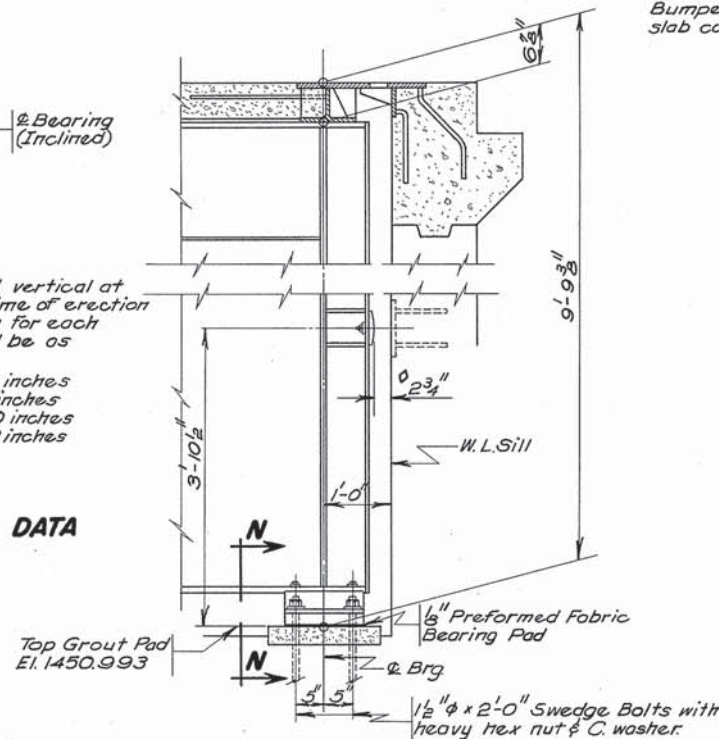
PIERS NO. 8 & NO. 10



PIER NO. 9



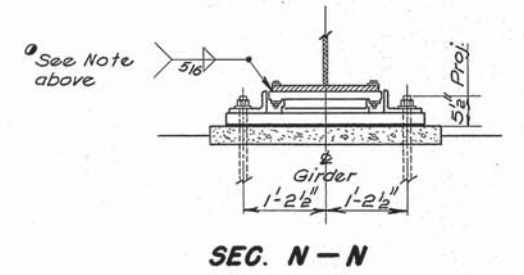
ROCKER ERECTION DATA



SILL NO. 11

* At 45° F. For each 10° change in temperature from 45° F. vary this dimension by 0.320"

NOTE - Final setting and adjustment of all Exp. Devices, Bumpers and Locking devices shall be made after all slab concrete has been poured.



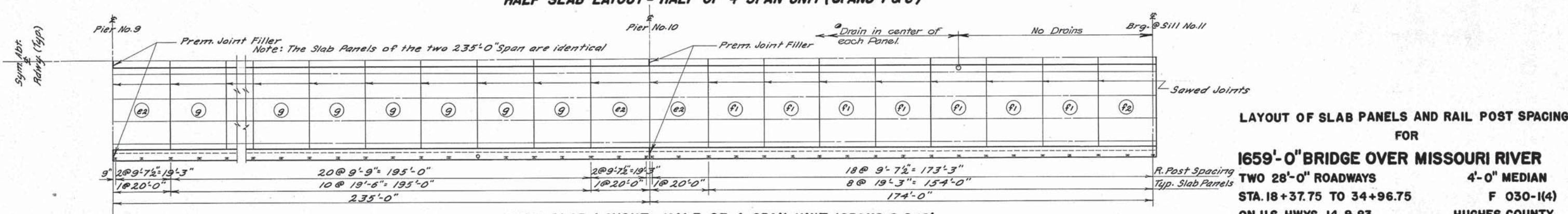
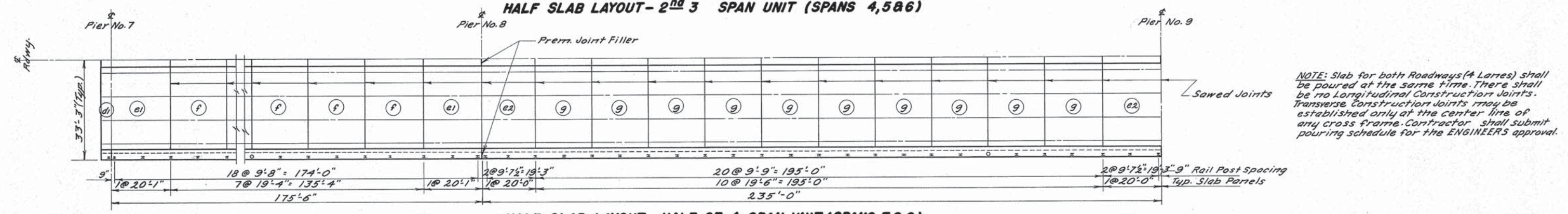
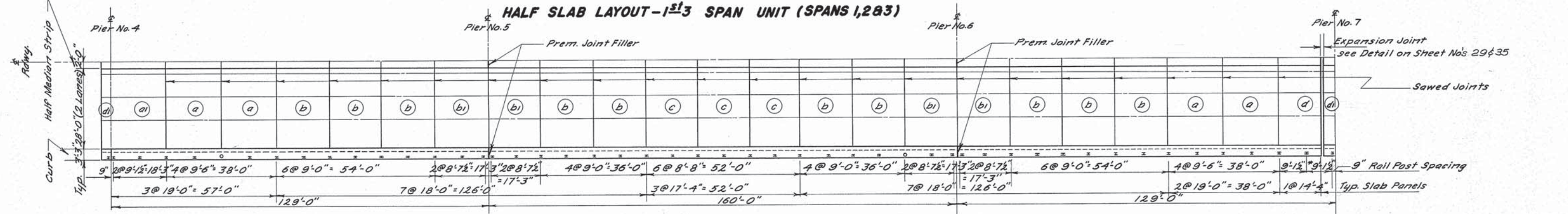
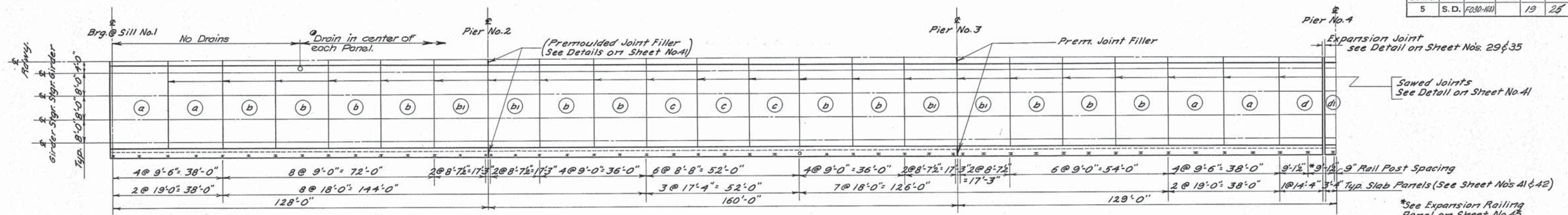
BEARING ELEVATIONS AND DETAILS FOR

1659'-0" BRIDGE OVER MISSOURI RIVER
 TWO 28'-0" ROADWAYS 4'-0" MEDIAN
 STA. 18+37.75 TO 34+96.75 F 030-1(4)
 ON U.S. HWYS. 14 & 83 HUGHES COUNTY
 SOUTH DAKOTA H20-S16-44

DEPARTMENT OF HIGHWAYS

OCT. 1960 39 OF 45

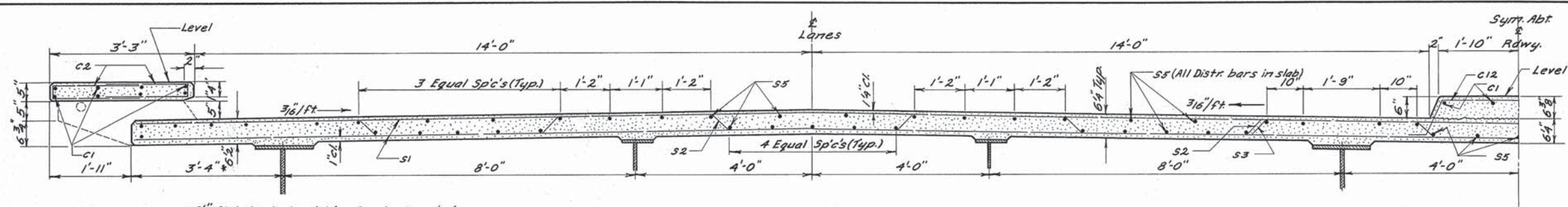
DESIGNED BY K.C.W.	DRAWN BY K.C.W. Tr. by G.A.	CHECKED BY E.K.	APPROVED R. P. [Signature] BRIDGE ENGINEER
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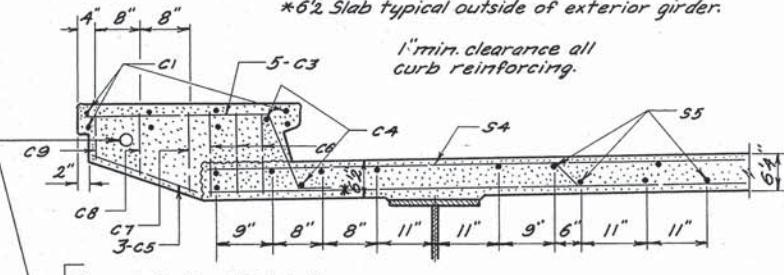
NOTE: Slab for both Roadways (4 Lanes) shall be poured at the same time. There shall be no Longitudinal Construction Joints. Transverse Construction Joints may be established only at the center line of any cross frame. Contractor shall submit pouring schedule for the ENGINEERS approval.

LAYOUT OF SLAB PANELS AND RAIL POST SPACING FOR 1659'-0" BRIDGE OVER MISSOURI RIVER
 TWO 28'-0" ROADWAYS 4'-0" MEDIAN
 STA. 18+37.75 TO 34+96.75 F 030-114)
 ON U.S. HWYS. 14 & 83 HUGHES COUNTY
 SOUTH DAKOTA H20-S16-44
 DEPARTMENT OF HIGHWAYS

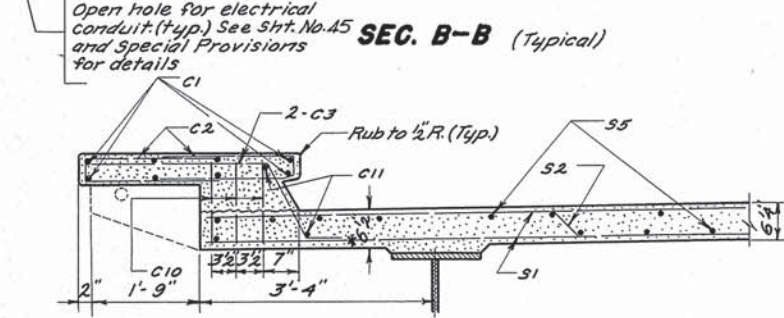
OCT. 1960 40 OF 45
 DESIGNED BY E.K. DRAWN BY E.K. CHECKED BY A.C.W. APPROVED R. P. [Signature] BRIDGE ENGINEER



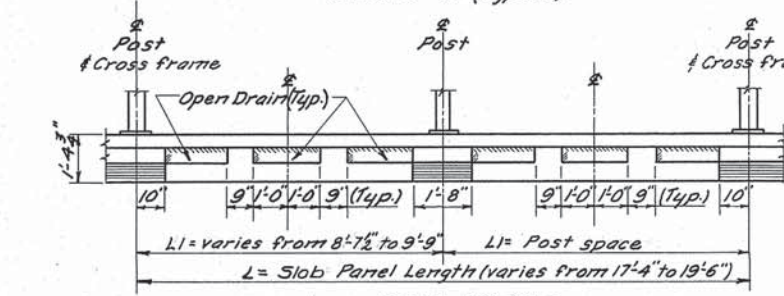
SEC. A-A (Typical)



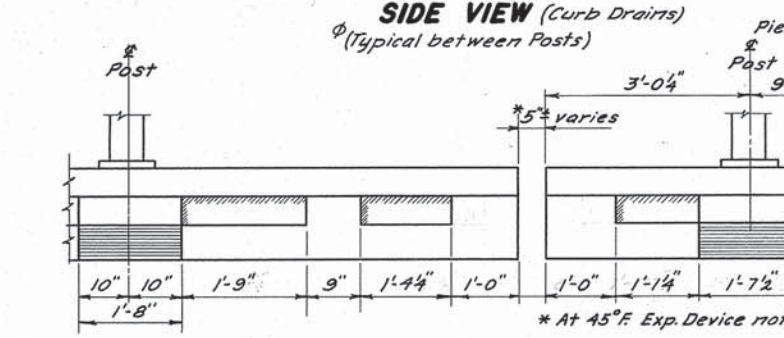
SEC. B-B (Typical)



SEC. C-C (Typical)

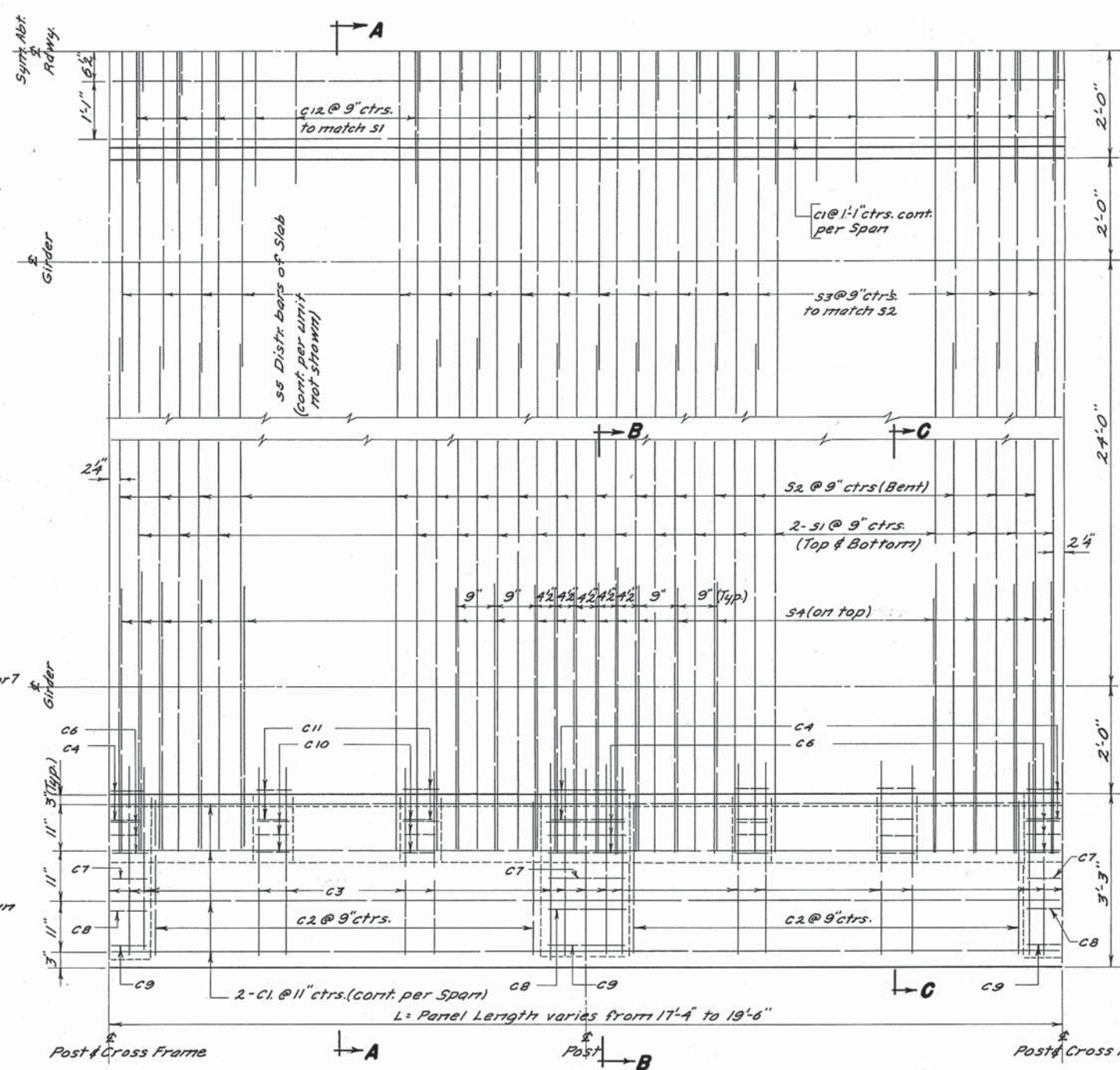


SIDE VIEW (Curb Drains)
Typical between Posts



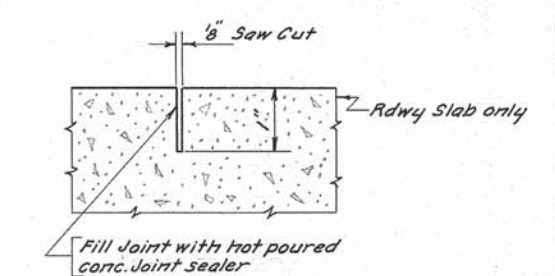
SIDE VIEW (Curb Drains)
Typical for Expansion Panel at Pier No. 4 & 7

There shall be no curb drains in first three and last three slab panels. Make curb full as in Sec. C-C above.

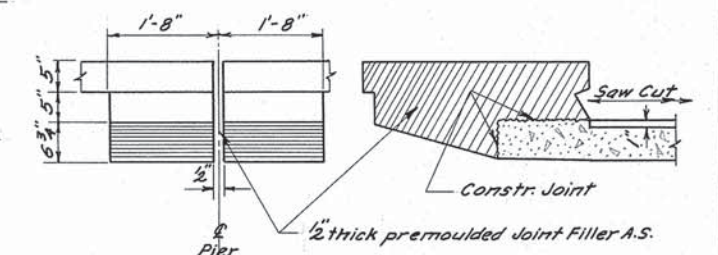


HALF PLAN - TYPICAL SLAB PANEL

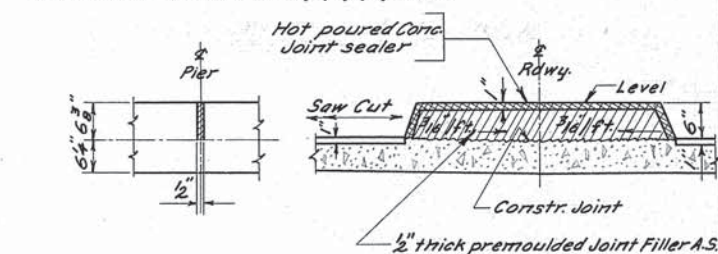
Typical for all Slab Panels except a1, b1, d1, e1, e2 & f2. For a1, b1, d1, e1, e2 & f2. See Details on Sheet No. 42



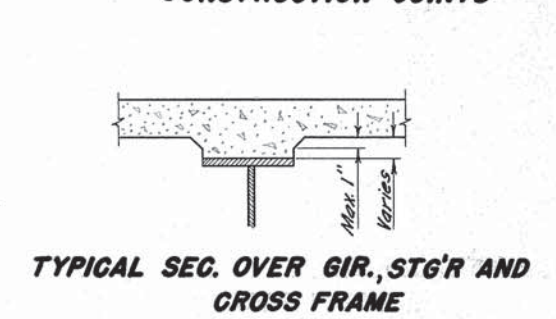
SAWED JOINT
(See Sheet No. 40 for location)



CURB JOINT AT PIERS NO. 2, 3, 5, 6, 8, 9 & 10



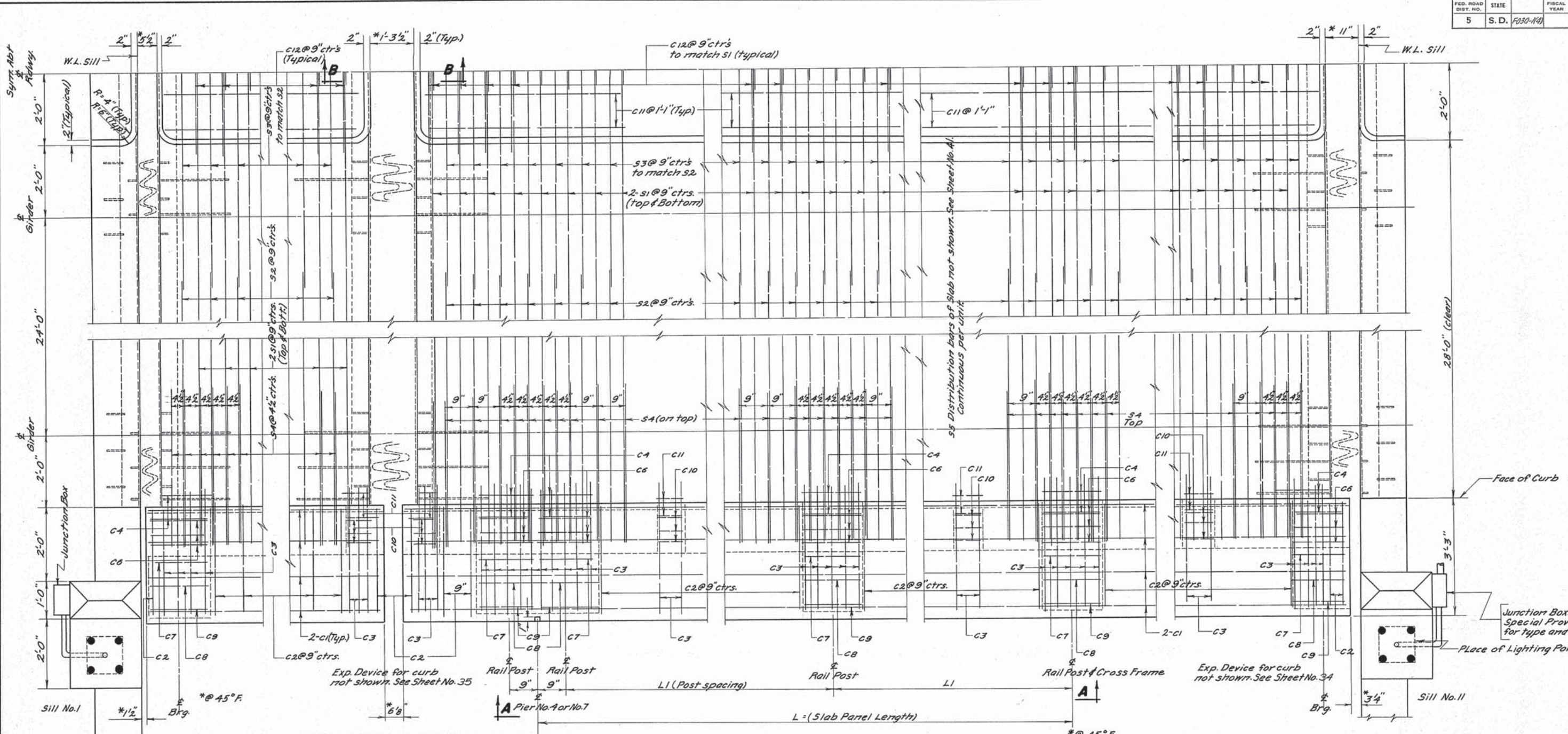
MEDIAN STRIP JOINT AT PIERS NO. 2, 3, 5, 6, 8, 9 & 10



TYPICAL SEC. OVER GIR., STG'R AND CROSS FRAME

ROADWAY SLAB DETAILS FOR
1659'-0" BRIDGE OVER MISSOURI RIVER
 TWO 28'-0" ROADWAYS 4'-0" MEDIAN
 STA. 18+37.75 TO 34+96.75 F 030-1(4)
 ON U.S. HWYS. 14 & 83 HUGHES COUNTY
 SOUTH DAKOTA H20-S16-44
 DEPARTMENT OF HIGHWAYS

DESIGNED BY E.K.	DRAWN BY E.K. TRACED BY W.C.R.	CHECKED BY H.C.W.	APPROVED [Signature] BRIDGE ENGINEER
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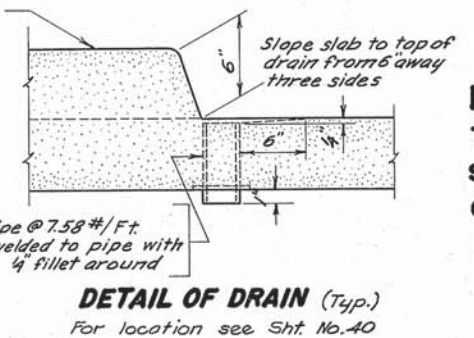
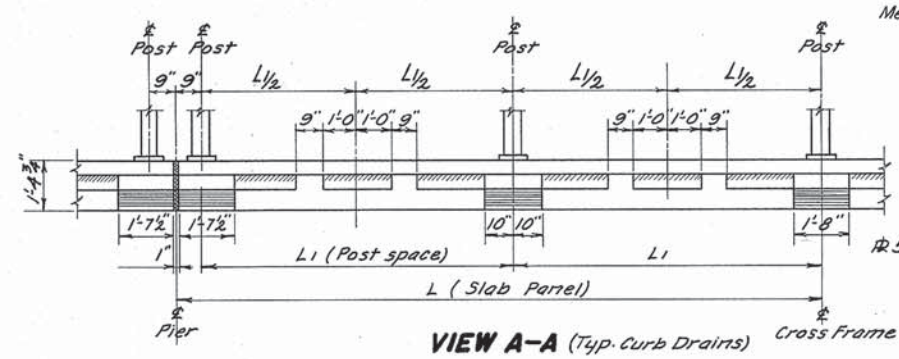
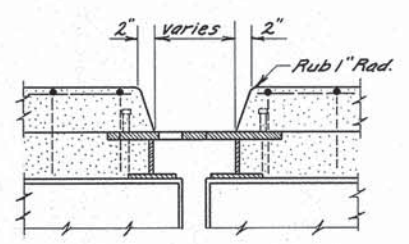


HALF OF END PANEL PART AT SILL NO. I

HALF OF PANEL PART AT EXP. POINTS "A" & "B"

HALF PLAN FOR SLAB PANELS a1, b1, e1 & e2

HALF OF END PANEL PART AT SILL NO. II



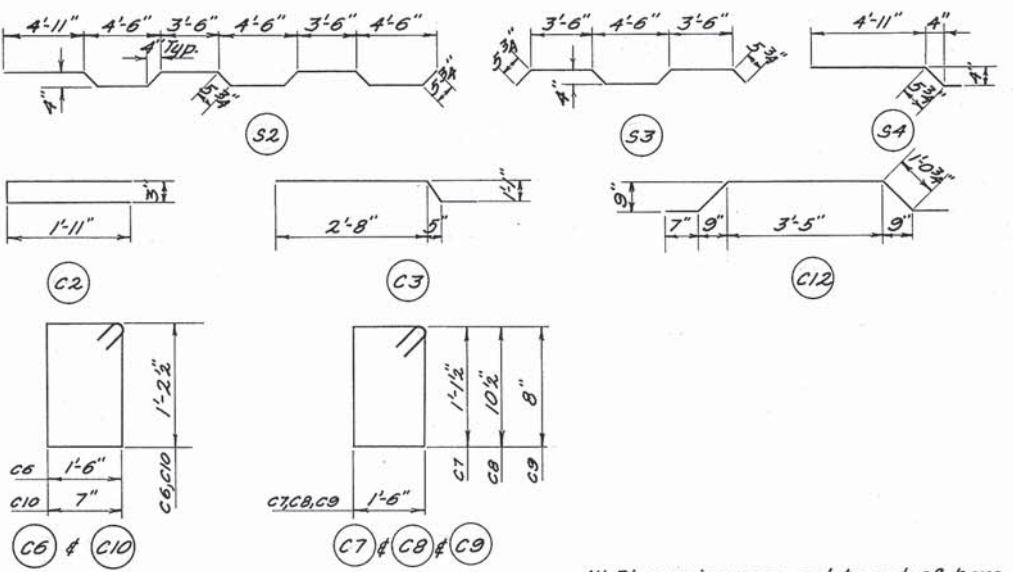
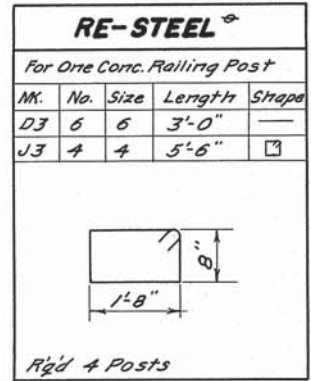
ROADWAY SLAB DETAILS FOR
1659'-0" BRIDGE OVER MISSOURI RIVER
 TWO 28'-0" ROADWAYS 4'-0" MEDIAN
 STA. 18+37.75 TO 34+96.75 F 030-1(4)
 ON U.S. HWYS. 14 & 83 HUGHES COUNTY
 SOUTH DAKOTA H20-S16-44
 DEPARTMENT OF HIGHWAYS
 OCT. 1960 (42 OF 45)

DESIGNED BY E. K.	DRAWN BY E. K.	CHECKED BY K. C. W.	APPROVED K. P. SCURR BRIDGE ENGINEER
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REINFORCING SCHEDULE

FED. ROAD DIST. NO.	STATE	FISCAL YEAR	SHEET NO.	TOTAL
5	S. D.	F030-140	22	25

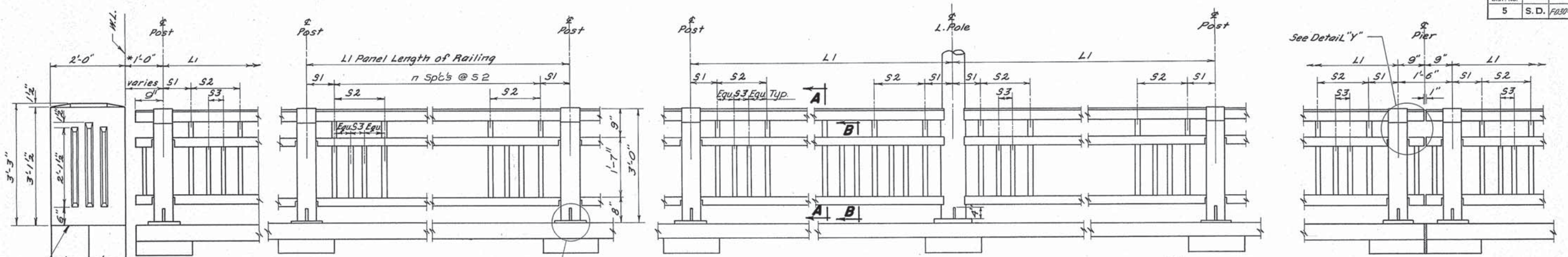
Units	Mk.	Size	Length	Shape	Panel Types ϕ						@ Sill No.	Total	Units	Mk.	Size	Length	Shape	Panel Types ϕ						@ Sill No.	Total			
					a (4)	b (11)	bi (4)	c (3)	d (1)	di (1)								e1 (2)	e2 (5)	f (7)	f1 (7)	f2 (1)	g (20)			di (1)		
	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.				
1st - 3 SPAN UNIT (Spans No. 1, No. 2, & No. 3) Curb & Median Strip	S1	5	32'-0"	—	4x100	—	11x96	4x96	3x92	1x76	1x16			S1	5	32'-0"	—	2x108	5x108	7x104	7x104	1x100	20x104					
	S2	1	26'-3"	~	4x50	—	11x48	4x48	3x46	1x38	1x8			S2	1	26'-3"	~	2x54	5x54	7x52	7x52	1x50	20x52					
	S3	1	12'-9"	~	4x25	—	11x24	4x24	3x23	1x19	1x4			S3	1	12'-9"	~	2x27	5x27	7x26	7x26	1x25	20x26					
	S4	5	6'-0"	—	4x40	—	11x40	4x40	3x40	1x34	1x10	1x2		S4	5	6'-0"	—	2x40	5x40	7x40	7x40	1x40	20x40					
	S5*	4	428'-0"	—	Total Length Rqd for the 1st Unit including Laps.									85	S5*	4	846'-0"	—	Total Length Rqd for the 3rd Unit including Laps.									85
	C1*	4	429'-0"	—	Total Length Rqd for the 1st Unit including Laps.									20	C1*	4	846'-0"	—	Total Length Rqd for the 3rd Unit including Laps.									20
	C2	3	4'-0"	—	4x88	—	11x80	4x80	3x80	1x68	1x12	1x4		C2	3	4'-0"	—	2x88	5x88	7x88	7x88	1x88	20x88		1x8			
	C3	6	4'-6"	—	4x36	—	11x36	4x41	3x36	1x33	1x16	1x4		C3	6	4'-6"	—	2x41	5x41	7x36	7x36	1x39	20x36					
	C4	4	1'-6"	—	4x8	—	11x8	4x10	3x8	1x6	1x4	1x4		C4	4	1'-6"	—	2x10	5x10	7x8	7x8	1x10	20x8					
	C5	4	1'-9"	—	4x12	—	11x12	4x15	3x12	1x9	1x6	1x4		C5	4	1'-9"	—	2x15	5x15	7x12	7x12	1x15	20x12					
	C6	4	6'-6"	□	4x12	—	11x12	4x15	3x12	1x9	1x6	1x6		C6	4	6'-6"	□	2x15	5x15	7x12	7x12	1x15	20x12					
	C7	4	6'-3"	□	4x4	—	11x4	4x5	3x4	1x3	1x2	1x2		C7	4	6'-3"	□	2x5	5x5	7x4	7x4	1x5	20x4					
C8	4	5'-9"	□	4x4	—	11x4	4x5	3x4	1x3	1x2	1x2		C8	4	5'-9"	□	2x5	5x5	7x4	7x4	1x5	20x4						
C9	4	5'-3"	□	4x4	—	11x4	4x5	3x4	1x3	1x2	1x2		C9	4	5'-3"	□	2x5	5x5	7x4	7x4	1x5	20x4						
C10	4	4'-6"	□	4x24	—	11x24	4x24	3x24	1x24	1x6			C10	4	4'-6"	□	2x24	5x24	7x24	7x24	1x24	20x24						
C11	4	0'-9"	—	4x16	—	11x16	4x16	3x16	1x16	1x4			C11	4	0'-9"	—	2x16	5x16	7x16	7x16	1x16	20x16						
C12	4	6'-9"	—	4x25	—	11x24	4x24	3x23	1x19	1x4			C12	4	6'-9"	—	2x27	5x27	7x26	7x26	1x25	20x26						
3/4" ϕ	1'-9"	Anchor Bolts with 3 Hex. Nuts & C.W. for R. Post. See Details Sht. No.									95x4	380	3/4" ϕ	1'-9"	Anchor Bolts for R. Posts. (Bent)									170x4	680			
1" ϕ	2'-0"	Anchor Bolts with 3 Hex. Nuts & C.W. for L. Pole Posts.									3x4	12	1" ϕ	2'-0"	Anchor Bolts for L. Pole Posts. (Bent)									6x4	24			



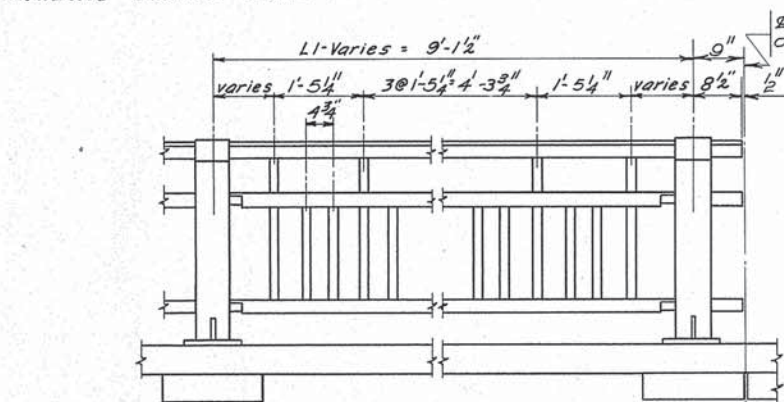
NOTE:
 ϕ For Types and Location of Panels see Sht. No. The number in parenthesis following each panel type indicates the number of that Panel required.
 *S5 Distribution Bars for Slab (See Sht. No. 41) shall be continuous per Unit and shall be lapped a min. 15" at any place except over Cross Frames. The total length of any continuous bar (S5) for the entire Bridge provides for 42 Laps.
 4C1 Distribution Bars for Curbs & Median Strip shall be continuous per Span only. Bars shall be lapped a min. of 15". The total length of any continuous bar C1 for the entire Bridge provides for 41 Laps.
 Contractor shall show on shop plans the locations of all Laps for approval.

REINFORCING SCHEDULE
 FOR
1659'-0" BRIDGE OVER MISSOURI RIVER
TWO 28'-0" ROADWAYS **4'-0" MEDIAN**
STA. 18+37.75 TO 34+96.75 **F 030-1(4)**
ON U.S. HWYS. 14 & 83 **HUGHES COUNTY**
 SOUTH DAKOTA H20-S16-44
 DEPARTMENT OF HIGHWAYS
 OCT. 1960 **(43) OF (45)**

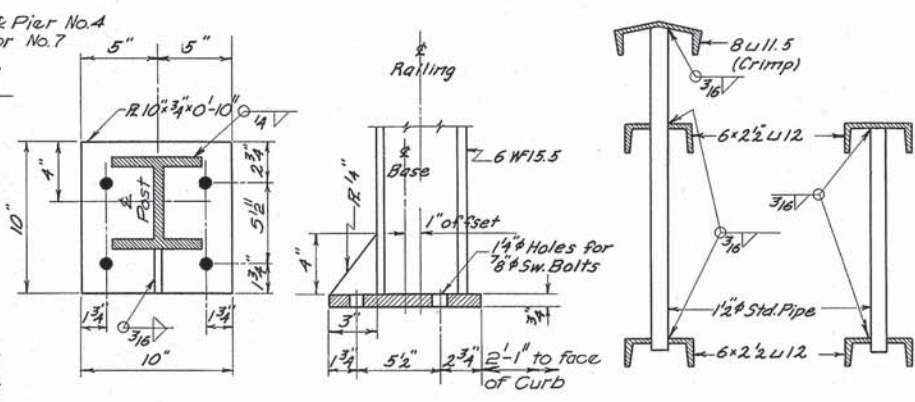
DESIGNED BY	DRAWN BY	CHECKED BY	APPROVED
	E. K. TRACED BY K.C.A.	H.C.W.	<i>[Signature]</i> BRIDGE ENGINEER



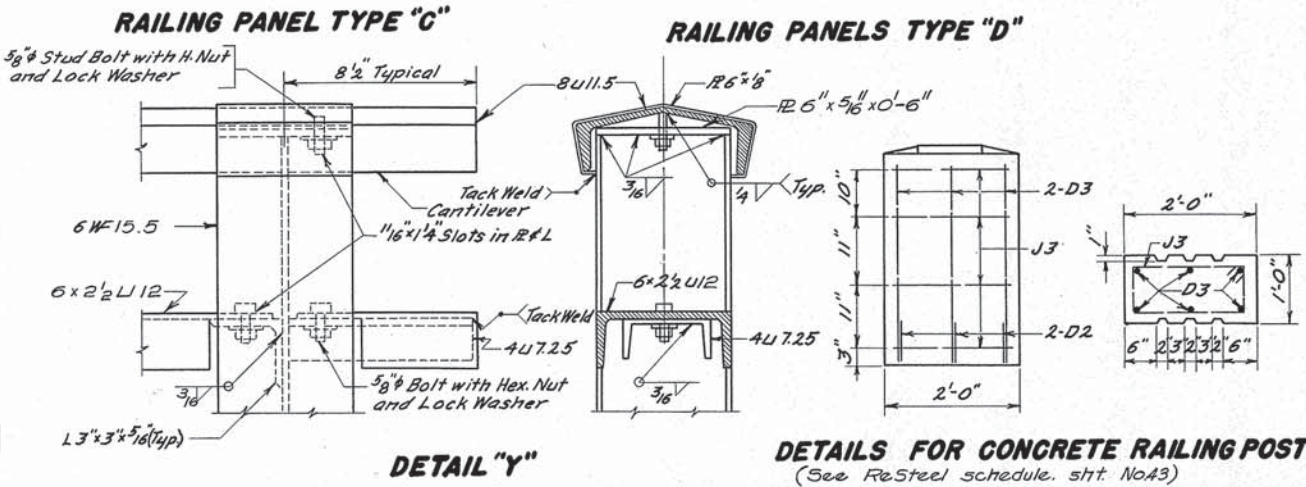
RAILING PANEL TYPE "A" **RAILING PANEL TYPE "B"** **RAILING PANEL TYPE "C"** **RAILING PANELS TYPE "D"**



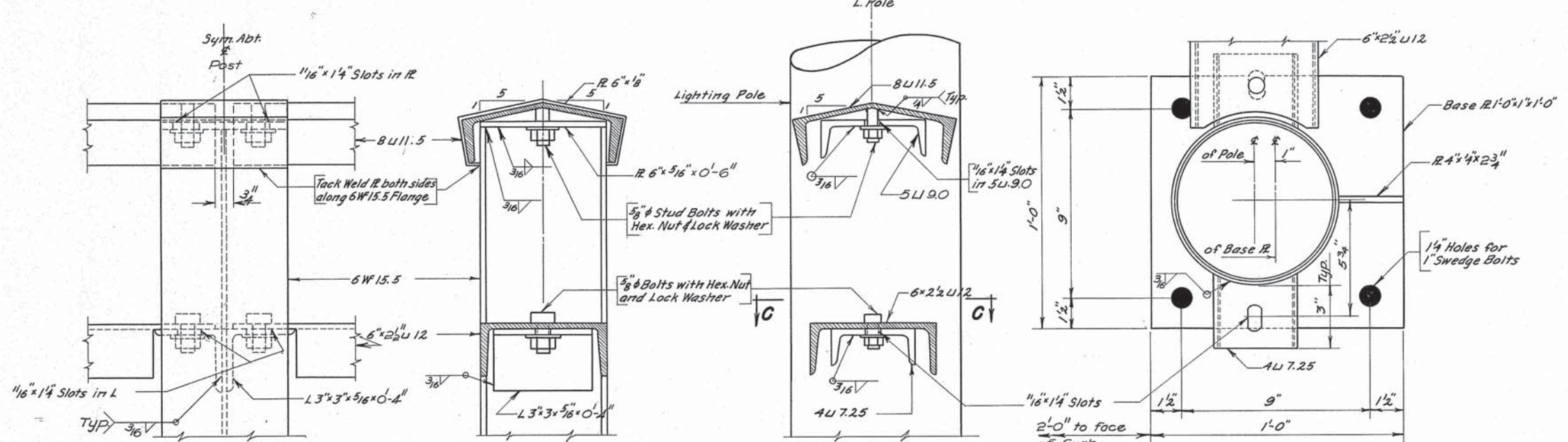
RAILING PANEL TYPE "F" **EXPANSION RAILING PANEL TYPE "E"**
For Details See Sheet No. 45



DETAIL "X" (Typical) **SEC. A-A** (Typical) **SEC. B-B** (Typical)



DETAIL "Y" (Typical) **DETAILS FOR CONCRETE RAILING POST**
(See ReSteel schedule, sht No. 43)



RAILING CONNECTION AT POSTS (Typical) **RAILING CONNECTION AT LIGHTING POLES** (Typical)
For Lighting Pole Details See Sheet No. 45

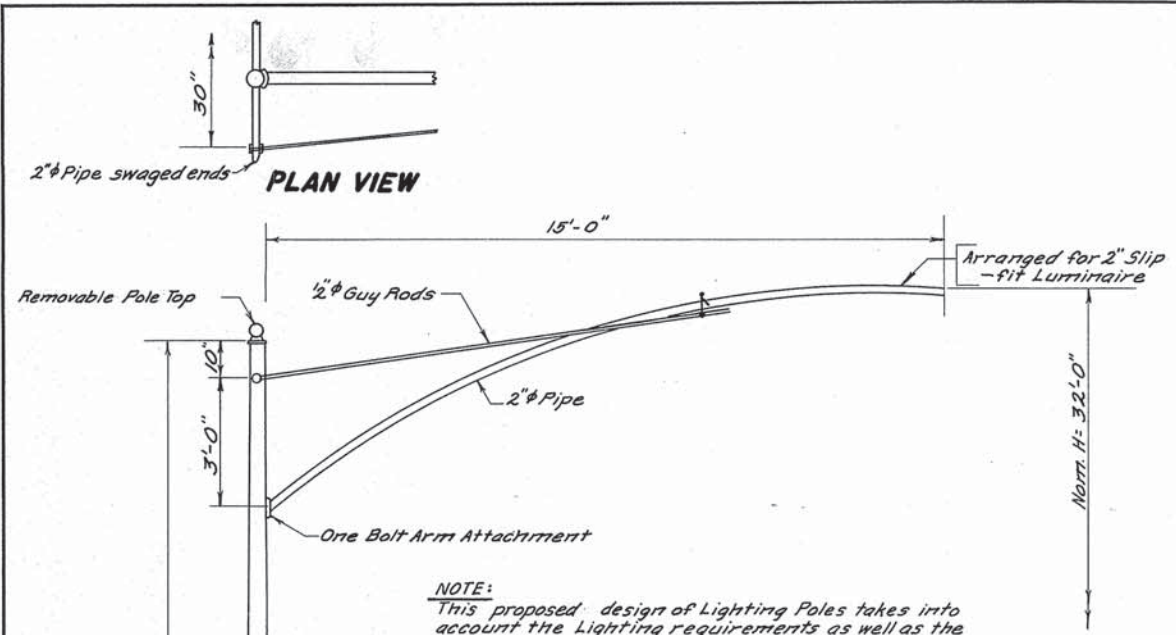
Panel Length	S1	17@ S2	S3	Required No. of Panels						
				Type F*	Type A	Type B	Type C	Type D	Type F	
L1 = 9'-6"	9"	6@ 1'-4"	4 1/2"	26	2	2	-	2	-	
L1 = 9'-0"	9"	6@ 1'-3"	4"	78	3	3	-	-	-	
L1 = 8'-7 1/2"	9 3/8"	5@ 1'-4 1/4"	4 3/4"	13	1	2	16	-	-	
L1 = 8'-8"	10 3/8"	5@ 1'-4 3/8"	4 3/8"	23	1	-	-	-	-	
L1 = 9'-1 1/2"	9 3/4"	6@ 1'-3"	4"	6	-	-	2	-	-	
L1 = 9'-8"	10"	6@ 1'-4"	4 1/2"	30	1	1	4	-	-	
L1 = 9'-7 1/2"	9 3/4"	6@ 1'-4"	4 1/2"	38	1	1	10	2	-	
L1 = 9'-9"	9 3/4"	6@ 1'-4 1/4"	4 3/4"	72	4	4	-	-	-	
Totals				4	286	13	13	32	4	-

* Special Panels; For Details see Sheet No. 45

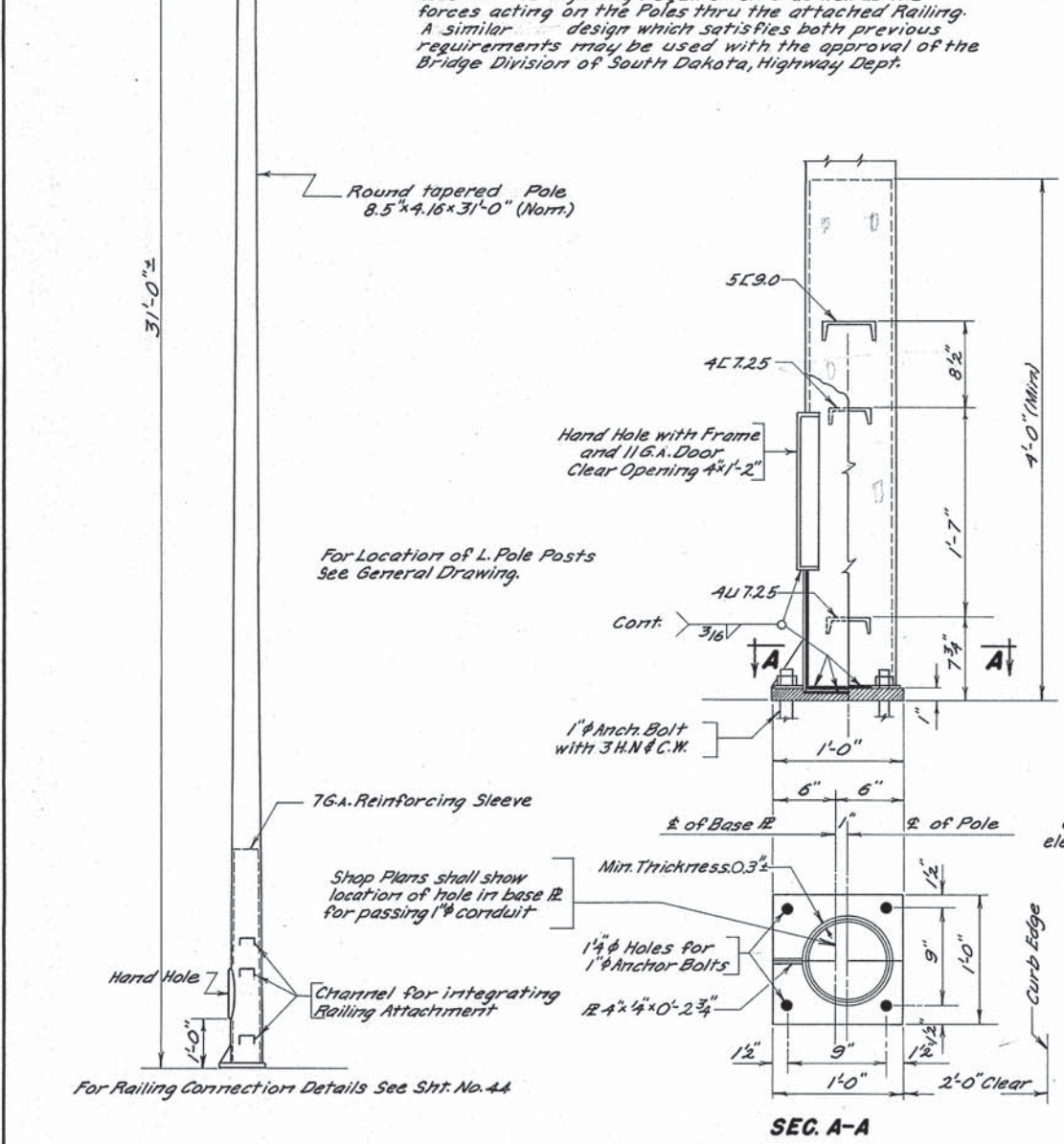
RAILING DETAILS FOR
1659'-0" BRIDGE OVER MISSOURI RIVER
TWO 28'-0" ROADWAYS 4'-0" MEDIAN
STA. 18+37.75 TO 34+96.75 F 030-1(4)
ON U.S. HWYS. 14 & 83 HUGHES COUNTY

SOUTH DAKOTA H20-S16-44
DEPARTMENT OF HIGHWAYS
OCT. 1960 44 OF 45

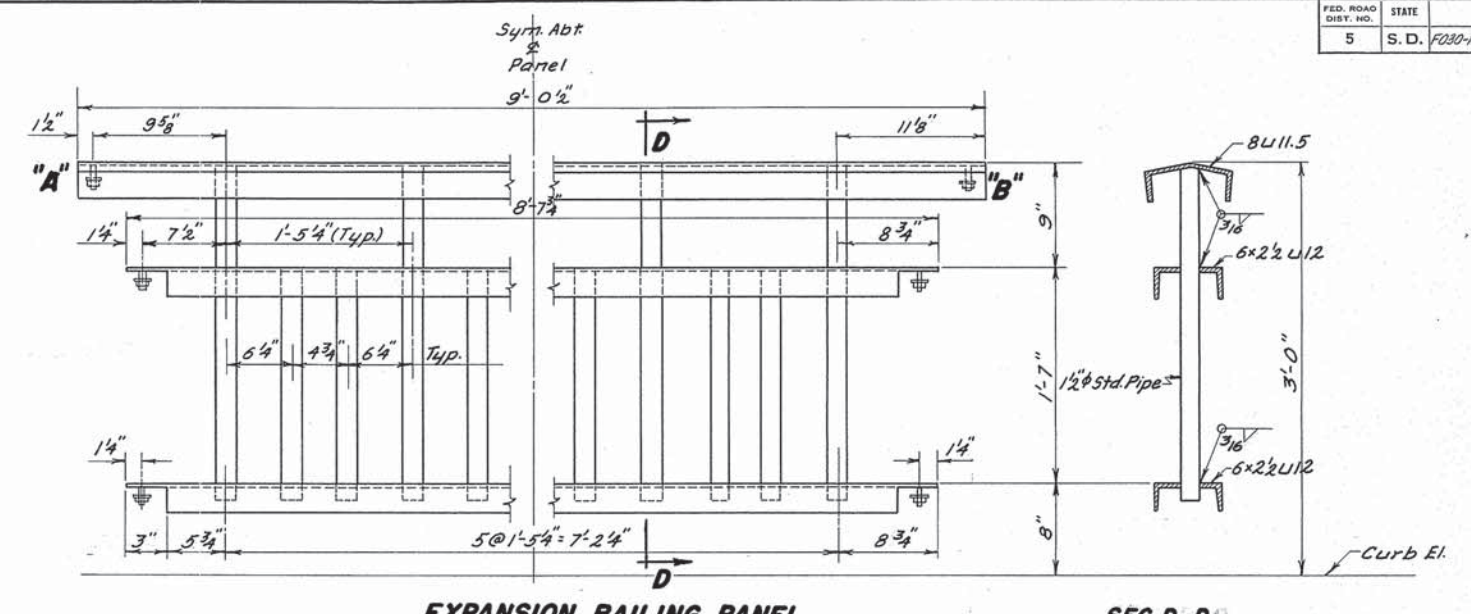
DESIGNED BY E. K.	DRAWN BY E. K.	CHECKED BY K.C.W.	APPROVED K.P. Brown BRIDGE ENGINEER
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NOTE:
 This proposed design of Lighting Poles takes into account the Lighting requirements as well as the forces acting on the Poles thru the attached Railing. A similar design which satisfies both previous requirements may be used with the approval of the Bridge Division of South Dakota, Highway Dept.

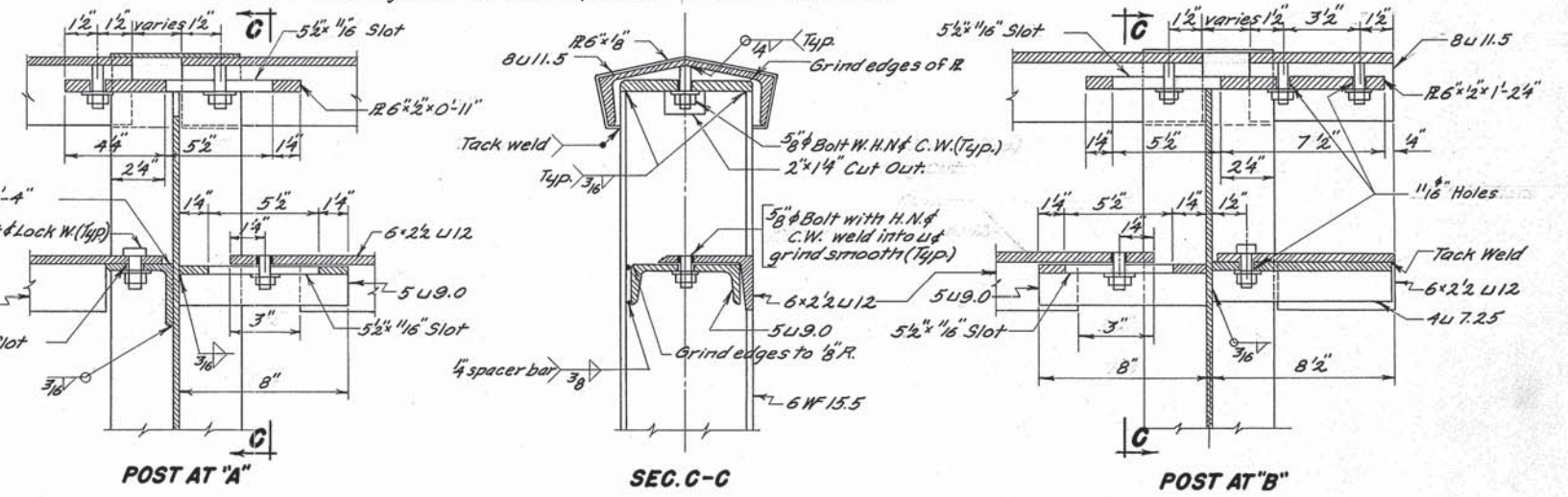


STEEL LIGHTING POLE USED ALSO FOR RAILING POST

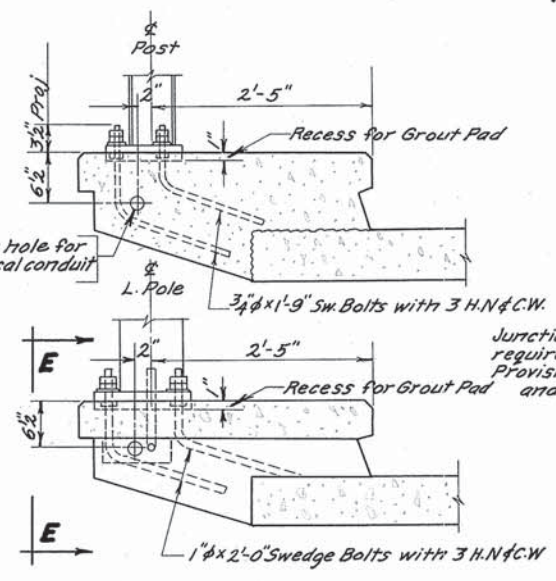


EXPANSION RAILING PANEL

The Exp. Railing Panel shall be placed symmetrical between the Posts regardless of the temperature at time of Erection.

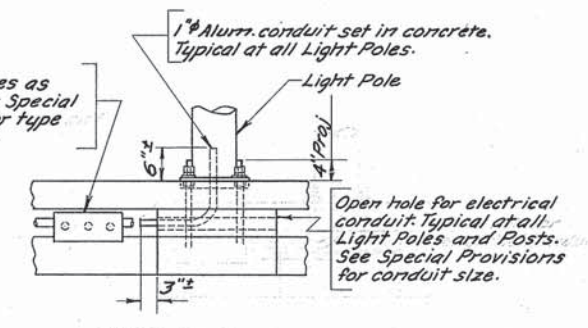


POSTS AT END OF EXPANSION RAILING PANEL



DETAILS FOR ANCHOR BOLTS FOR RAILING
 Re-Steel not shown

NOTE: Open holes shall be large enough to allow conduit to pass freely. Provide slip joint in conduit at all expansion joints. Details of slip joint shall be submitted for approval.



VIEW E-E

RAILING DETAILS FOR
1659'-0" BRIDGE OVER MISSOURI RIVER
 TWO 28'-0" ROADWAYS 4'-0" MEDIAN
 STA. 18+37.75 TO 34+96.75 F 030-1(4)
 ON U.S. HWYS. 14 & 83 HUGHES COUNTY
 SOUTH DAKOTA H20-S16-44
 DEPARTMENT OF HIGHWAYS

DESIGNED BY E.K.	DRAWN BY E.K.	CHECKED BY H.C.W.	APPROVED [Signature] BRIDGE ENGINEER
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ITEM	ESTIMATED QUANTITIES									
	Class A Conc. Cu. Yds.	Reinf. Steel Lbs.	Driving Steel Bearing Piles - Lin. Ft.		Pile Splices Each		Excavation - Cu. Yds.		BACK FILL MTU. TO STABL. FTGS. (ROCK)	
			14BP102	14BP89	14BP102	14BP89	Structure	Unclass.		
Sill No. 1	18.57 18.57	12,780	—	14@70'=980' ¹⁰⁹⁷	—	7	23	6057.50	1793	400
Pier No. 2	260.0	31,635	—	26@45'=1170' ¹⁵⁵⁶	—	13	8	200		12
Pier No. 3	264.6	29,990	—	26@45'=1170' ¹⁴⁷⁸	—	13	25	200	11.98	13
Pier No. 4	272.1	32,395	—	26@45'=1170' ¹⁴⁹²	—	13	14	150	94.37	
Pier No. 5	298.0	40,335	—	28@45'=1260' ¹⁴⁶⁰	—	14	5	90	177.13	60
Pier No. 6	303.0	36,215	—	28@45'=1260' ¹⁶⁶⁹	—	14	5	300	429.75	
Pier No. 7	310.4	38,620	—	28@45'=1260' ¹⁶⁴⁷	—	14	7	500	617.64	60
Pier No. 8	336.7	48,450	—	34@45'=1530' ¹⁹³⁹	—	17	8	580	624.7	60
Pier No. 9	417.0	63,385	36@45' ²¹⁵⁴ 1620'	—	13	21	—	640	77.83	
Pier No. 10	335.3	47,840	—	34@45'=1530' ¹⁶¹⁹	—	17	10	600	660.80	14576
Sill No. 11	18.57 18.57	12,780	—	14@85'=1190' ¹³⁷³	—	7	28	60	56.18	12,600
Totals	2,999.5 2,993.6	*394,425	2154	φ 1620	φ 12-520 15,230	* 21 210 Ft.	* 133 1330 Ft.	3,360 34,151.67	Δ 13,000 16,369	205

QUANTITY NOTES.—

*REINFORCING STEEL: Includes 330 Lbs. of Structural Steel.
 φPILE NOTE: Piling to be furnished by State.— See special provisions.
 *PILE SPLICES: Approximately 147 pile splices to be measured and paid for as noted in special provisions.
 Δ UNCLASSIFIED EXCAVATION: Includes all excavation within 50'± Rt and 50'± Lt. of @ Sill No. 1 as shown on General Drawing, and such additional excavation as required for compacted embankment below berm elevation at each Sill as shown on General Drawing. Additional excavation for compacted embankment will be available from the STATE designated borrow pits within one half mile haul. All costs of water for compaction shall be absorbed in the unit price bid for Unclassified Excavation. See Special Provisions.

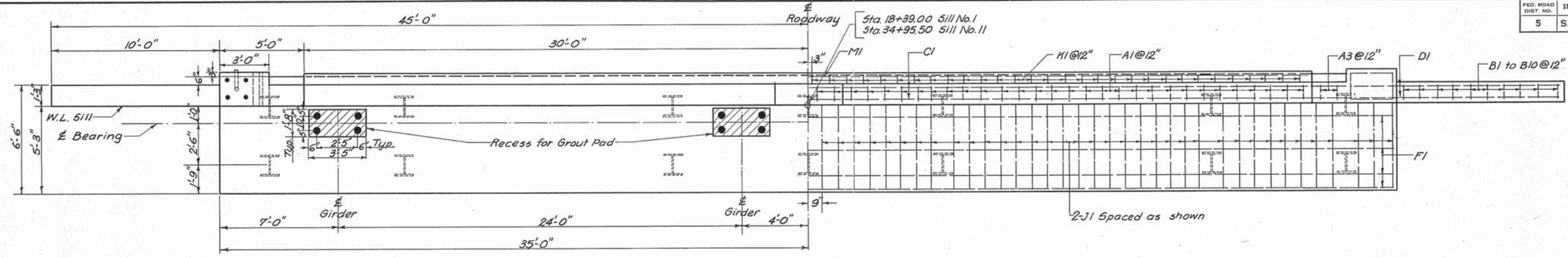
SPECIFICATION NOTE.—

Use current South Dakota Standard Specifications for Roads and Bridges
 14 BP 102 in place & splices 2364 ft
 14 BP 89 in place & splices 16,860 ft

ESTIMATED QUANTITIES
 FOR
1659'-0" BRIDGE OVER MISSOURI RIVER
 TWO 28'-0" ROADWAYS 4'-0" MEDIAN
 STA. 18+37.75 TO 34+96.75 F 030-1(2)
 ON U.S. HWYS. 14 & 83 STANLEY-HUGHES COUNTIES
 SOUTH DAKOTA H20-S16-44
 DEPARTMENT OF HIGHWAYS
 MAY 1960 (6) OF (26)

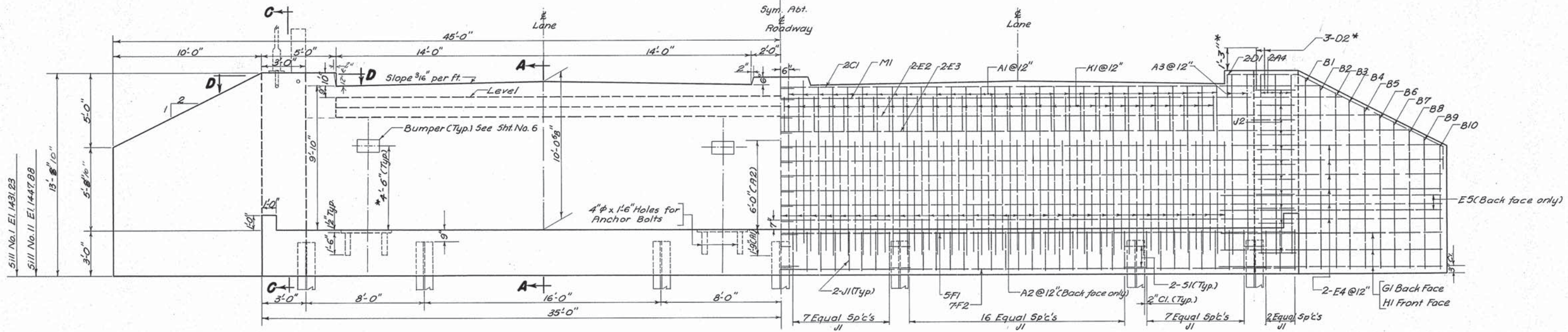
DESIGNED BY	DRAWN BY E.K. Tr. By B.G.	CHECKED BY H.C.W.	APPROVED BRIDGE ENGINEER
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FED. ROAD DIST. NO.	STATE	FISCAL YEAR	SHEET NO.	TOTAL
5	S. D.		7	26

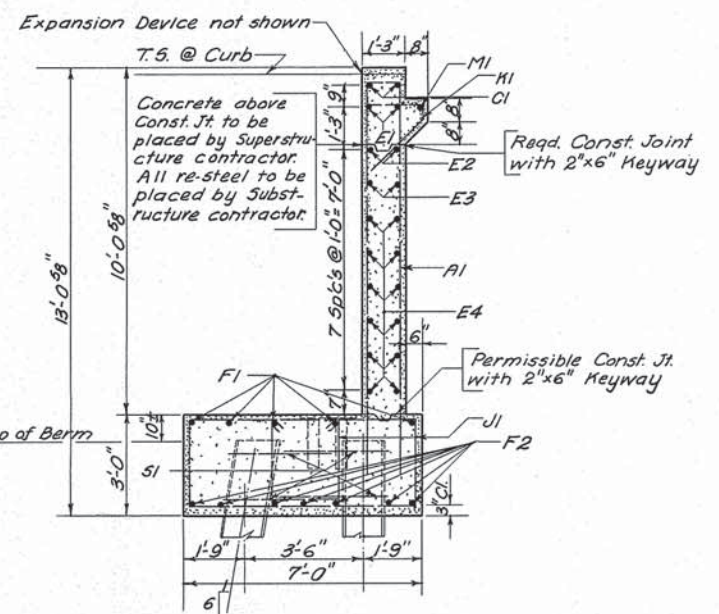


PLAN

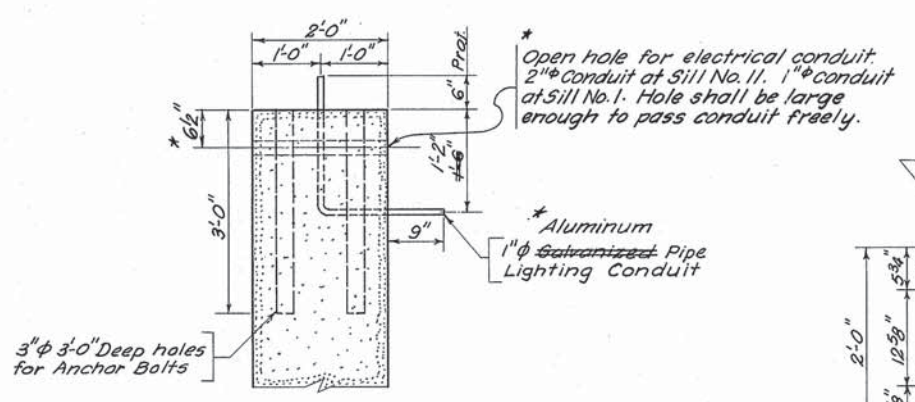
Sill No.11 as shown
Sill No.1 opp. hand



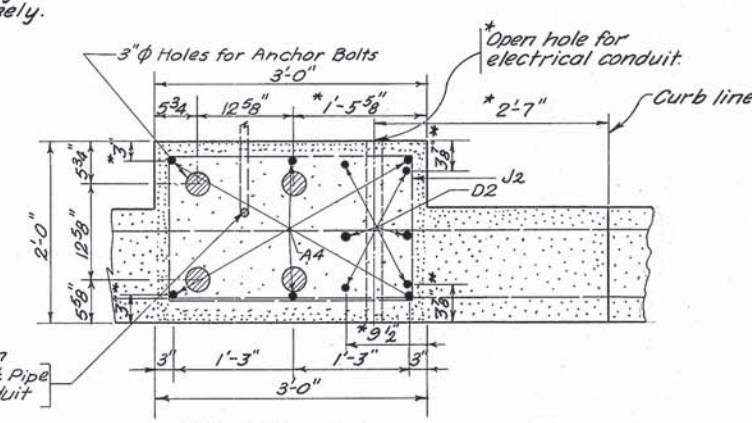
ELEVATION



SEC. A-A



SEC. C-C

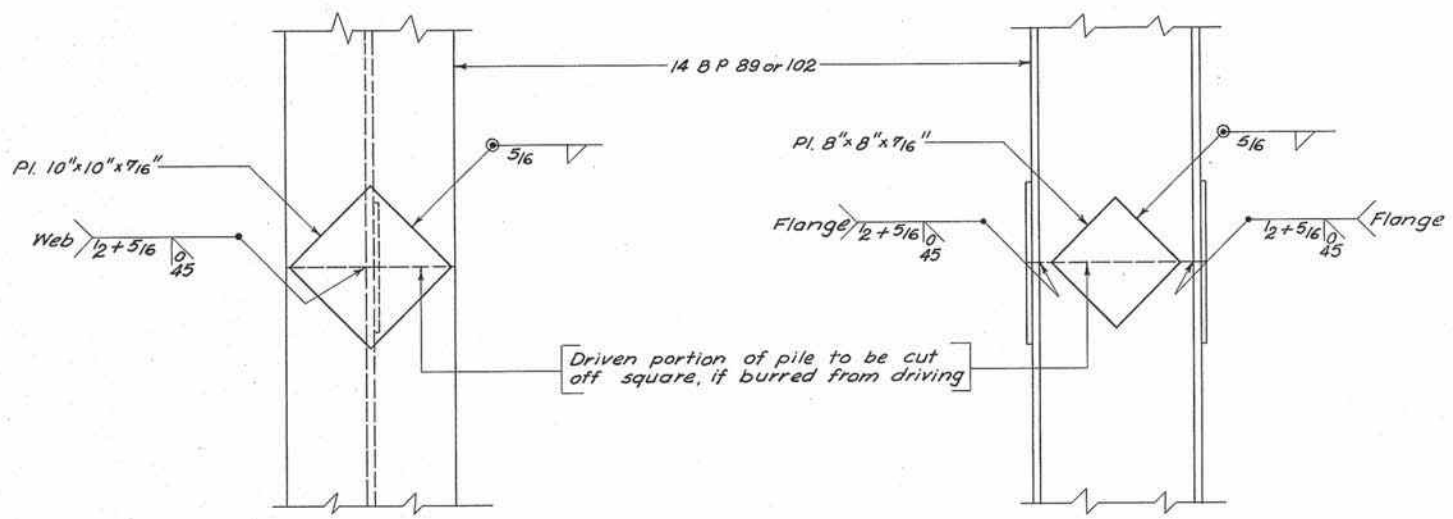


SECTION D-D

* Revision 8-12-60
* Revised 10-20-60

DETAILS OF SILLS NO.1&11
FOR
1659'-0" BRIDGE OVER MISSOURI RIVER
TWO 28'-0" ROADWAYS 4'-0" MEDIAN
STA. 18+37.75 TO 34+96.75 F 030-1(2)
ON US HWYS. 14 & 83 STANLEY-HUGHES COUNTIES
SOUTH DAKOTA H20-S16-44
DEPARTMENT OF HIGHWAYS
MAY 1960 (7) OF (26)

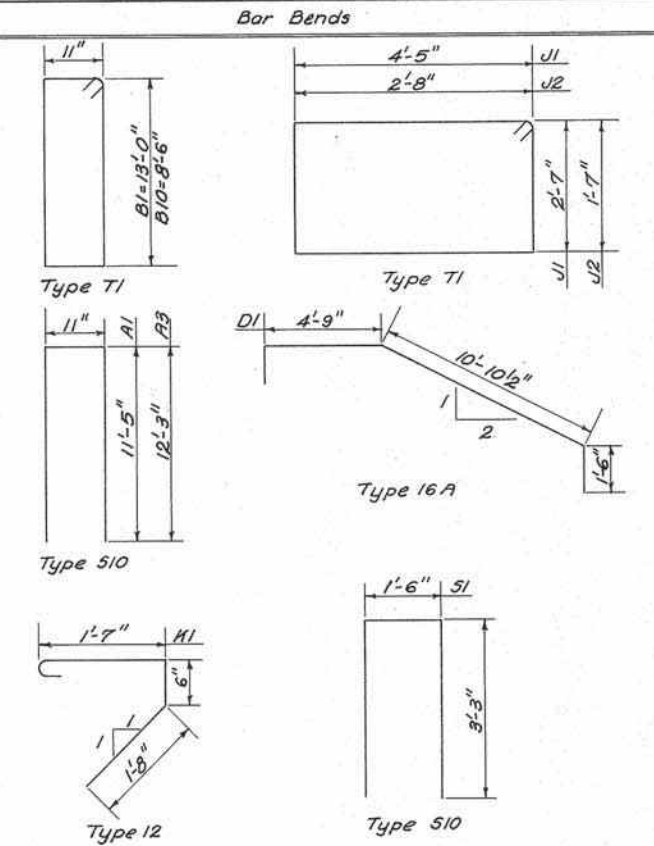
DESIGNED BY E. K. & A. C. W.	DRAWN BY MKM	CHECKED BY E. K.	APPROVED J. P. Severs BRIDGE ENGINEER
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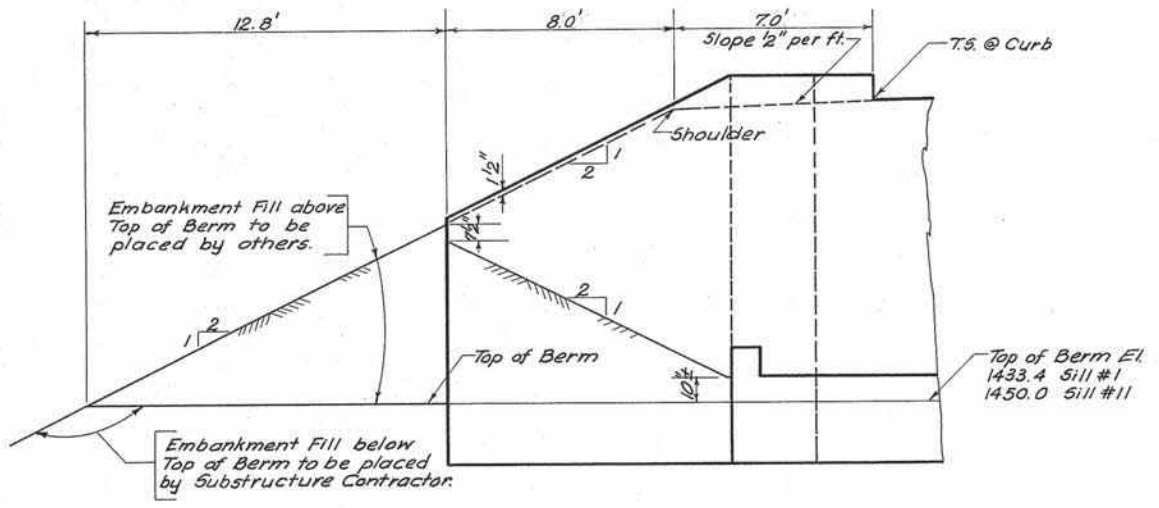
NOTE: Flame scarf lower end of upper section on the ground and weld on splice plates. Then place upper section on lower section and weld.

PILE SPLICE DETAIL

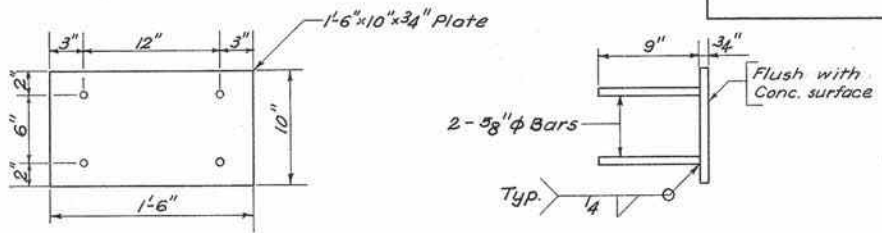
REINFORCING SCHEDULE				
MK.	No.	Size	Length	Type
A1	60	5	23'-9"	510
A2	61	5	7'-9"	Str.
A3	4	5	25'-6"	510
A4	12	6	12'-3"	Str.
B1	2	5	28'-9"	T1
B2	2		27'-9"	
B3	2		26'-9"	
B4	2		25'-9"	
B5	2		24'-9"	
B6	2		23'-9"	
B7	2		22'-9"	
B8	2		21'-9"	
B9	2		20'-9"	
B10	2		19'-9"	T1
C1	4	5	37'-9"	Str.
D1	4	6	18'-6"	16A
D2	*12	5	*2'-6"	Str.
E1	4		39'-3"	
E2	4		41'-9"	
E3	4		43'-9"	
E4	24	5	45'-6"	
E5	4	9	15'-0"	
F1	10	10	35'-9"	
F2	14	11	36'-0"	
G1	6	11	15'-0"	
H1	6	6	12'-6"	Str.
J1	144	5	15'-0"	T1
J2	22	4	9'-6"	T1
K1	60	4	4'-3"	12
M1	2	4	30'-6"	Str.
S1	28	5	8'-0"	510



All dimensions are out to out of bars.



PART ELEV. OF SILL
(Showing Earth fill)



BUMPER PLATE DETAILS

GENERAL NOTES

- All exposed edges shall be chamfered 1" except as shown.
- Use 2" clear cover on all reinforcing steel except as shown.

ITEM	UNIT	QUANTITIES	
		Sill No. 1	Sill No. 11
Class "A" Concrete	Cu. Yd.	132.2	104.2
Reinforcing Steel	Lb.	12,780	12,780
Driving Steel Brg. Piles 14BP89	Lin. Ft.	14@70=980	14@85=1190
Structure Excavation	Cu. Yd.	60.5750	60.5418
Unclass. Excavation	Cu. Yd.	400	12,600
		1793	14,574

NOTE:-
1. See Sheet No. 4 for pile splice quantities.
2. * 165 Lbs. of Structural Steel in this item.

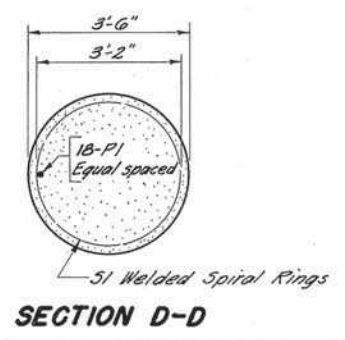
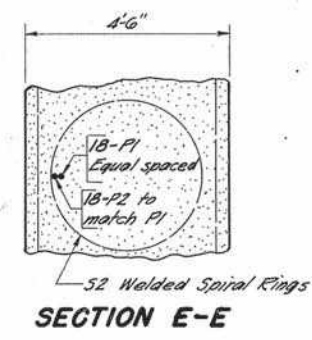
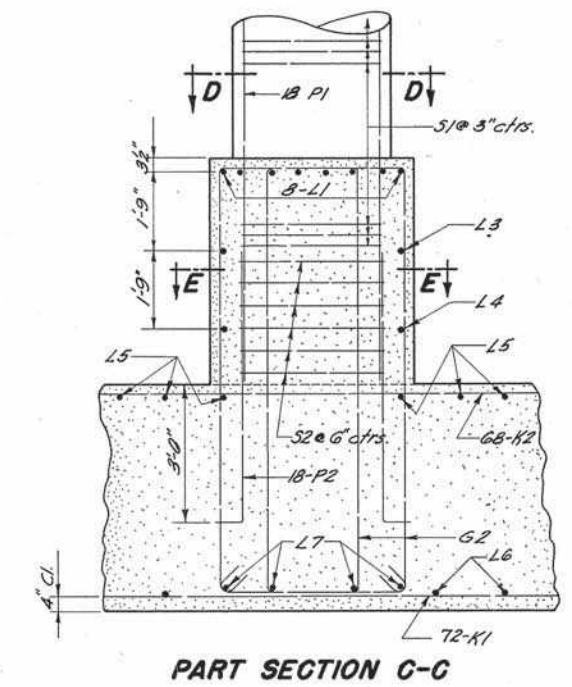
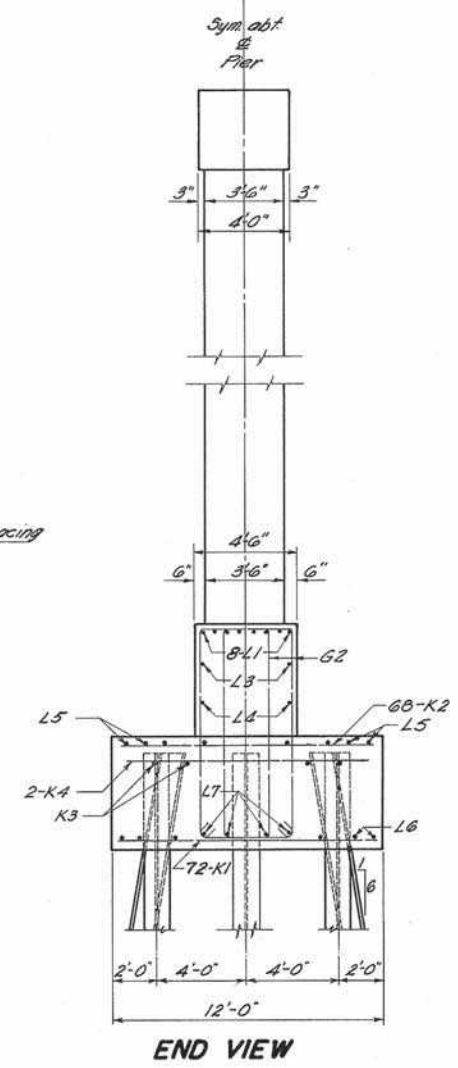
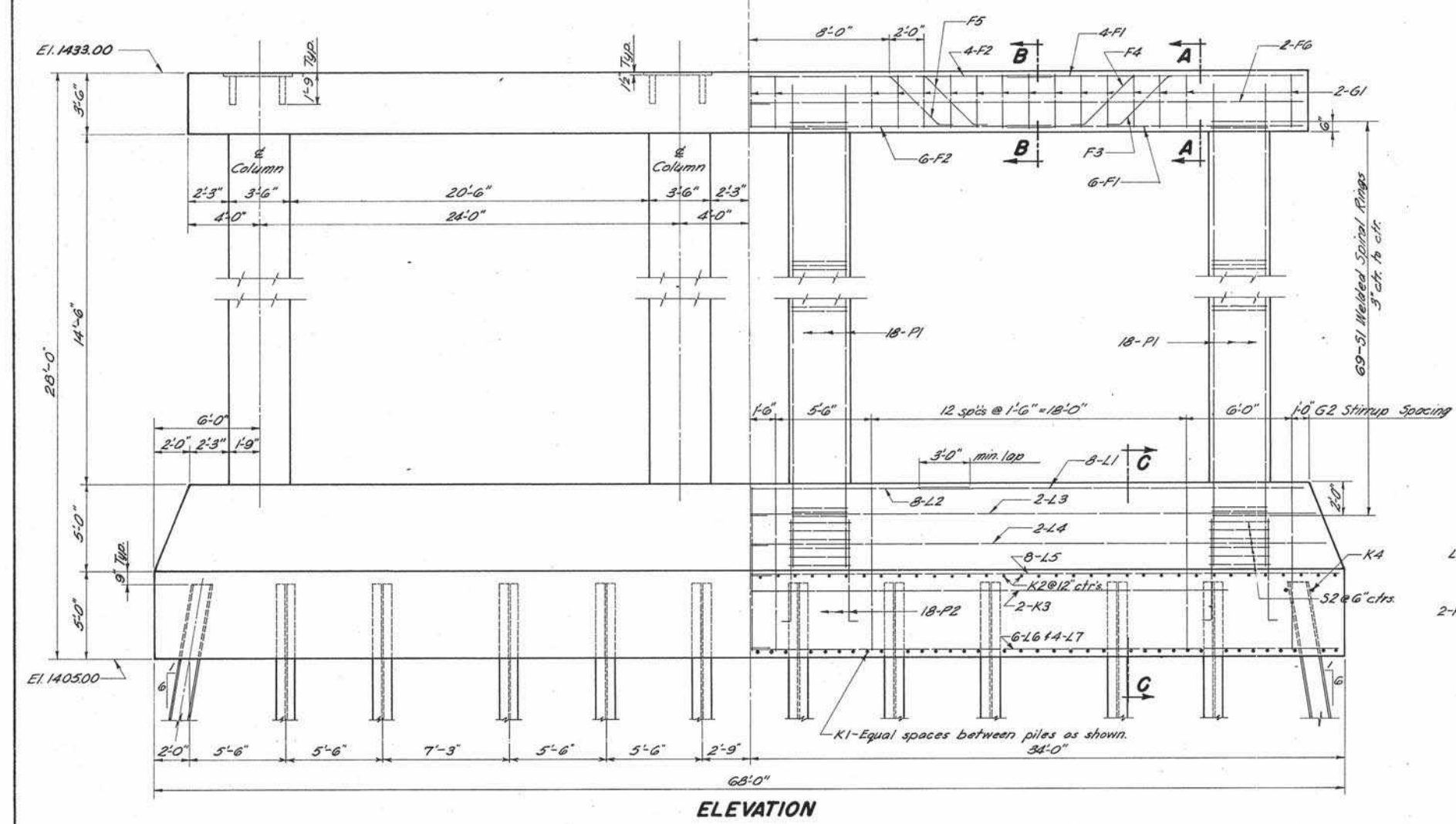
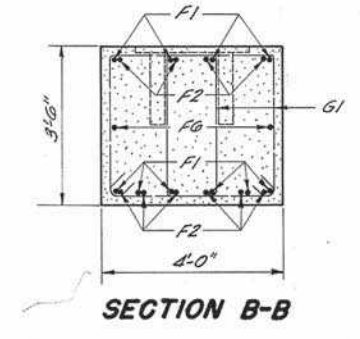
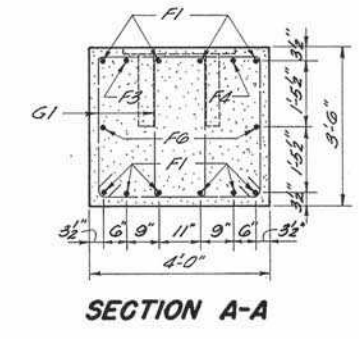
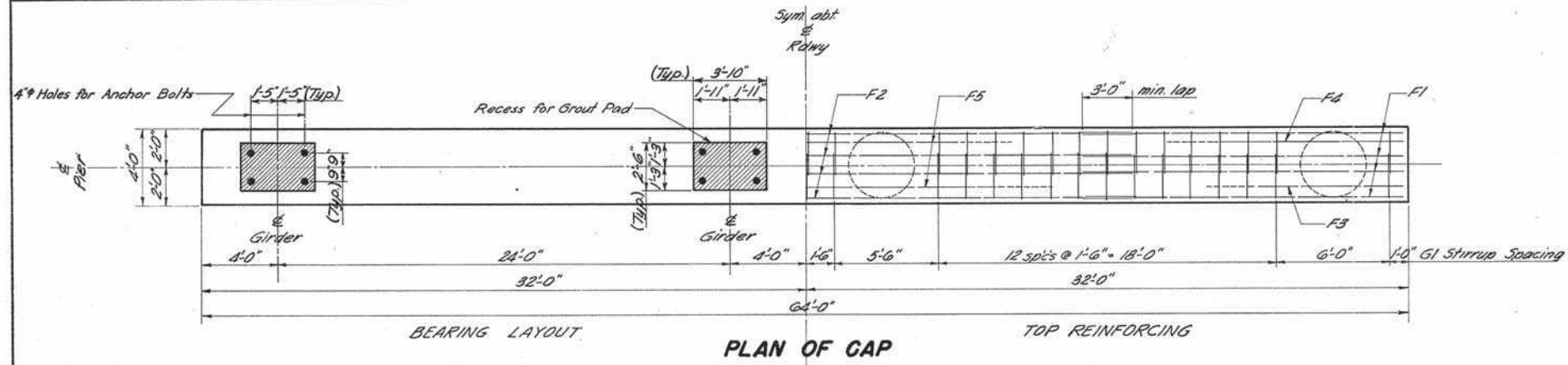
	Piling in Place	Splice	Totals
Sill No. 1	1097	230	1327
Sill No. 11	1373	280	1653

DETAILS OF SILLS NO. 1 & 11
FOR
1659'-0" BRIDGE OVER MISSOURI RIVER
TWO 28'-0" ROADWAYS 4'-0" MEDIAN
STA. 18+37.75 TO 34+96.75 F 030-1(2)
ON US HWYS. 14 & 83 STANLEY-HUGHES COUNTIES
SOUTH DAKOTA H20-S16-44

DEPARTMENT OF HIGHWAYS
MAY 1960 8 OF 26

DESIGNED BY E.K. & K.C.W.	DRAWN BY MKM	CHECKED BY E.K.	APPROVED R.R. SCHEER BRIDGE ENGINEER
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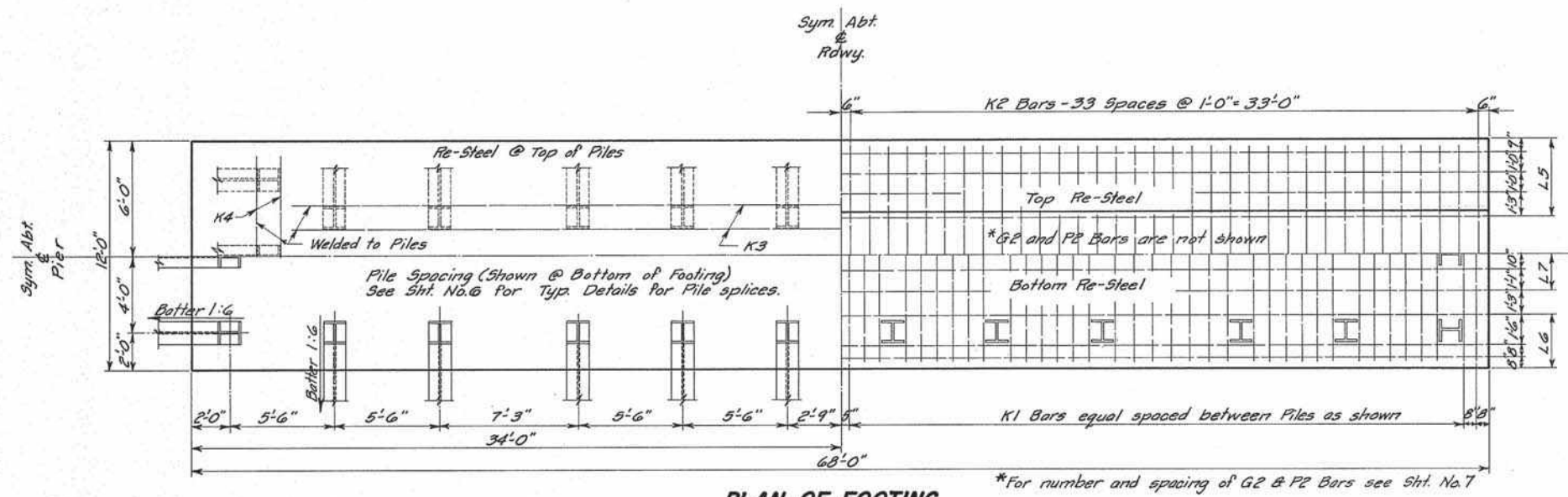
* Revision 8-12-60



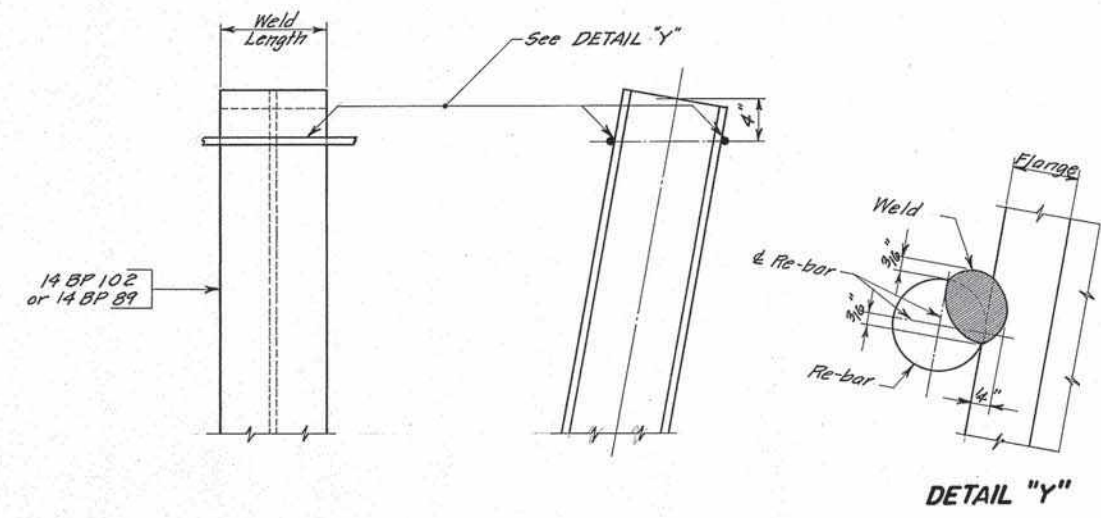
GENERAL NOTES—
 1. All edges on bent cap shall be chamfered 1".
 2. Use 2" clear cover on all reinforcing steel except as shown.

DETAILS OF PIER NO. 2
 FOR
1659'-0" BRIDGE OVER MISSOURI RIVER
 TWO 28'-0" ROADWAYS 4'-0" MEDIAN
 STA. 18+37.75 TO 34+96.75 F 030-1(2)
 ON US HWYS 14 & 83 STANLEY-HUGHES COUNTIES
 SOUTH DAKOTA H20-S16-44
 DEPARTMENT OF HIGHWAYS
 MAY 1960 9 OF 26

DESIGNED BY: E.K. & H.C.W. DRAWN BY: H.C.W. CHECKED BY: E.K. APPROVED: R.R. Seem BRIDGE ENGINEER



PLAN OF FOOTING
See det. below for typical details for welding of re-bars to piles.



DETAIL "Y"

REINFORCING SCHEDULE

Mark	No.	Size	Length	Type
<i>Cap</i>				
F1	20	11	17'-3"	Str.
F2	10	11	35'-0"	Str.
F3	2	11	12'-9"	6a
F4	2	11	14'-9"	6a
F5	2	11	28'-0"	4a
F6	4	8	32'-9"	Str.
G1	62	5	12'-3"	T1
<i>Col.</i>				
P1	72	11	22'-6"	Str.
S1	276	5	10'-3"	*Ring
<i>Wall</i>				
L1	16	11	22'-3"	Str.
L2	8	11	25'-0"	Str.
L3	4	6	33'-3"	Str.
L4	4	6	34'-0"	Str.
P2	72	11	6'-9"	20
S2	24	5	11'-0"	*Ring
<i>Footing</i>				
L5	16	5	34'-6"	Str.
L6	12	8	34'-9"	Str.
L7	8	10	35'-0"	Str.
K1	72	7	11'-6"	Str.
K2	68	6	11'-6"	Str.
K3	8	8	29'-6"	Str.
K4	4	8	11'-6"	Str.
G2	62	5	26'-0"	T1

6a

20

4a

51

52

SPIRAL RING WELDING DETAILS

* Welded Spiral Rings See Welding Details

Continuous Spirals may be substituted for the Circularly Welded Rings, at the option of the contractor. Payment will be based on Circular Ring weight. Use 4 Vertical Spacer Bars for all Columns. Weight of spacer bars included in Re-Steel Estimate.

All dimensions are out to out of bars.

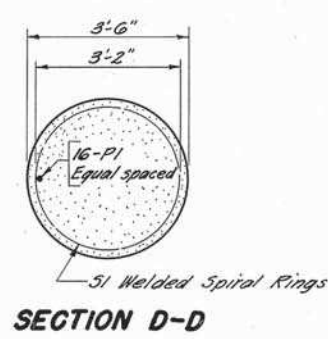
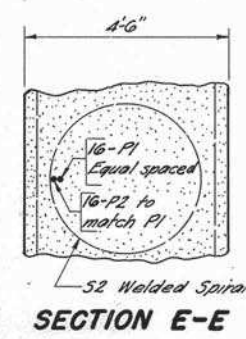
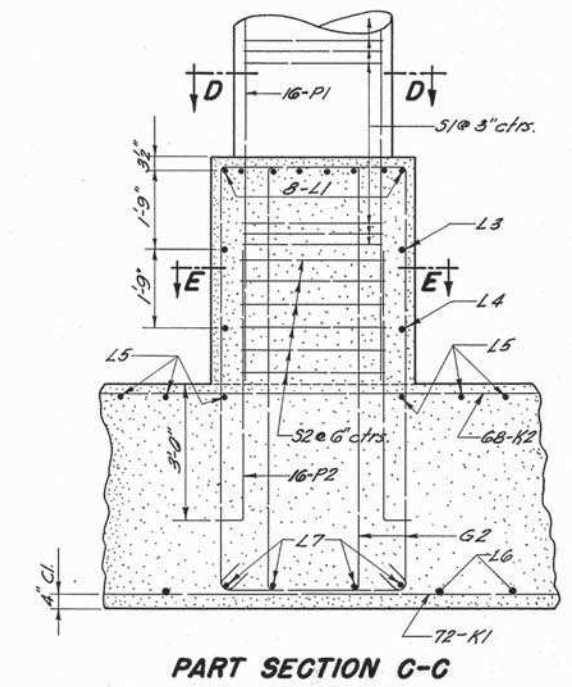
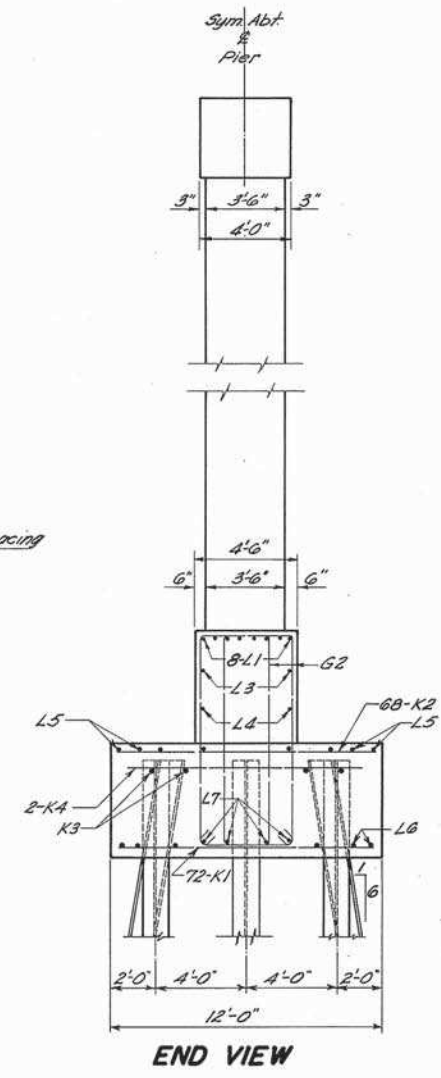
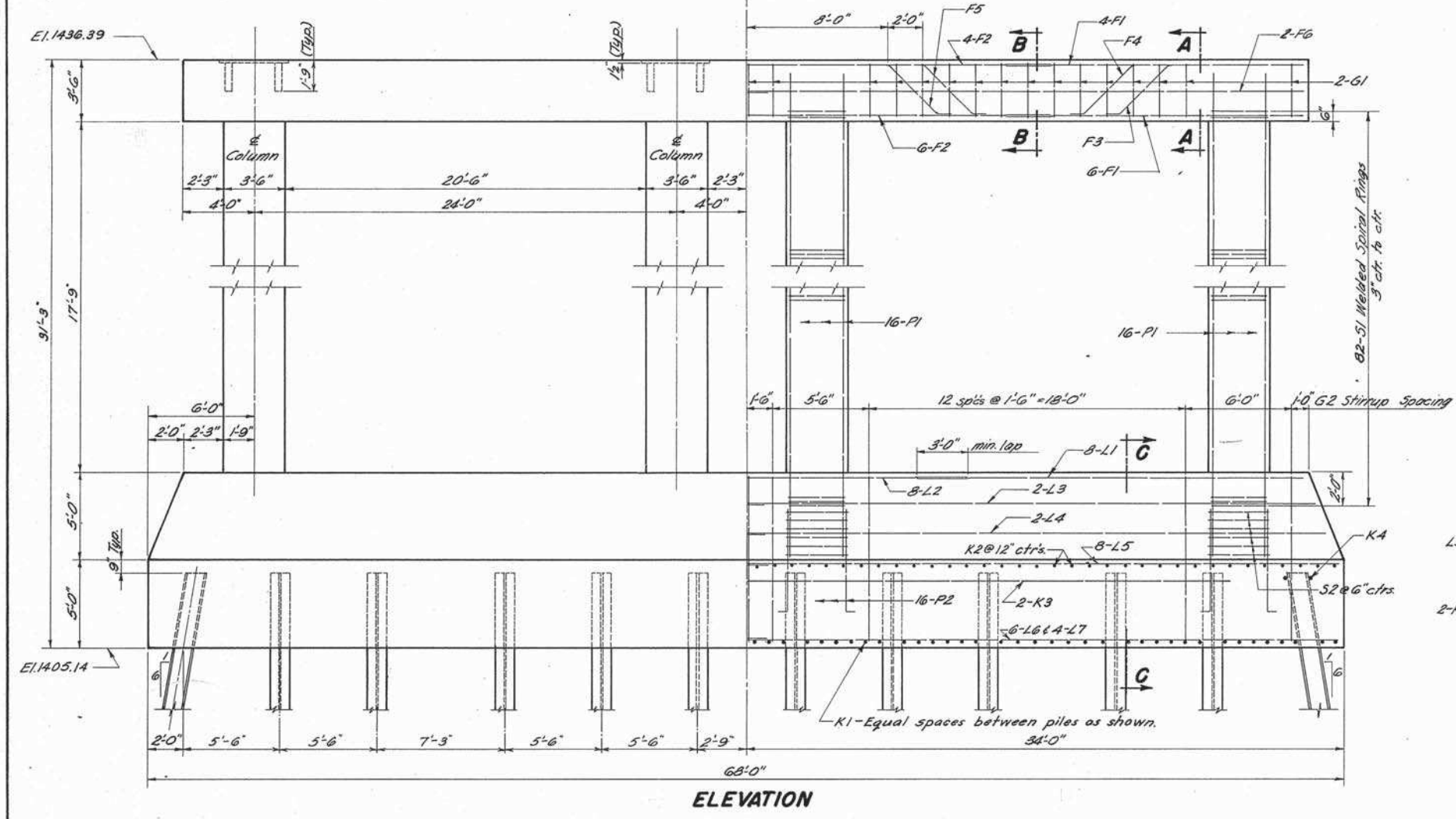
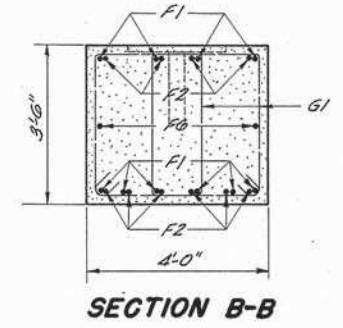
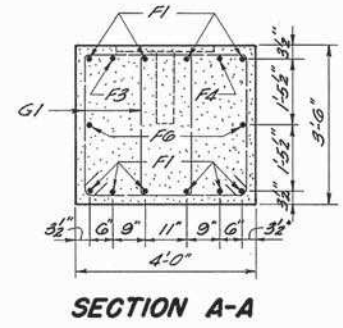
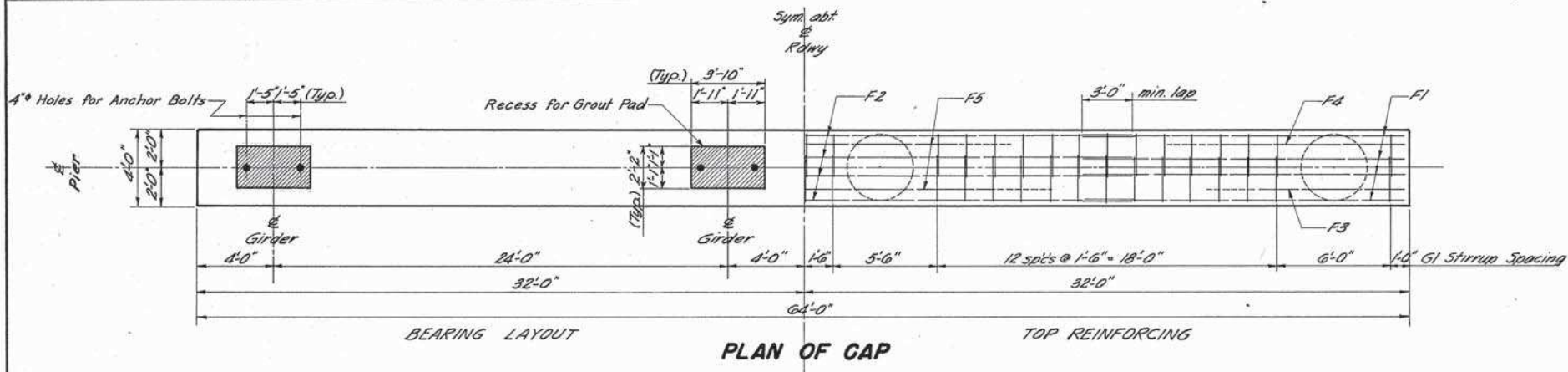
ESTIMATED QUANTITIES		
ITEM	UNIT	QUANTITIES
Class "A" Concrete	Cu. Yds.	260.0
Reinforcing Steel	Lbs.	31,635
Driving Steel Bearing Piles 14BP89	Lin. Ft. x 26 @ 45' = H70 1636	
Structure Excavation	Cu. Yds.	200

NOTE: See Sht. No. 4 for pile splice quantities. * Includes Splices

	Piling	Splice	Total
Pier No 2	1556	80	1636

FOOTING DETAILS OF PIER NO. 2
FOR
1659'-0" BRIDGE OVER MISSOURI RIVER
TWO 28'-0" ROADWAYS 4'-0" MEDIAN
STA. 18+37.75 TO 34+96.75 F 030-102
ON U.S. HWYS. 14 & 83 STANLEY-HUGHES COUNTIES
SOUTH DAKOTA H20-S16-44
DEPARTMENT OF HIGHWAYS
MAY 1960 (10) OF (26)

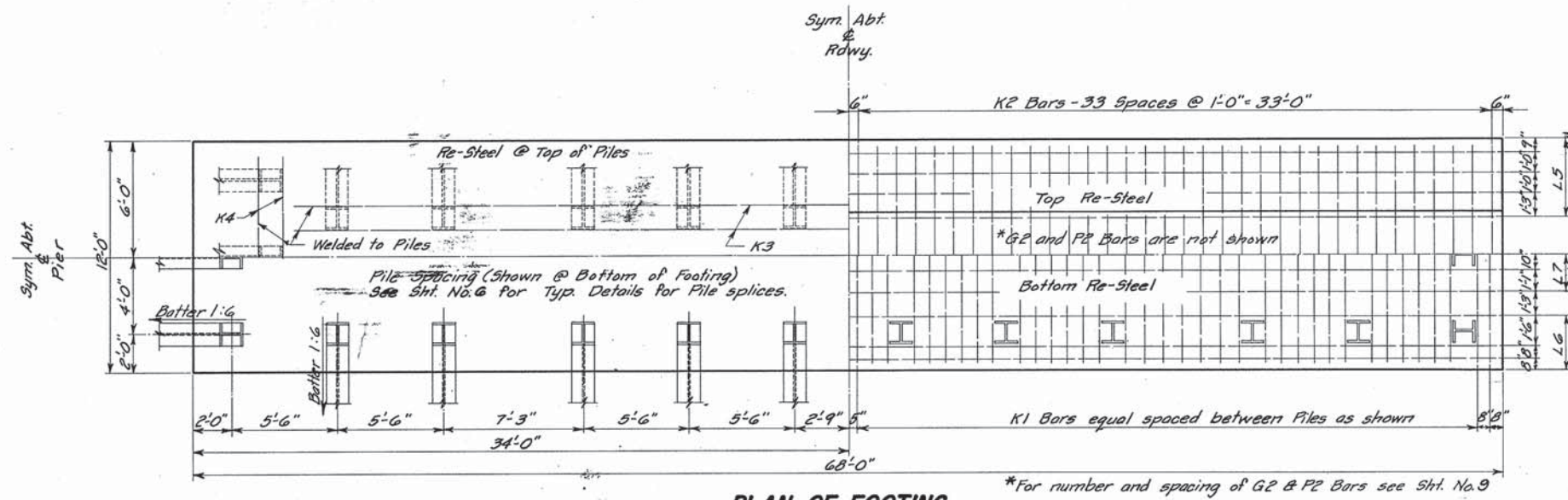
DESIGNED BY E.K.	DRAWN BY D.G.	CHECKED BY K.C.W.	APPROVED A. R. Deussen BRIDGE ENGINEER
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GENERAL NOTES—
 1. All edges on bent cap shall be chamfered 1".
 2. Use 2" clear cover on all reinforcing steel except as shown.

DETAILS OF PIER NO. 3
 FOR
1659'-0" BRIDGE OVER MISSOURI RIVER
 TWO 28'-0" ROADWAYS 4'-0" MEDIAN
 STA. 18+37.75 TO 34+96.75 F 030-11(2)
 ON US HWYS 14 & 83 STANLEY-HUGHES COUNTIES
 SOUTH DAKOTA H20-S16-44
 DEPARTMENT OF HIGHWAYS
 MAY 1960 (11) OF (26)

DESIGNED BY E.K. & K.C.W.	DRAWN BY A.C.W.	CHECKED BY E.K.	APPROVED [Signature] BRIDGE ENGINEER
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PLAN OF FOOTING
See Sht. No. 8 for typical details for welding of re-bars to piles.

REINFORCING SCHEDULE					
Mark	No.	Size	Length	Type	
Cap	F1	20	17'-3"	Str.	
	F2	10	35'-0"	Str.	
	F3	2	12'-9"	6a	
	F4	2	14'-9"	6a	
	F5	2	11	28'-0"	4a
	F6	4	8	32'-9"	Str.
Col.	P1	64	10	25'-0"	Str.
	S1	32B	5	10'-3"	*Ring
Wall	L1	16	11	22'-3"	Str.
	L2	8	11	25'-0"	
	L3	4	6	33'-3"	
	L4	4	6	34'-0"	Str.
	P2	64	10	6'-9"	20
	S2	24	5	11'-0"	*Ring
Footing	L5	16	5	34'-6"	Str.
	L6	12	8	34'-9"	
	L7	8	10	35'-0"	
	K1	72	7	11'-6"	
	K2	68	6	11'-6"	
	K3	8	8	29'-6"	
K4	4	8	14'-6"	Str.	
G2	62	5	26'-0"	TI	

*** Welded Spiral Rings**
See Welding Details

Continuous Spirals may be substituted for the Circularly Welded Rings, at the option of the contractor. Payment will be based on Circular Ring weight. Use 4 Vertical Spacer Bars for all Columns. Weight of Spacer Bars included in Re-Steel Estimate.

SPIRAL RING WELDING DETAILS
SEC. A-A

All dimensions are out to out of bars.

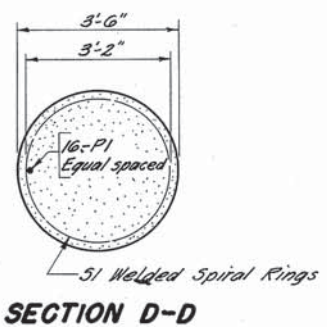
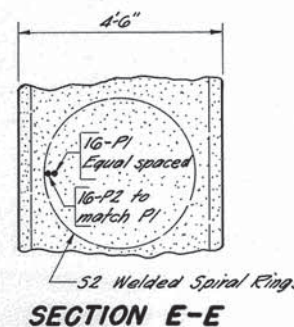
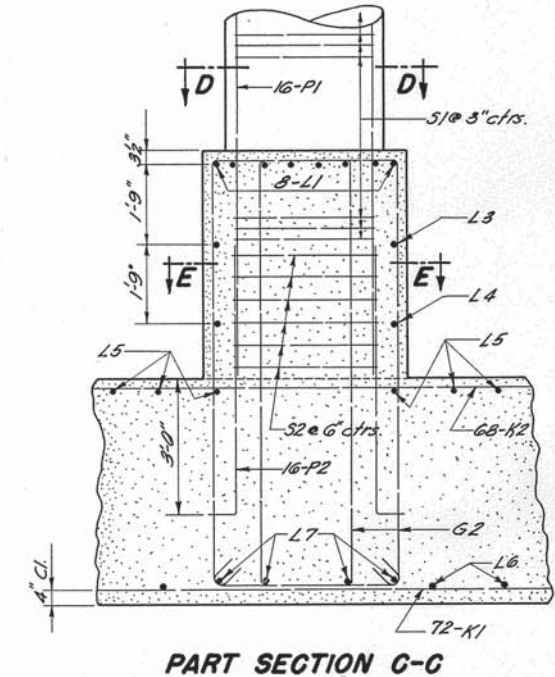
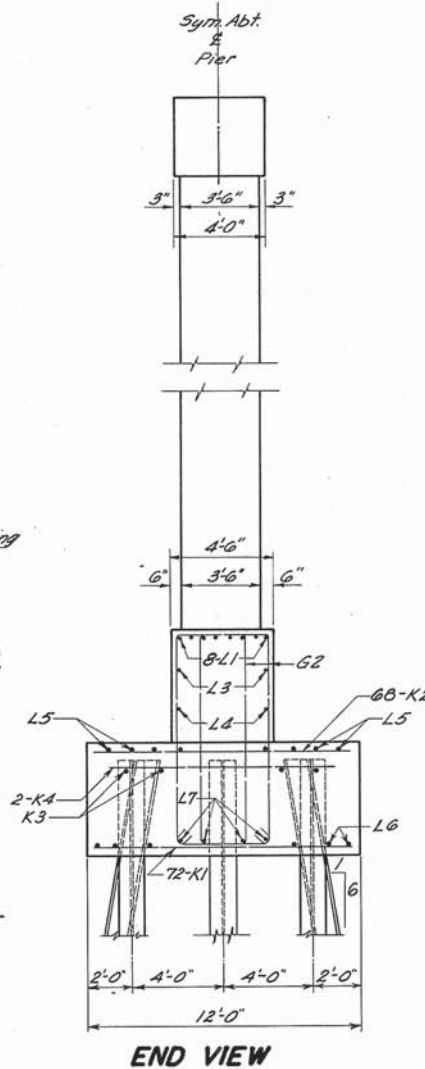
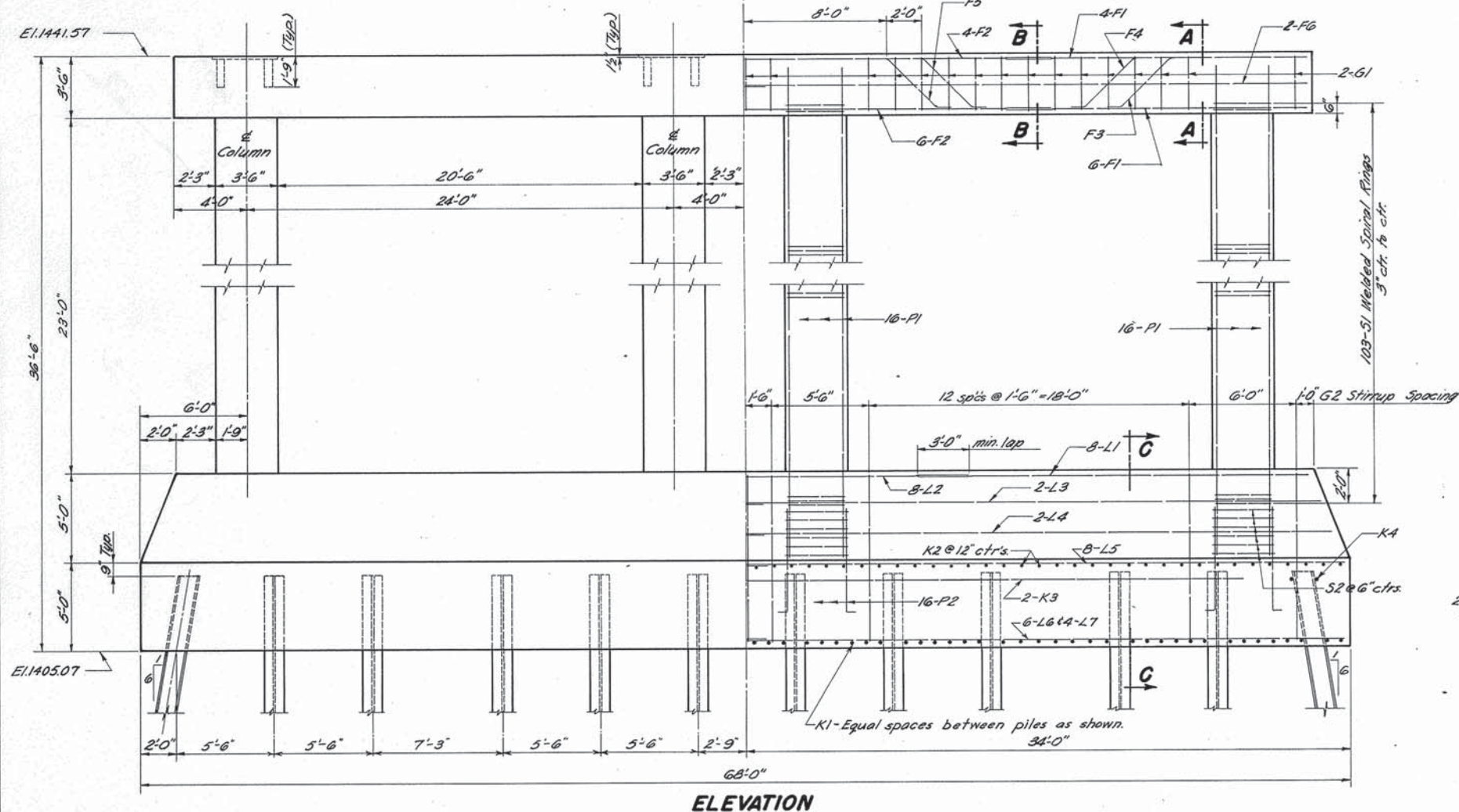
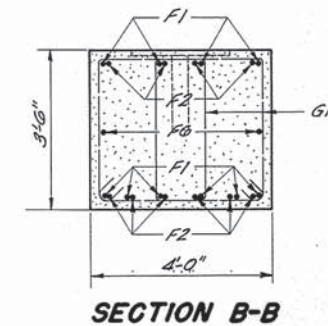
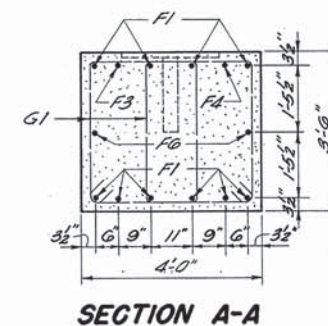
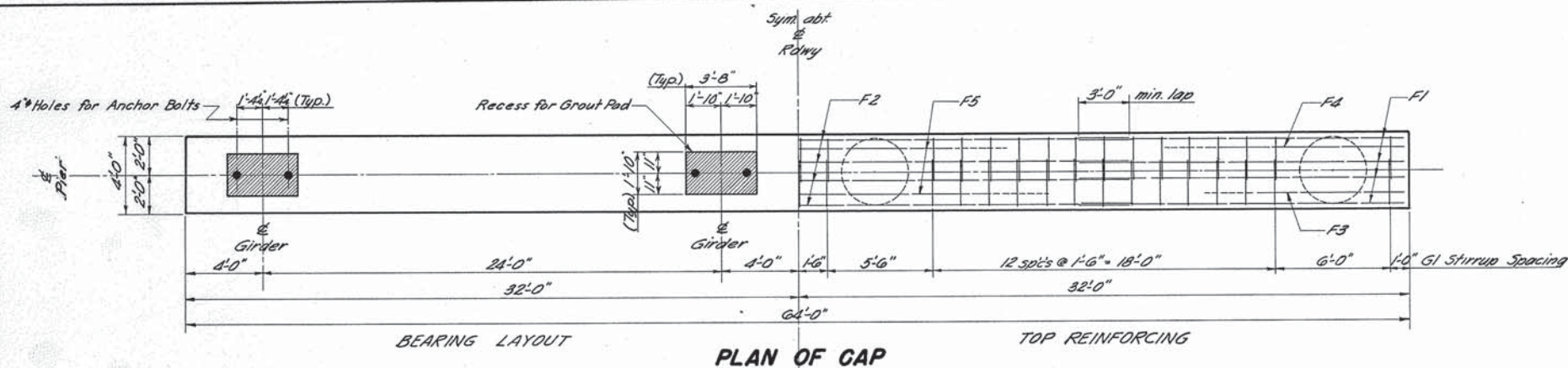
ESTIMATED QUANTITIES		
ITEM	UNIT	QUANTITIES
Class "A" Concrete	Cu. Yds.	264.6
Reinforcing Steel	Lbs.	29,990
Driving Steel Bearing Piles 14BP89	Lin. Ft.	26 @ 45' = 1170
Structure Excavation	Cu. Yds.	200 11.98

NOTE: See Sht. No. 4 for pile splice quantities.

	Piling	Splice	Total
Pier No 3	1478	250	1728

FOOTING DETAILS OF PIER NO. 3
FOR
1659'-0" BRIDGE OVER MISSOURI RIVER.
TWO 28'-0" ROADWAYS 4'-0" MEDIAN
STA. 18+37.75 TO 34+96.75 F 030-(12)
ON U.S. HWYS. 14 & 83 STANLEY-HUGHES COUNTIES
SOUTH DAKOTA H20-S16-44
DEPARTMENT OF HIGHWAYS
MAY 1960 12 OF 26

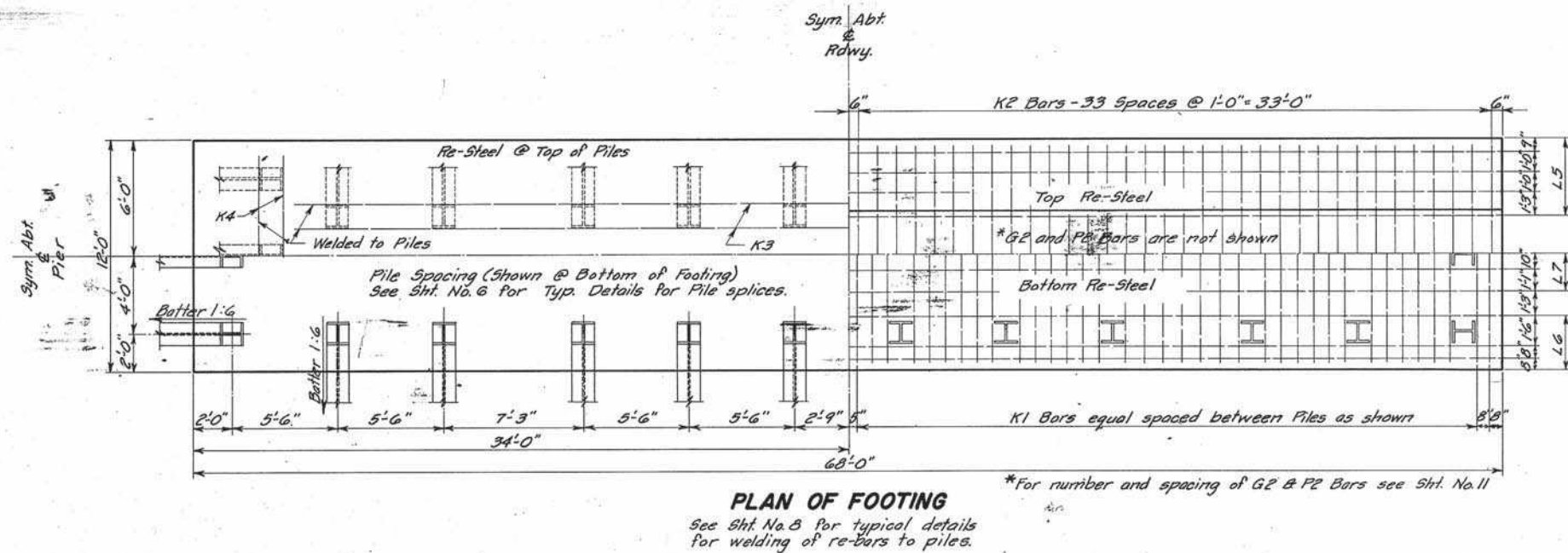
DESIGNED BY E.K. & K.C.W.
DRAWN BY D.C.
CHECKED BY H.C.W.
APPROVED [Signature] BRIDGE ENGINEER



GENERAL NOTES—
 1. All edges on bent cap shall be chamfered 1".
 2. Use 2" clear cover on all reinforcing steel except as shown.

DETAILS OF PIER NO. 4
 FOR
1659'-0" BRIDGE OVER MISSOURI RIVER
 TWO 28'-0" ROADWAYS 4'-0" MEDIAN
 STA. 18+37.75 TO 34+96.75 F 030-(12)
 ON US HWYS 14 & 83 STANLEY-HUGHES COUNTIES
 SOUTH DAKOTA H20-S16-44
 DEPARTMENT OF HIGHWAYS
 MAY 1960 13 OF 26

DESIGNED BY E.K. & K.C.W. DRAWN BY H.C.W. CHECKED BY P.K. APPROVED *[Signature]* BRIDGE ENGINEER



REINFORCING SCHEDULE				
Mark	No.	Size	Length	Type
Cap				
F1	20	11	17'-3"	Str.
F2	10		35'-0"	Str.
F3	2		12'-9"	6a
F4	2		14'-9"	6a
F5	2	11	28'-0"	4a
F6	4	8	32'-9"	Str.
G1	62	5	12'-3"	T1
Col.				
P1	64	10	31'-0"	Str.
S1	412	5	10'-3"	*Ring
Wall				
L1	16	11	22'-3"	Str.
L2	8	11	25'-0"	
L3	4	6	33'-3"	
L4	4	6	34'-0"	Str.
P2	64	10	6'-9"	20
S2	24	5	11'-0"	*Ring
Footing				
L5	16	5	34'-6"	Str.
L6	12	8	34'-9"	
L7	8	10	35'-0"	
K1	72	7	11'-6"	
K2	68	6	11'-6"	
K3	8	8	29'-6"	
K4	4	8	11'-6"	Str.
G2	62	5	26'-0"	T1

Bar Bends

* Welded Spiral Rings
See Welding Details

Continuous Spirals may be substituted for the Circularly Welded Rings, at the option of the contractor. Payment will be based on Circular Ring weight.
Use 4 Vertical Spacer Bars for all Columns. Weight of Spacer Bars included in Re-Steel Estimate.

SPIRAL RING WELDING DETAILS

SEC. A-A
3/8" Min. Fillets
2" Long

All dimensions are out to out of bars.

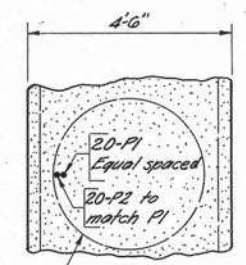
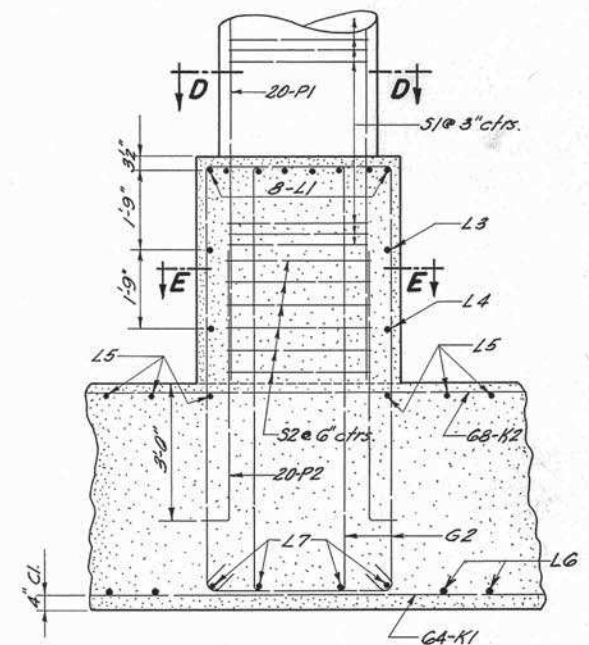
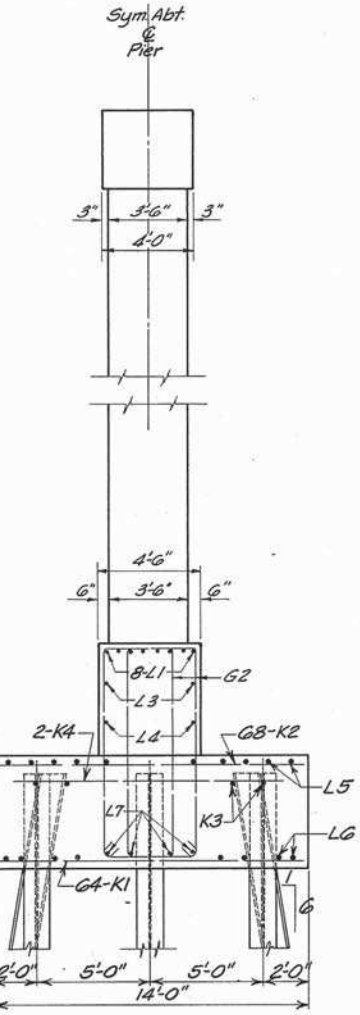
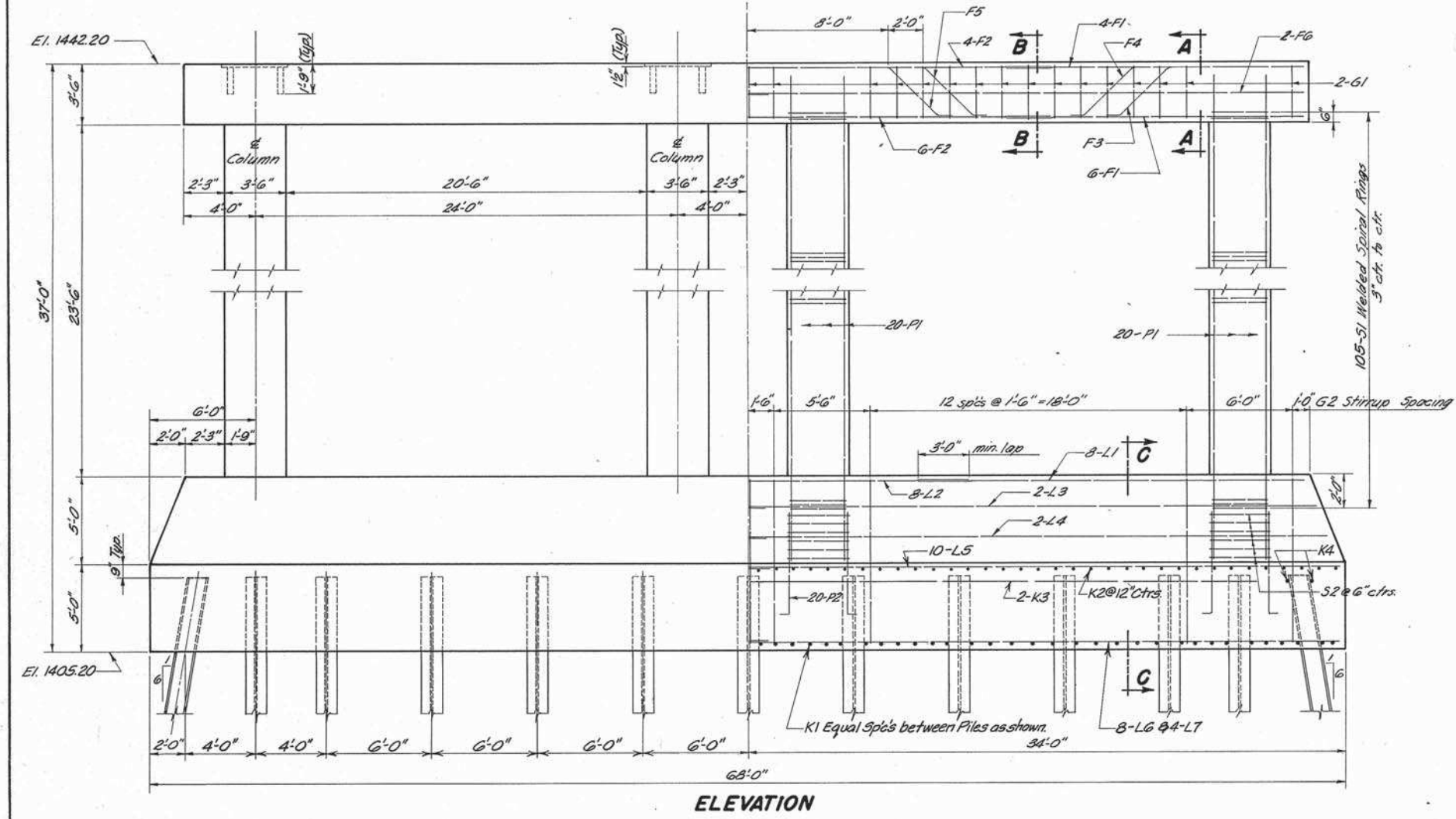
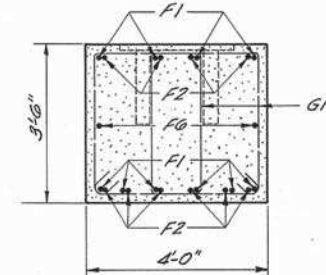
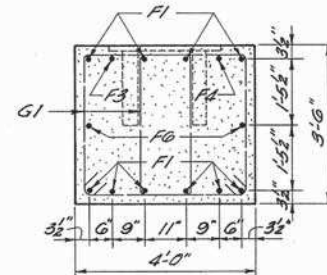
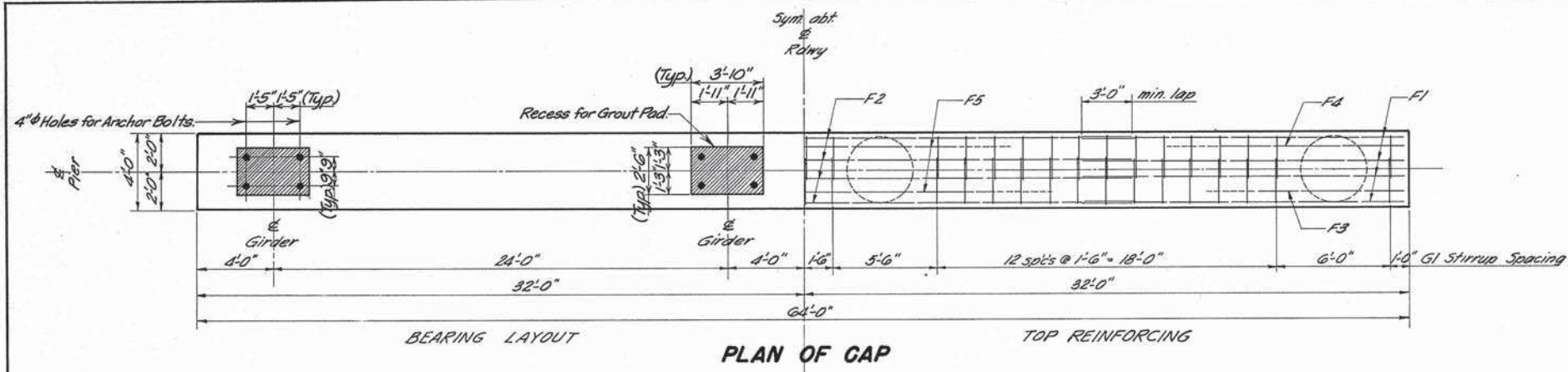
ESTIMATED QUANTITIES		
ITEM	UNIT	QUANTITIES
Class "A" Concrete	Cu. Yds.	272.1
Reinforcing Steel	Lbs.	32,396
Driving Steel Bearing Piles 14BPB9	Lin. Ft.	26 @ 45' = 1170
Structure Excavation	Cu. Yds.	150 94.37

NOTE: See Sht. No. 4 for pile splice quantities.

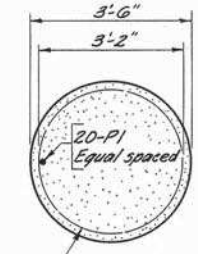
	Piling	Splice	Total
Pier No. 4	1492	140	1632

FOOTING DETAILS OF PIER NO. 4
FOR
1659'-0" BRIDGE OVER MISSOURI RIVER
TWO 28'-0" ROADWAYS 4'-0" MEDIAN
STA. 18+37.75 TO 34+96.75 F 030-(12)
ON U.S. HWYS. 14 & 83 STANLEY-HUGHES COUNTIES
SOUTH DAKOTA H20-S16-44
DEPARTMENT OF HIGHWAYS
MAY 1960 14 OF 26

DESIGNED BY R. K. DRAWN BY A.C.W. CHECKED BY H.C.W. APPROVED [Signature] BRIDGE ENGINEER



SECTION E-E



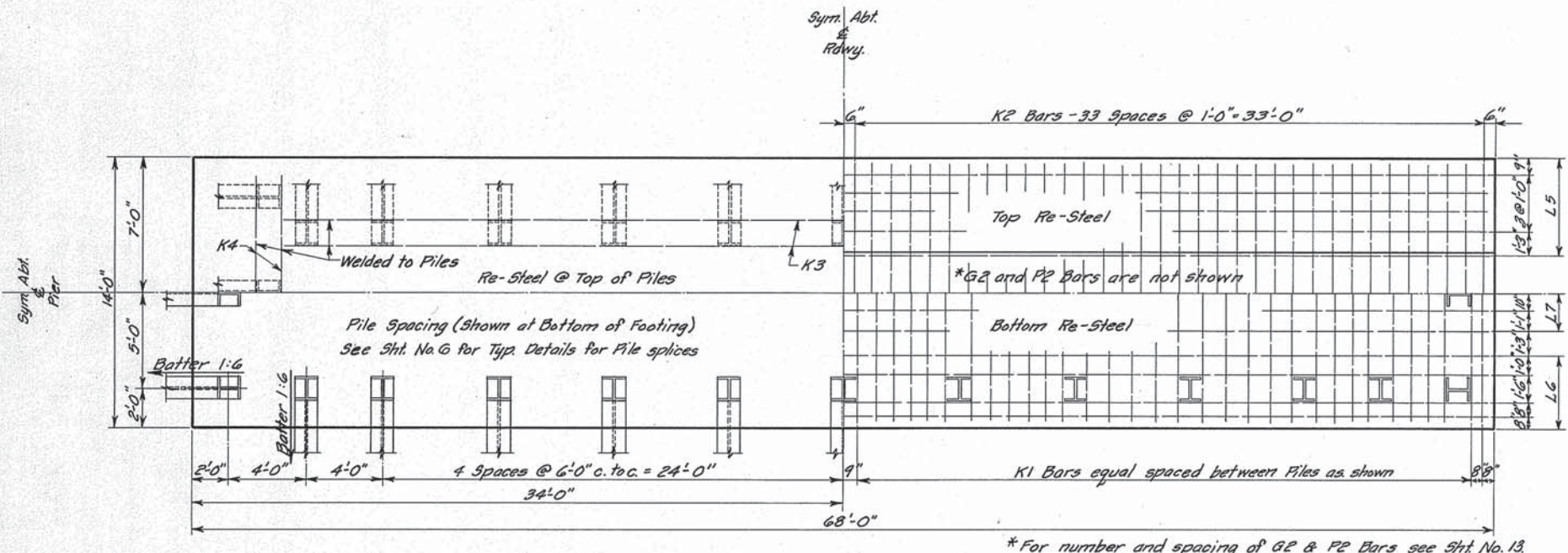
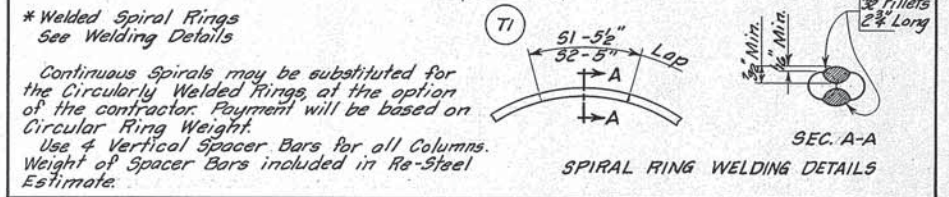
SECTION D-D

GENERAL NOTES—
 1. All edges on bent cap shall be chamfered 1".
 2. Use 2" clear cover on all reinforcing steel except as shown.

DETAILS OF PIER NO.5
 FOR
1659'-0" BRIDGE OVER MISSOURI RIVER
 TWO 28'-0" ROADWAYS 4'-0" MEDIAN
 STA. 18+37.75 TO 34+96.75 F 030-(12)
 ON US HWYS 14 & 83 STANLEY-HUGHES COUNTIES
 SOUTH DAKOTA H20-S16-44
 DEPARTMENT OF HIGHWAYS
 MAY 1960 (15) OF (26)

DESIGNED BY E.K. & K.C.W.	DRAWN BY K.C.W.	CHECKED BY E.K.	APPROVED R. Deurs BRIDGE ENGINEER
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REINFORCING SCHEDULE				
Bar Bands				
All dimensions are out to out of bars.				
Cap	Mark	No.	Size	Type
	F1	20	11	17'-3" Str.
	F2	10	11	35'-0" Str.
	F3	2	11	12'-9" 6a
	F4	2	11	14'-9" 6a
	F5	2	11	28'-0" 4a
Col.	P1	80	11	31'-6" Str.
	S1	420	5	10'-3" Ring
Wall	L1	16	11	22'-3" Str.
	L2	8	11	25'-0" Str.
	L3	4	6	33'-3" Str.
	L4	4	6	34'-0" Str.
	P2	80	11	6'-9" 20
	S2	24	5	11'-0" Ring
Footing	L5	20	5	34'-6" Str.
	L6	16	8	34'-9" Str.
	L7	8	10	35'-0" Str.
	K1	67	9	13'-6" Str.
	K2	68	6	13'-6" Str.
	K3	4	8	29'-6" Str.
	K4	4	8	13'-6" Str.
	G2	62	5	26'-0" T1



PLAN OF FOOTING
See Sht. No. 8 for typical details for welding of re-bars to piles.

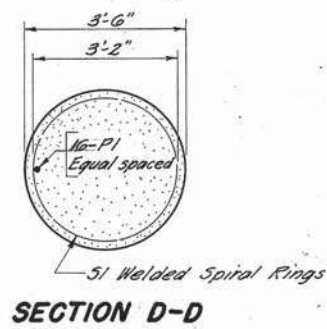
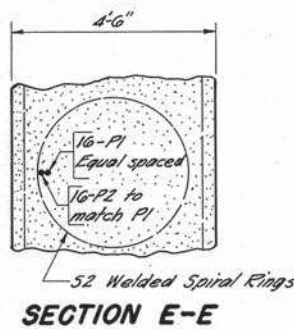
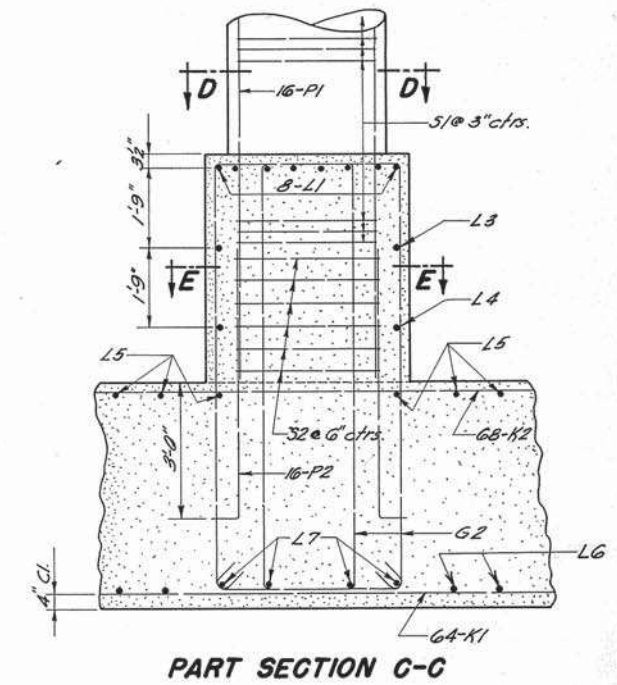
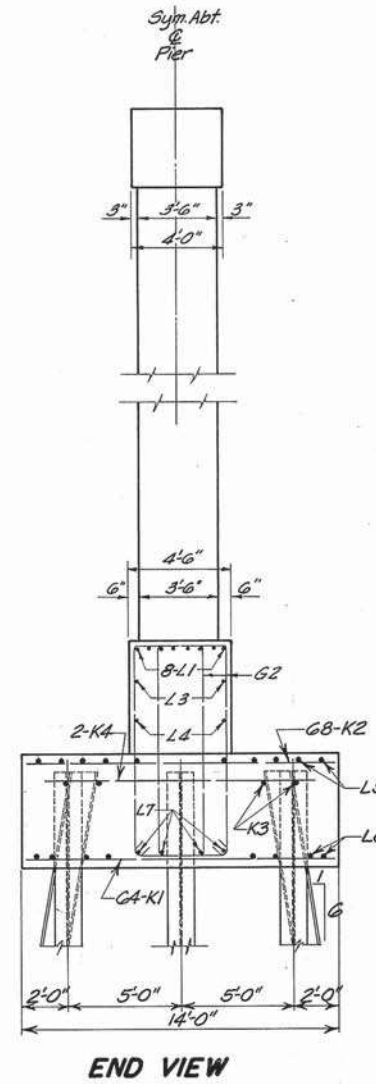
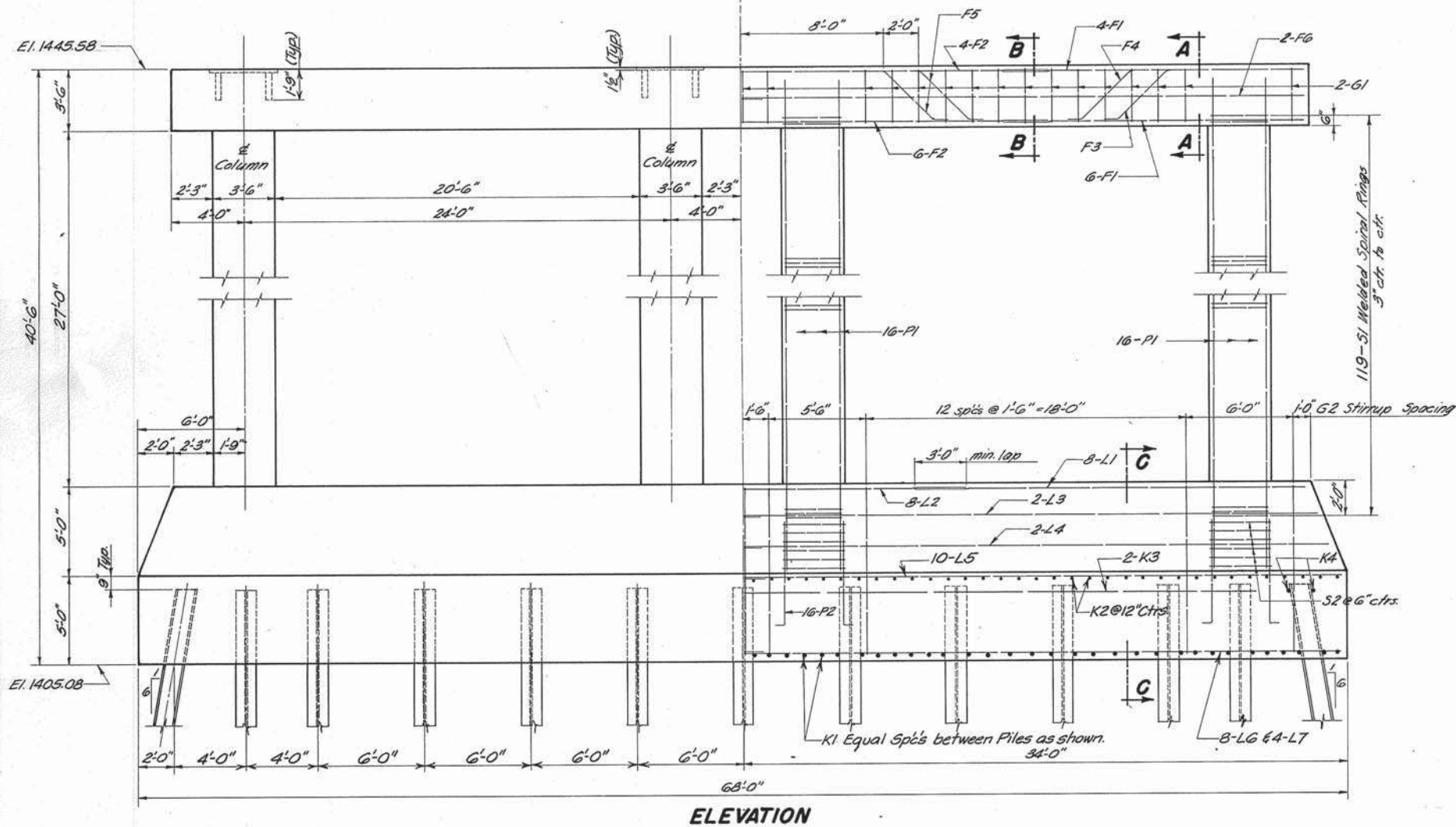
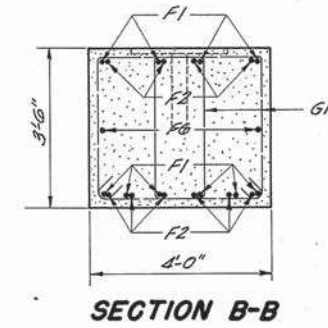
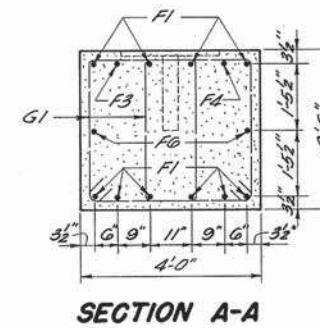
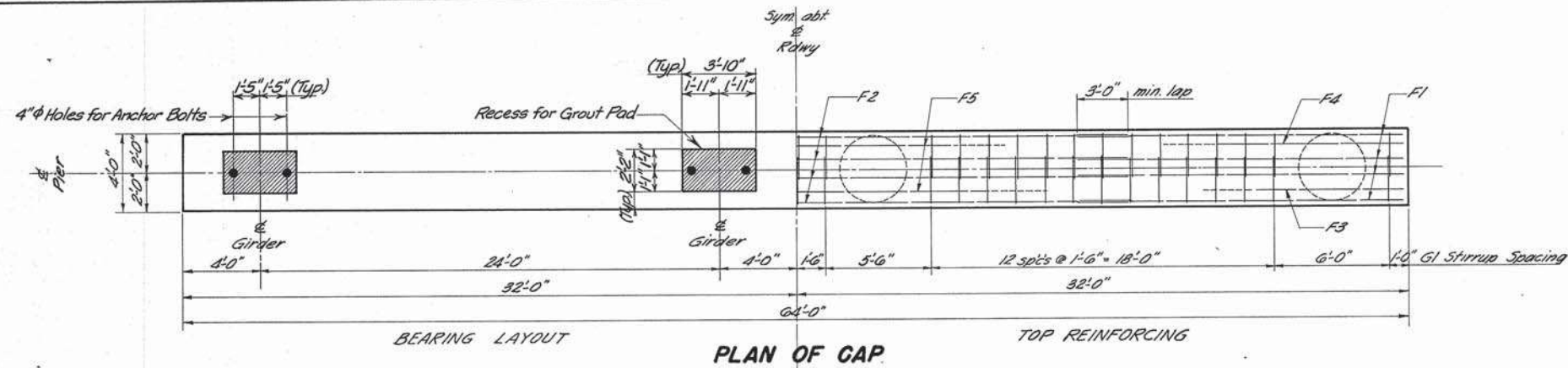
ESTIMATED QUANTITIES		
ITEM	UNIT	QUANTITIES
Class "A" Concrete	Cu. Yds.	298.0
Reinforcing Steel	Lbs.	40,335
Driving Steel Bearing Piles 14BP89	Lin. Ft.	28 @ 55 = 1540
Structure Excavation	Cu. Yds.	40 177.13

NOTE: See Sht. No. 4 for pile splice quantities.

	Piling	Splice	Total
Pier No 5	1660	50	1710

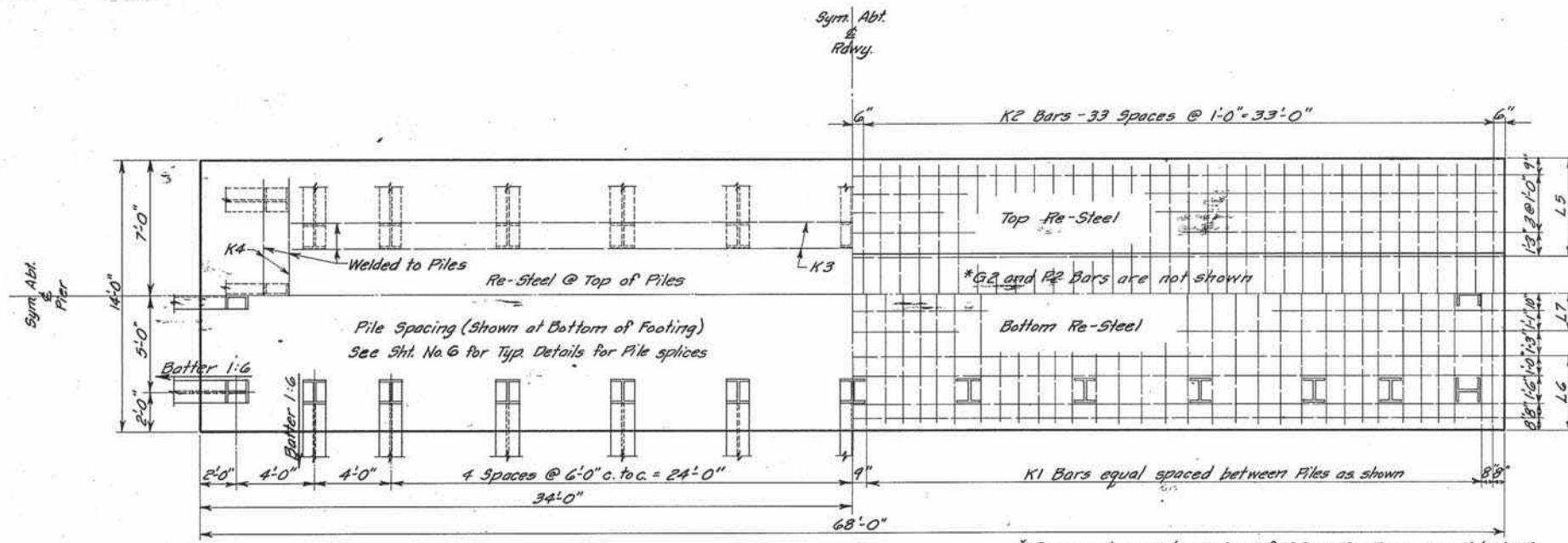
FOOTING DETAILS OF PIER NO. 5
FOR
1659'-0" BRIDGE OVER MISSOURI RIVER
TWO 28'-0" ROADWAYS 4'-0" MEDIAN
STA. 18+37.75 TO 34+96.75 F 030-1(2)
ON U.S. HWYS. 14 & 83 STANLEY-HUGHES COUNTIES
SOUTH DAKOTA H20-S16-44
DEPARTMENT OF HIGHWAYS
MAY 1960 16 OF 26

DESIGNED BY E. K.	DRAWN BY E. K.	CHECKED BY H. C. W.	APPROVED J. R. Deane BRIDGE ENGINEER
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GENERAL NOTES—
 1. All edges on bent cap shall be chamfered 1".
 2. Use 2" clear cover on all reinforcing steel except as shown.

DETAILS OF PIER NO. 6
 FOR
1659'-0" BRIDGE OVER MISSOURI RIVER
 TWO 28'-0" ROADWAYS 4'-0" MEDIAN
 STA. 18+37.75 TO 34+96.75 F 030-(12)
 ON US HWYS 14 & 83 STANLEY-HUGHES COUNTIES
 SOUTH DAKOTA H20-S16-44
 DEPARTMENT OF HIGHWAYS
 MAY 1960 (17) OF (26)
 DESIGNED BY EK & KCW DRAWN BY H.C.W. CHECKED BY E.K. APPROVED F.P. Deum BRIDGE ENGINEER



PLAN OF FOOTING
See Sht. No. 3 for typical details for welding of re-bars to piles.

REINFORCING SCHEDULE

Mark	No.	Size	Length	Type
F1	20	11	17'-3"	Str.
F2	10		35'-0"	Str.
F3	2		12'-9"	6a
F4	2		14'-9"	6a
F5	2	11	28'-0"	4a
F6	4	8	32'-9"	Str.
G1	62	5	12'-3"	T1
P1	64	10	35'-0"	Str.
S1	476	5	10'-3"	*Ring
L1	16	11	22'-3"	Str.
L2	8	11	25'-0"	
L3	4	6	33'-3"	
L4	4	6	34'-0"	Str.
P2	64	10	6'-9"	20
S2	24	5	11'-0"	*Ring
L5	20	5	34'-6"	Str.
L6	16	8	34'-9"	
L7	8	10	35'-0"	
K1	64	9	13'-6"	
K2	68	6	13'-6"	
K3	8	8	29'-6"	
K4	4	8	13'-6"	Str.
G2	62	5	26'-0"	T1

Bar Bends

All dimensions are out to out of bars.

* Welded Spiral Rings
See Welding Details

Continuous Spirals may be substituted for the Circularly Welded Rings, at the option of the contractor. Payment will be based on Circular Ring Weight.
Use 4 Vertical Spacer Bars for all Columns.
Weight of Spacer Bars included in Re-Steel Estimate.

SPIRAL RING WELDING DETAILS

ESTIMATED QUANTITIES

ITEM	UNIT	QUANTITIES
Class "A" Concrete	Cu. Yds.	303.0
Reinforcing Steel	Lbs.	36,215
Driving Steel Bearing Piles 14BP89	Lin. Ft.	28 @ 45' = 1260
Structure Excavation	Cu. Yds.	300 @ 29.75

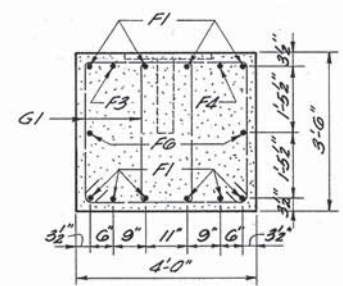
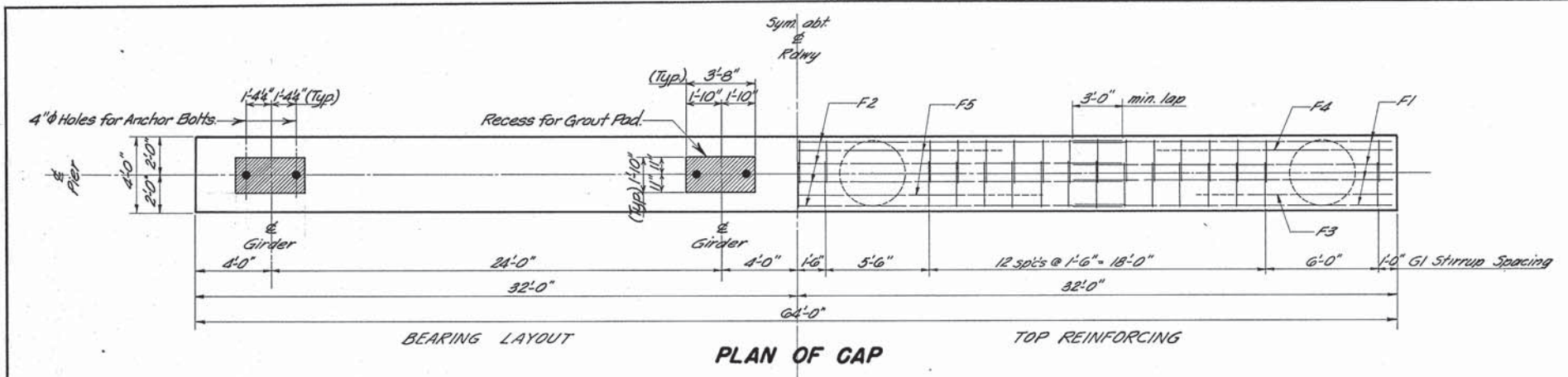
NOTE: See Sht. No. 4 for pile splice quantities.

	Piling	Splice	Total
Pier No. 6	1669	50	1719

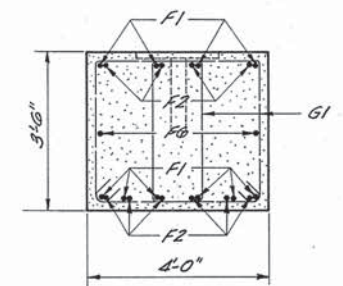
FOOTING DETAILS OF PIER NO. 6
FOR
1659'-0" BRIDGE OVER MISSOURI RIVER
TWO 28'-0" ROADWAYS 4'-0" MEDIAN
STA. 18+37.75 TO 34+96.75 F 030-102
ON U.S. HWYS. 14 & 83 ~~STANLEY~~-HUGHES COUNTIES
SOUTH DAKOTA H20-S16-44
DEPARTMENT OF HIGHWAYS
MAY 1960 18 OF 26

DESIGNED BY E.K. & K.C.W.	DRAWN BY E.K. Tr. by D.P.	CHECKED BY K.C.W.	APPROVED A. P. [Signature] BRIDGE ENGINEER
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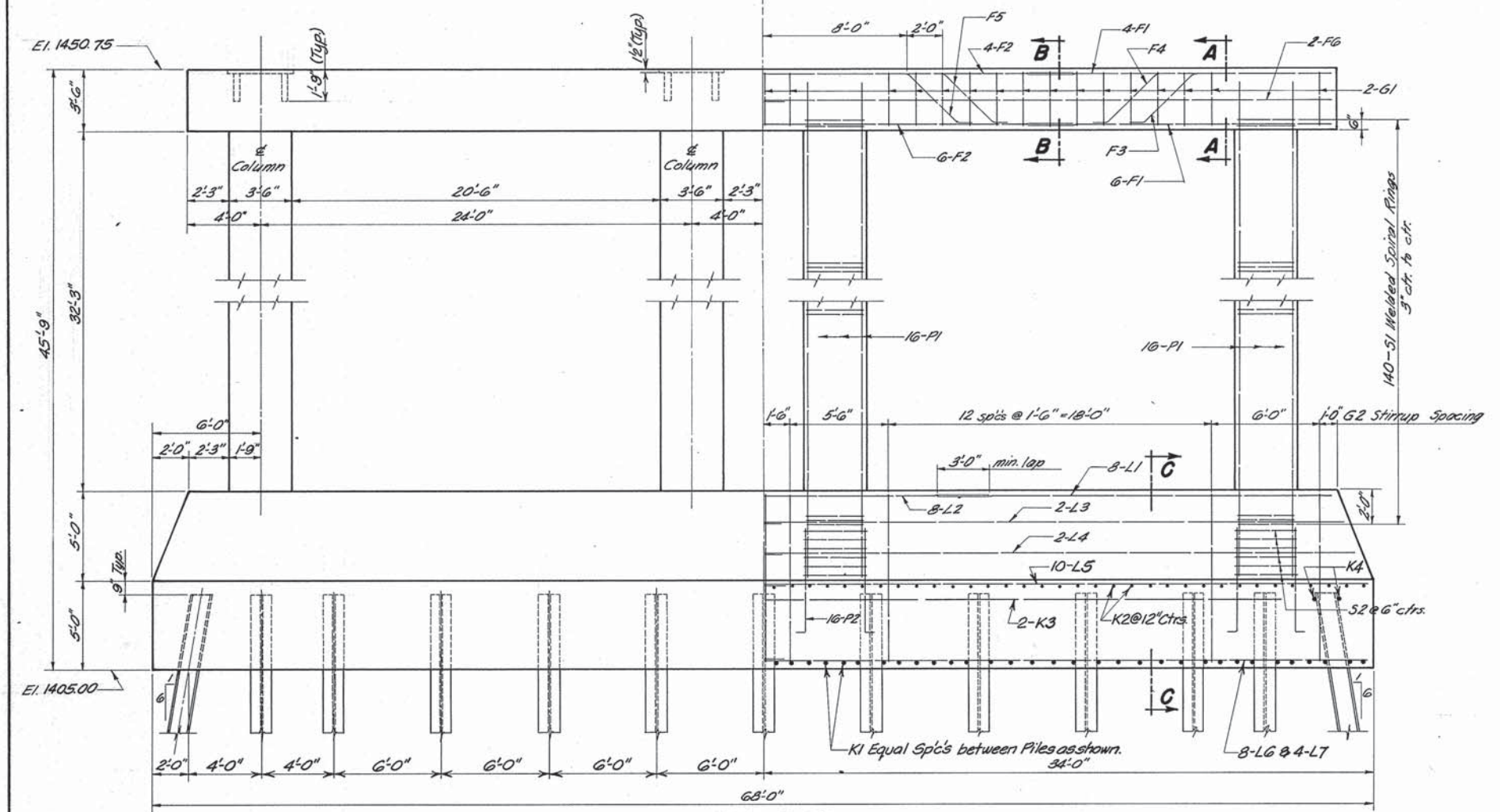
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5	S. D.		19	26



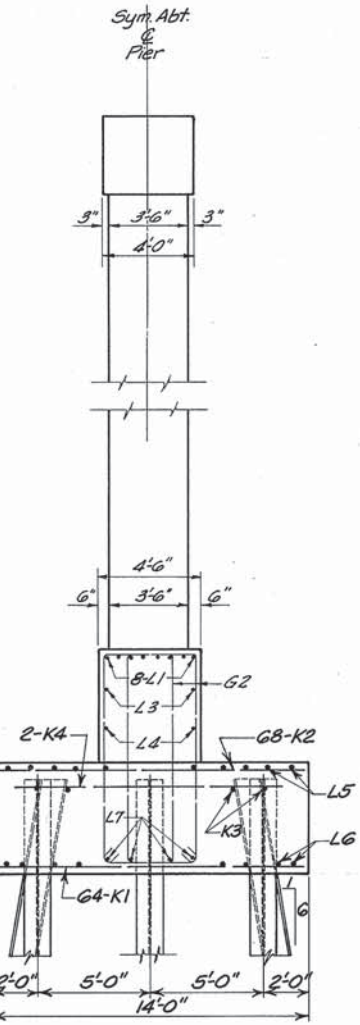
SECTION A-A



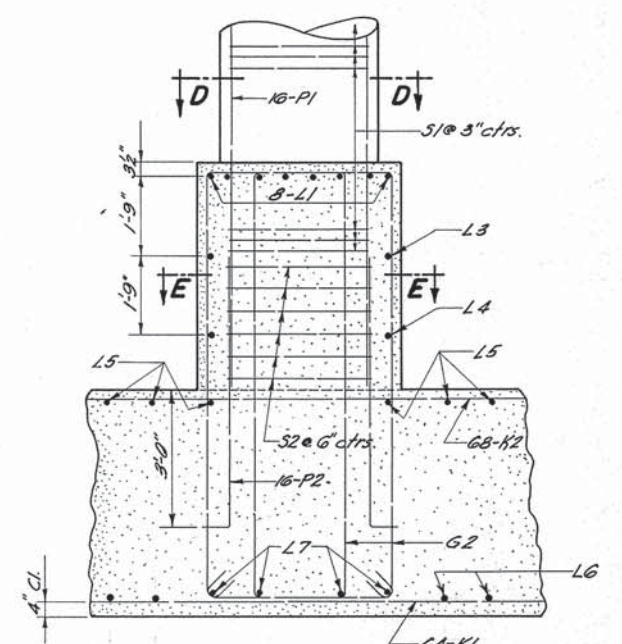
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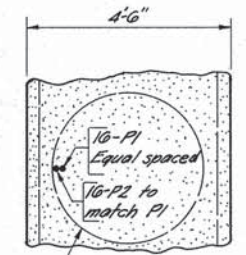
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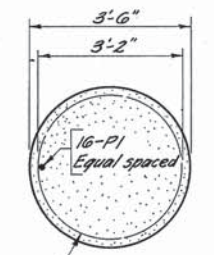
END VIEW



PART SECTION C-C



SECTION E-E

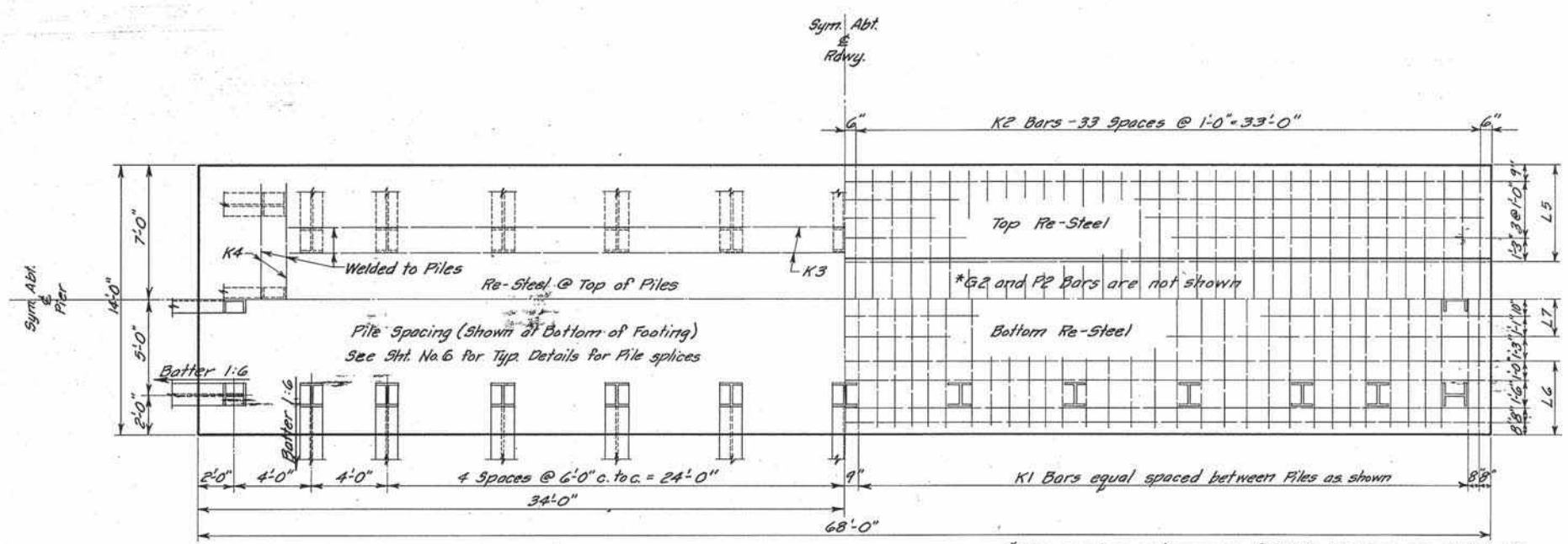


SECTION D-D

GENERAL NOTES—
 1. All edges on bent cap shall be chamfered 1".
 2. Use 2" clear cover on all reinforcing steel except as shown.

DETAILS OF PIER NO.7
 FOR
1659'-0" BRIDGE OVER MISSOURI RIVER
 TWO 28'-0" ROADWAYS 4'-0" MEDIAN
 STA. 18+37.75 TO 34+96.75 F 030-1(2)
 ON US HWYS 14 & 83 STANLEY-HUGHES COUNTIES
 SOUTH DAKOTA H20-S16-44
 DEPARTMENT OF HIGHWAYS
 MAY 1960 19 OF 26

DESIGNED BY R.K. & H.C.W.	DRAWN BY H.C.W.	CHECKED BY E.K.	APPROVED K. Reuter BRIDGE ENGINEER
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PLAN OF FOOTING

See Sht. No. 8 for typical details for welding of re-bars to piles.

REINFORCING SCHEDULE

Mark	No.	Size	Length	Type
F1	20	11	17'-3"	Str.
F2	10		35'-0"	Str.
F3	2		12'-9"	6a
F4	2		14'-9"	6a
F5	2	11	28'-0"	4a
F6	4	8	32'-9"	Str.
G1	G2	5	12'-3"	T1
P1	G4	10	40'-3"	Str.
S1	S60	5	10'-3"	*Ring
L1	16	11	22'-3"	Str.
L2	8	11	25'-0"	
L3	4	6	33'-3"	
L4	4	6	34'-0"	Str.
P2	G4	10	6'-9"	20
S2	24	5	11'-0"	*Ring
L5	20	5	34'-6"	Str.
L6	16	8	34'-9"	
L7	8	10	35'-0"	
K1	G4	9	13'-6"	
K2	G8	6	13'-6"	
K3	8	8	29'-6"	
K4	4	8	13'-6"	Str.
G2	G2	5	26'-0"	T1

Bar Bends
All dimensions are out to out of bars.

* Welded Spiral Rings
See Welding Details

Continuous Spirals may be substituted for the Circularly Welded Rings, at the option of the contractor. Payment will be based on Circular Ring Weight.
Use 4 Vertical Spacer Bars for all Columns.
Weight of Spacer Bars included in Re-Steel Estimate.

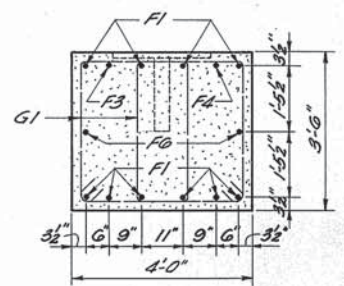
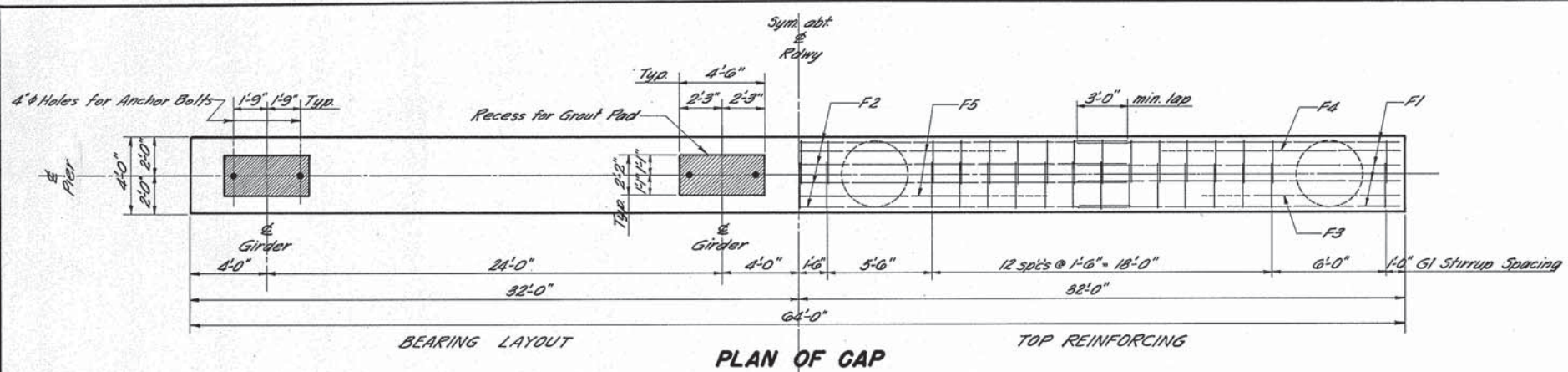
ESTIMATED QUANTITIES		
ITEM	UNIT	QUANTITIES
Class "A" Concrete	Cu. Yds.	310.4
Reinforcing Steel	Lbs.	38,620
Driving Steel Bearing Piles 14BP89	Lin. Ft.	28 @ 45' = 1260
Structure Excavation	Cu. Yds.	300 617.66

NOTE: See Sht. No. 4 for pile splice quantities.

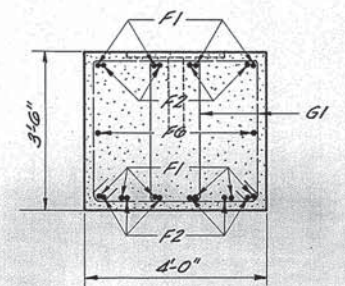
	PILING	SPLICE	TOTAL
Pier No. 7	1647	70	1717

FOOTING DETAILS OF PIER NO. 7
FOR
1659'-0" BRIDGE OVER MISSOURI RIVER
TWO 28'-0" ROADWAYS 4'-0" MEDIAN
STA. 18+37.75 TO 34+96.75 F 030-1(2)
ON U.S. HWYS. 14 & 83 ~~STANLEY~~-HUGHES COUNTIES
SOUTH DAKOTA H20-S16-44
DEPARTMENT OF HIGHWAYS
MAY 1960 **20 OF 26**

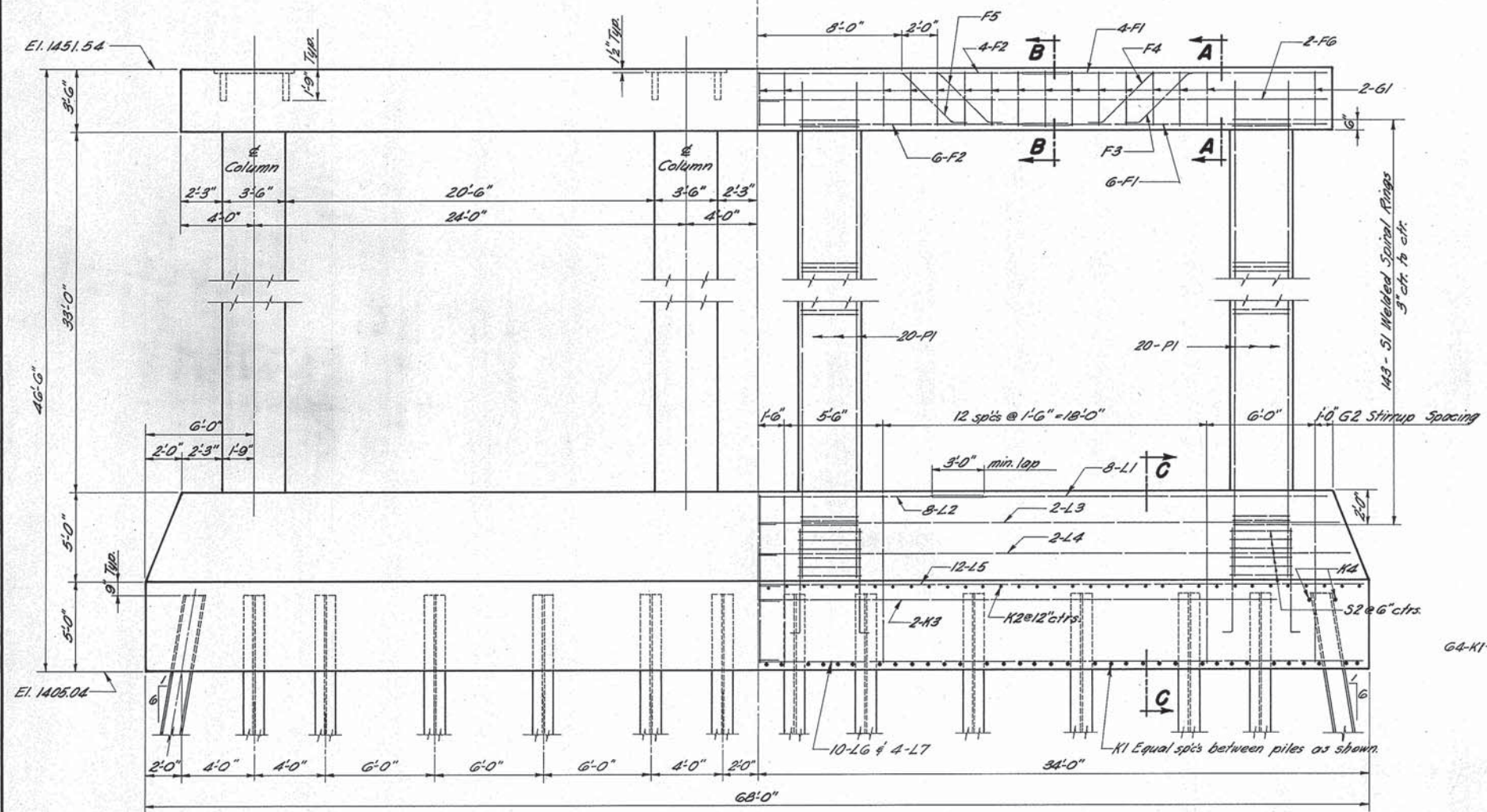
DESIGNED BY E.K. & H.C.W.	DRAWN BY E.K. Tr. by D.P.	CHECKED BY H.C.W.	APPROVED <i>R. Plouffe</i> BRIDGE ENGINEER
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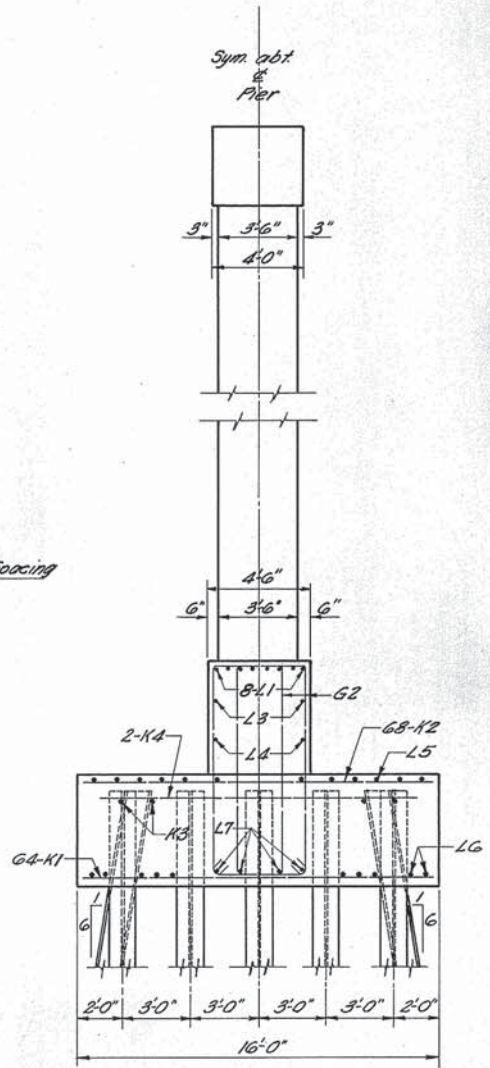
SECTION A-A



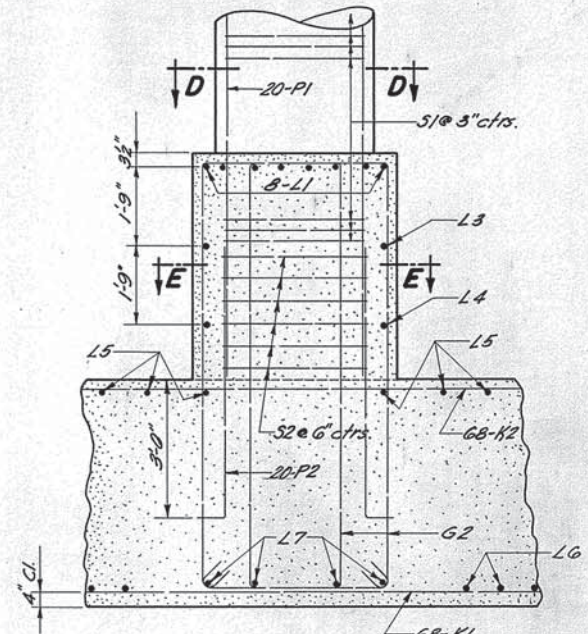
SECTION B-B



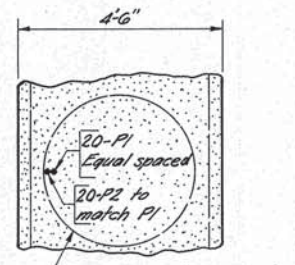
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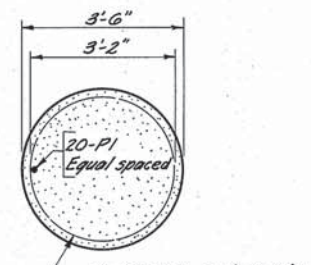
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PART SECTION C-C



SECTION E-E

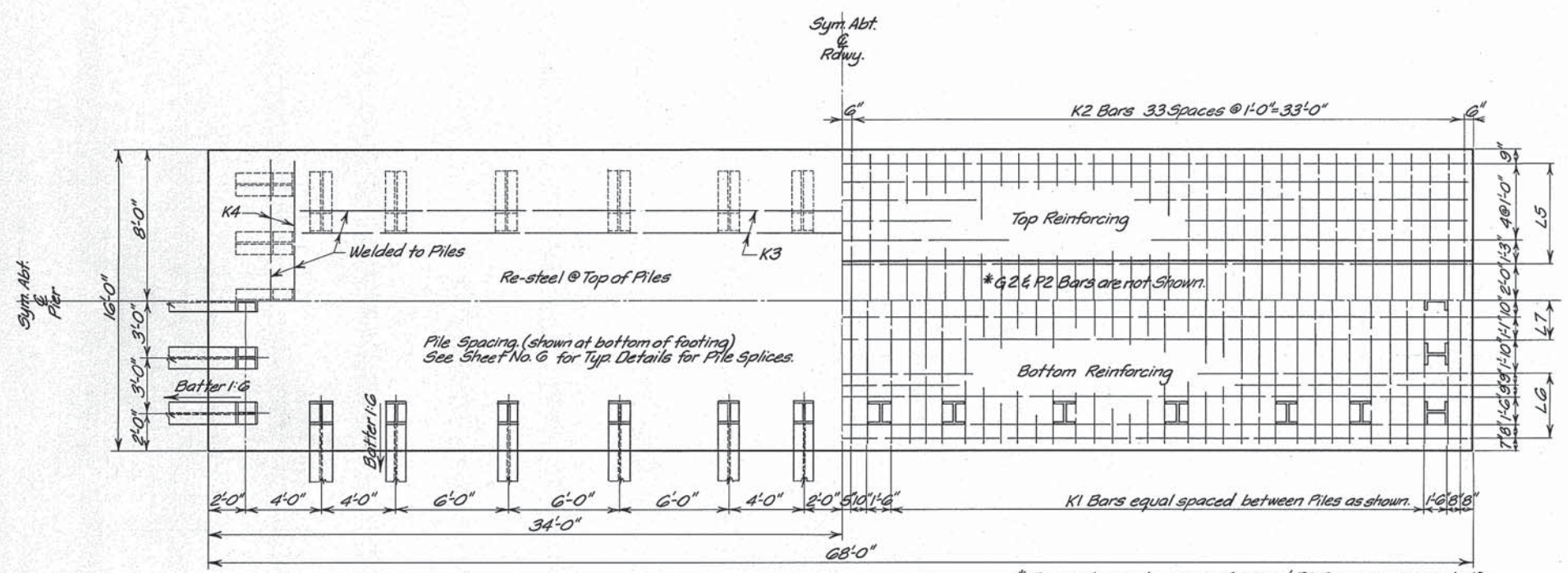


SECTION D-D

GENERAL NOTES—
 1. All edges on bent cap shall be chamfered 1".
 2. Use 2" clear cover on all reinforcing steel except as shown.

DETAILS OF PIER NO. 8
 FOR
1659'-0" BRIDGE OVER MISSOURI RIVER
 TWO 28'-0" ROADWAYS 4'-0" MEDIAN
 STA. 18+37.75 TO 34+96.75 F 030-1(2)
 ON US HWYS 14 & 83 STANLEY-HUGHES COUNTIES
 SOUTH DAKOTA H20-S16-44

DEPARTMENT OF HIGHWAYS
 MAY 1960 (21) OF (26)
 DESIGNED BY A.C.W. DRAWN BY A.C.W. CHECKED BY E.K. APPROVED [Signature] BRIDGE ENGINEER



PLAN OF FOOTING
See Sheet No. 8 for typical details for welding of Re-bars to Piles.

* For number and spacing of G2 and P2 Bars See Sheet No. 19.

ESTIMATED QUANTITIES		
ITEM	UNIT	QUANTITIES
Class "A" Concrete	Cu. Yds.	336.7
Reinforcing Steel	Lbs.	48,450
Driving Steel Bearing Piles 14BP39	Lin. Ft.	34 @ 45' = 1530
Structure Excavation	Cu. Yds.	580 602.47

Note: See Sheet No. 4 for Pile Splice quantities.

	PILING	SPLICE	TOTAL
PIER No. 8	1939	80	2019

REINFORCING SCHEDULE

Mark	No.	Size	Length	Type	
Cap	F1	20	11	17'-3"	Str.
	F2	10	1	35'-0"	Str.
	F3	2	2	12'-9"	Ga
	F4	2	2	14'-9"	Ga
	F5	2	11	28'-0"	4a
	F6	4	8	32'-9"	Str.
Cal.	P1	80	11	41'-0"	Str.
	S1	572	5	10'-3"	Ring*
Wall	L1	16	11	22'-3"	Str.
	L2	8	11	25'-0"	Str.
	L3	4	6	33'-3"	Str.
	L4	4	6	34'-9"	Str.
	P2	80	11	6'-9"	20
	S2	24	5	11'-0"	Ring*
Footing	L5	24	5	34'-6"	Str.
	L6	20	8	34'-9"	Str.
	L7	8	10	35'-0"	Str.
	K1	68	10	15'-6"	
	K2	68	6	15'-6"	
	K3	8	8	29'-6"	
G2	K4	4	8	15'-6"	Str.
	G2	62	5	26'-0"	TI

* Welded Spiral Rings. See Welding Details.

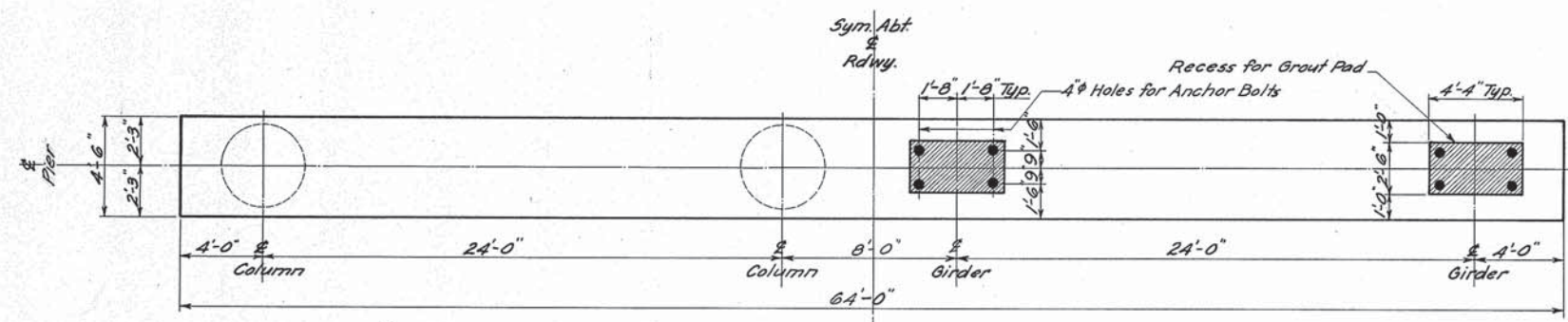
Continuous Spirals may be substituted for the circularly Welded Rings, at the option of the contractor. Payment will be based on Circular Ring Weight.
Use 4 Vertical Spacer Bars for all Columns. Weight of Spacer Bars included in Re-Steel Estimate.

Note: All dimensions are out to out of bars.

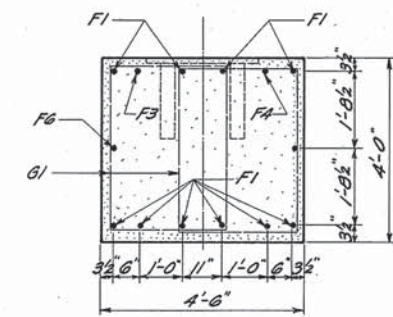
SPIRAL RING WELDING DETAILS

FOOTING DETAILS OF PIER NO. 8
FOR
1659'-0" BRIDGE OVER MISSOURI RIVER
TWO 28'-0" ROADWAYS 4'-0" MEDIAN
STA. 18+37.75 TO 34+96.75 F 030-(12)
ON U.S. HWYS. 14 & 83 ~~STANLEY~~-HUGHES COUNTIES
SOUTH DAKOTA H20-S16-44
DEPARTMENT OF HIGHWAYS
MAY 1960 22 OF 26

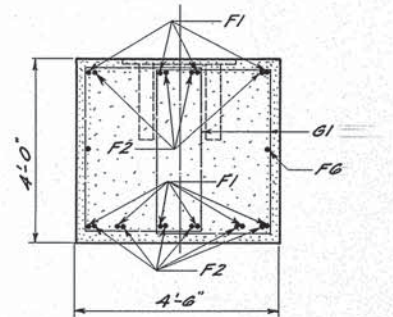
DESIGNED BY E. N. & H. C. W.	DRAWN BY E. K.	CHECKED BY H. C. W.	APPROVED F. R. Seaman BRIDGE ENGINEER
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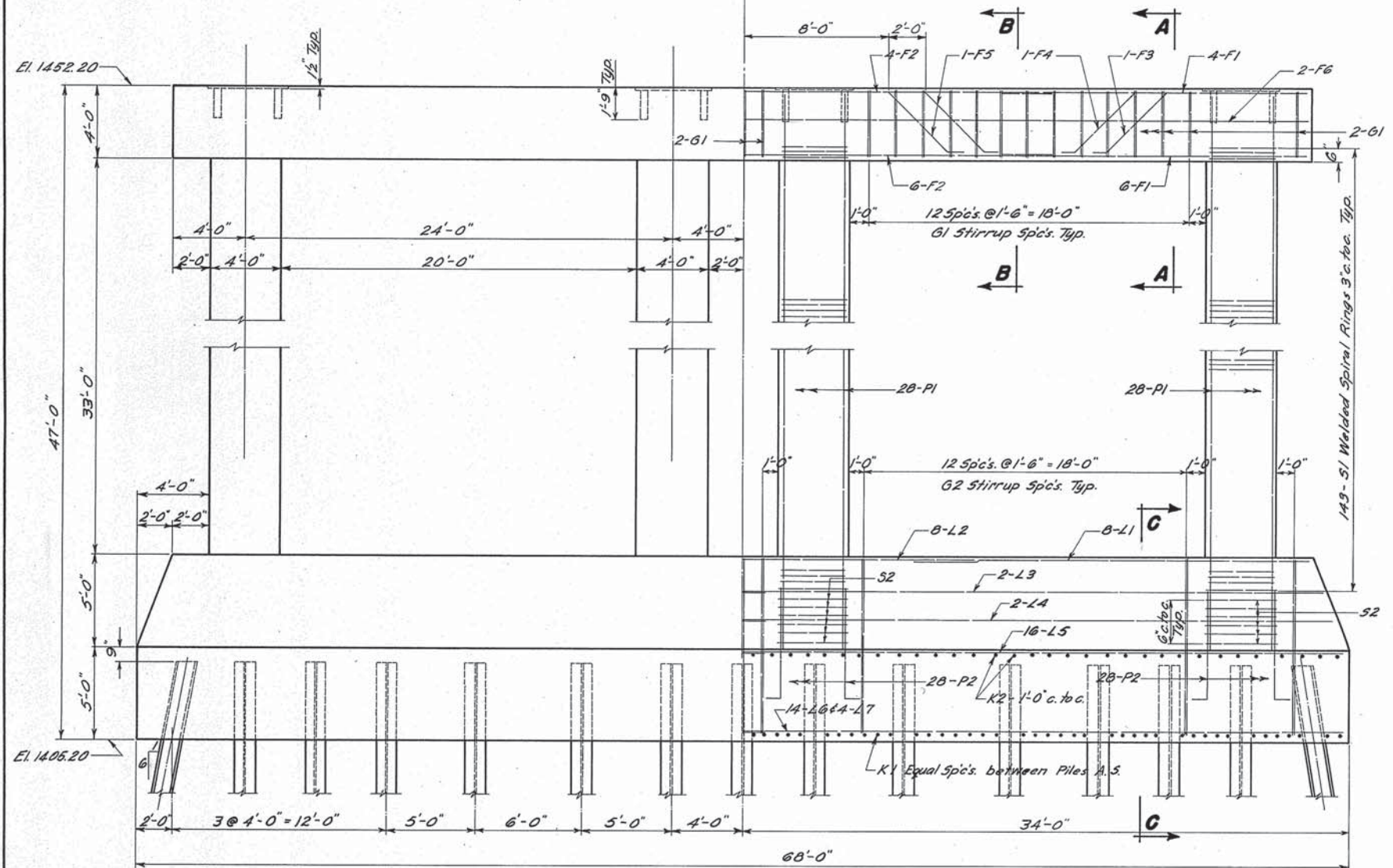
PLAN OF CAP



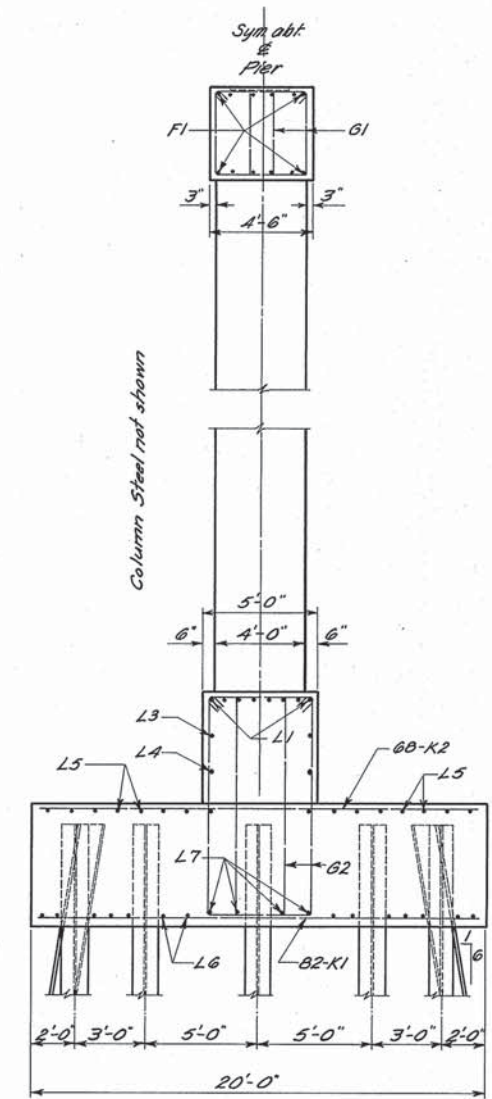
SECTION A-A



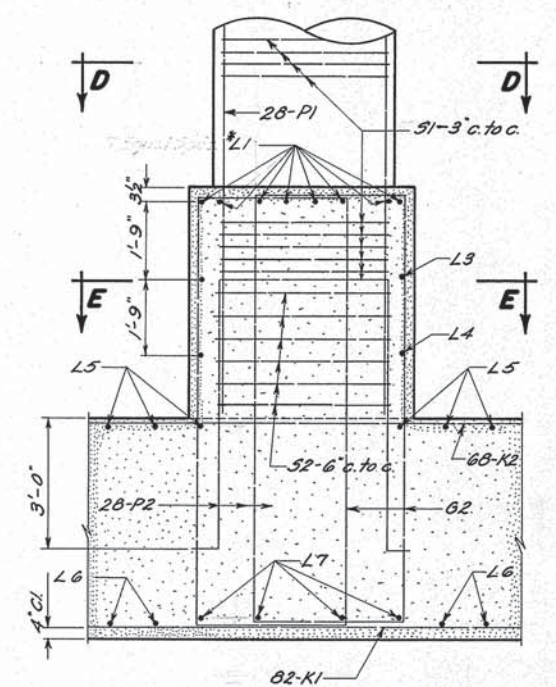
SECTION B-B



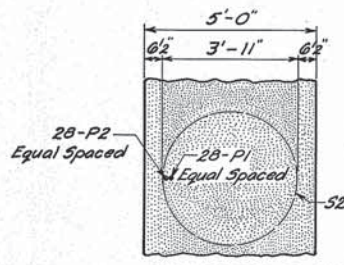
ELEVATION



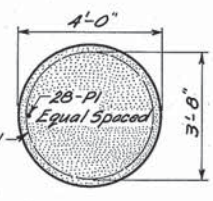
END VIEW



PART SECTION C-C



SECTION E-E



SECTION D-D

GENERAL NOTES—

1. All edges on bent cap shall be chamfered 1".
2. Use 2" clear cover on all reinforcing steel except as shown.

DETAILS OF PIER NO. 9 FOR

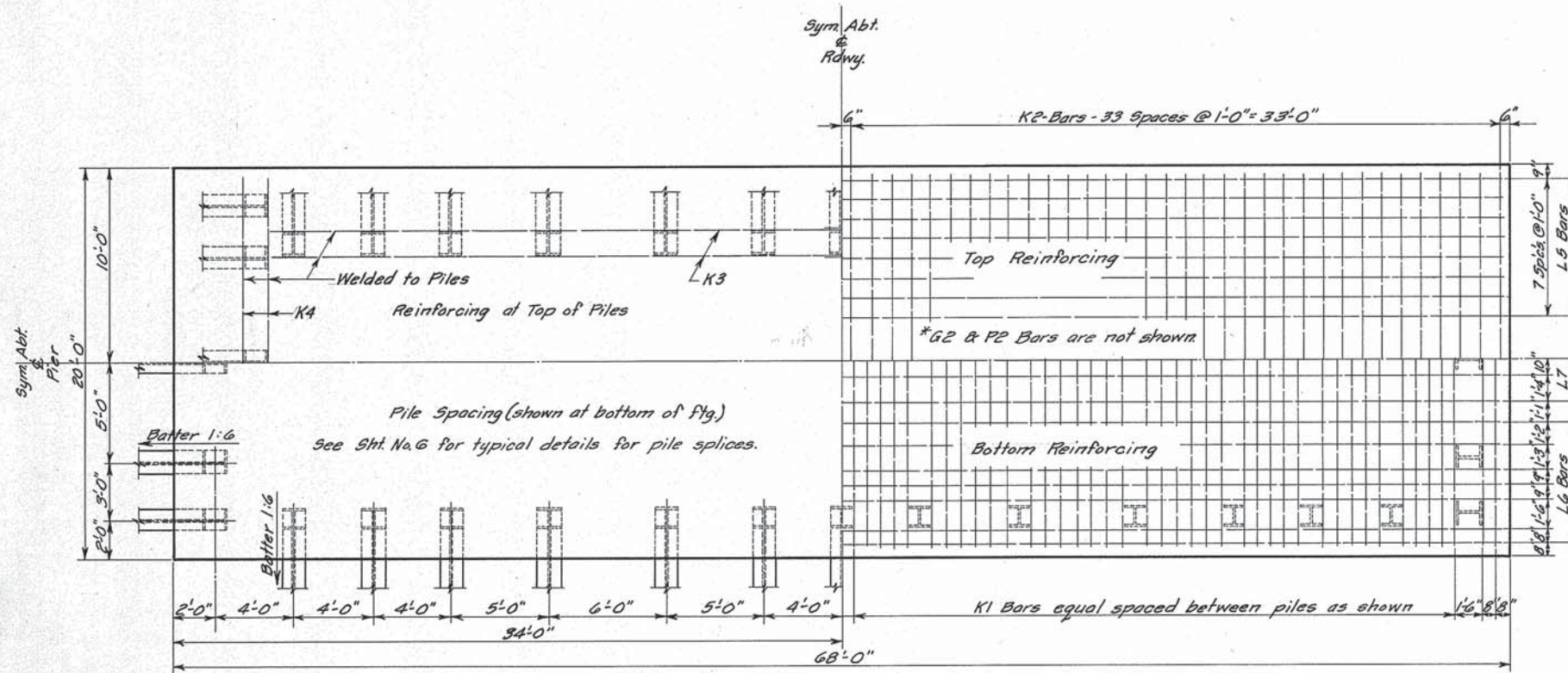
1659'-0" BRIDGE OVER MISSOURI RIVER
TWO 28'-0" ROADWAYS 4'-0" MEDIAN

STA. 18+37.75 TO 34+96.75 F 030-1(2)
 ON U.S. HWYS 14 & 83 STANLEY-HUGHES COUNTIES

SOUTH DAKOTA H20-S16-44
 DEPARTMENT OF HIGHWAYS

MAY 1960 (23) OF (26)

DESIGNED BY E.K.	DRAWN BY E.K.	CHECKED BY K.C.W.	APPROVED H.P. [Signature] BRIDGE ENGINEER
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*For Number and Spacing of G2 & P2 Bars see Sht. No. 21.

PLAN OF FOOTING

See sheet No. 8 for typical details for welding of re-bars to piles.

REINFORCING SCHEDULE					
Mark	No.	Size	Length	Type	
Cap	F1	20	17'-3"	Str.	
	F2	10	35'-0"	Str.	
	F3	2	13'-6"	6a	
	F4	2	15'-6"	6a	
	F5	2	29'-6"	4a	
	F6	4	8	32'-9"	Str.
G1	62	5	13'-6"	T1	
Col.	P1	112	11	41'-6"	Str.
	S1	572	5	11'-9"	*Ring
Wall	L1	16	11	22'-3"	Str.
	L2	8	11	25'-0"	Str.
	L3	4	6	33'-3"	Str.
	L4	4	6	34'-0"	Str.
	P2	112	11	6'-9"	20
	S2	24	5	12'-9"	*Ring
Footing	L5	32	5	34'-6"	Str.
	L6	28	8	34'-9"	Str.
	L7	8	10	35'-0"	Str.
	K1	82	11	19'-6"	Str.
	K2	68	6	19'-6"	Str.
	K3	8	8	29'-6"	Str.
K4	4	8	19'-0"	Str.	
G2	62	5	26'-6"	T1	

Bar Bends

SPIRAL RING WELDING DETAILS

*Welded Spiral Rings
See Welding Details

Continuous Spirals may be substituted for the Circularly Welded Rings, at the option of the contractor. Payment will be made based on circular ring weight. Use 4 Vertical Spacer Bars for all columns. Weight of Spacer Bars is included in Re-Steel Estimate.

All dimensions are out to out of bars.

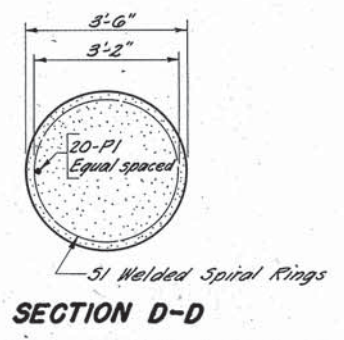
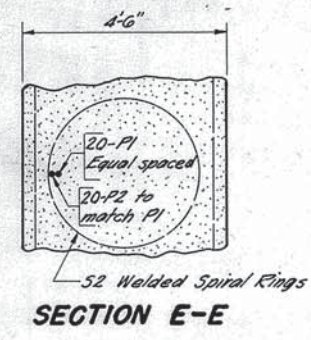
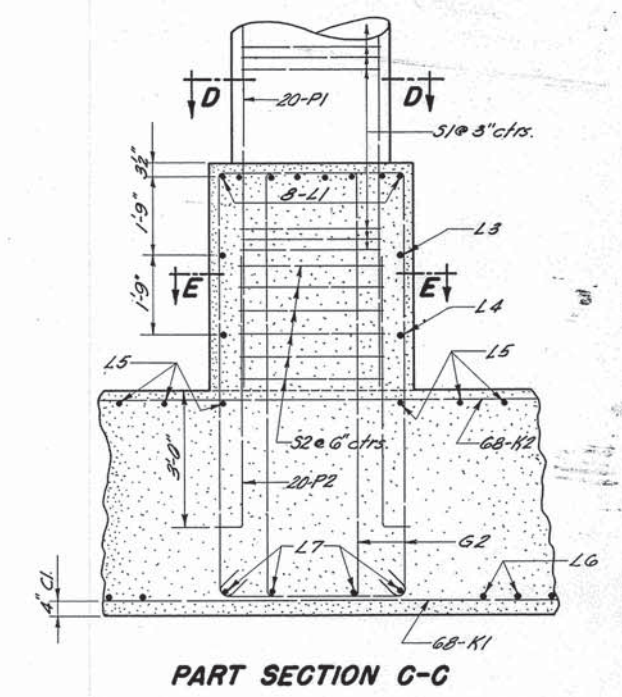
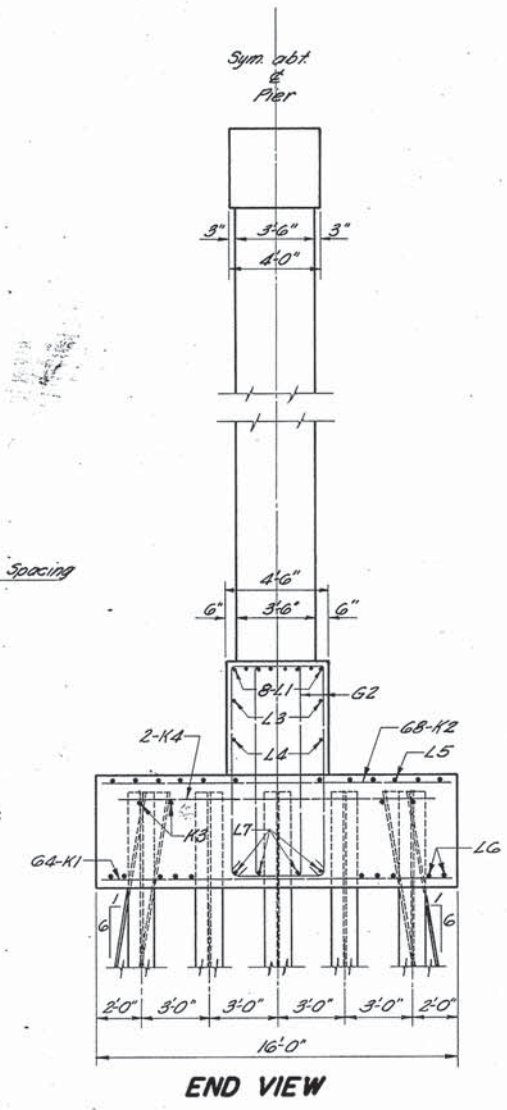
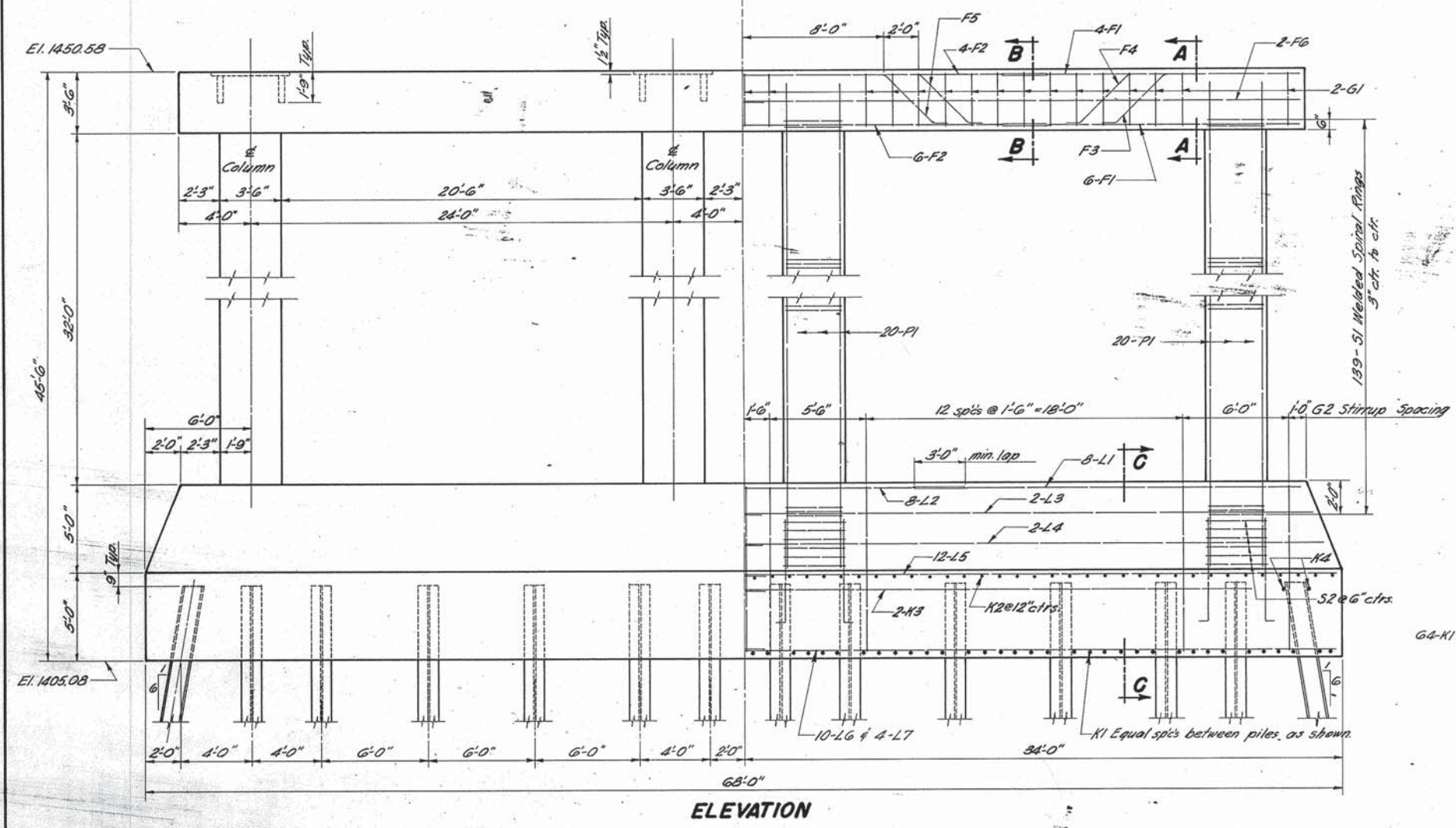
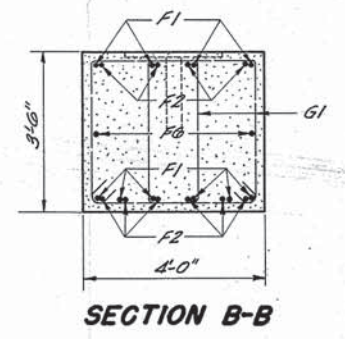
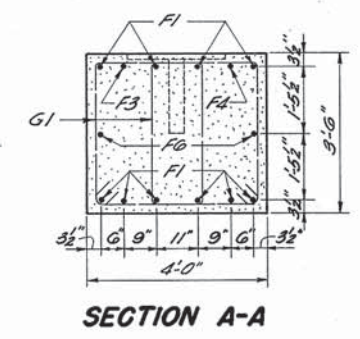
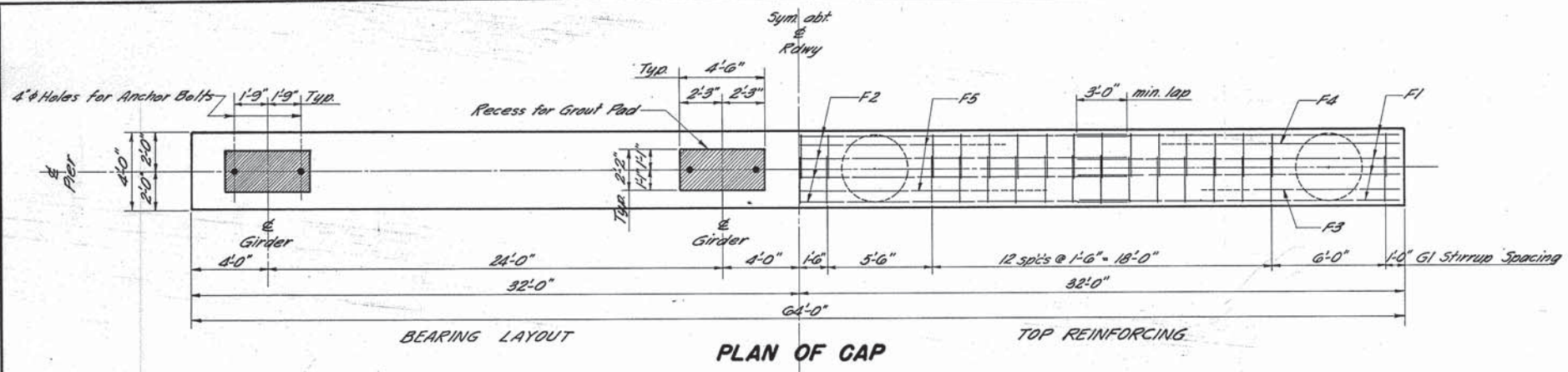
ESTIMATED QUANTITIES		
ITEM	UNIT	QUANTITIES
Class "A" Concrete	Cu. Yds.	417.0
Reinforcing Steel	Lbs.	63,385
Driving Steel Bearing Piles 14BP102	Lin. Ft.	36 @ 45' = 1620
Structure Excavation	Cu. Yds.	640 707.83

NOTE: See Sht. No. 4 for pile splice quantities.

	Piling	Splice	Total
Pier No 9	2154	210	2364

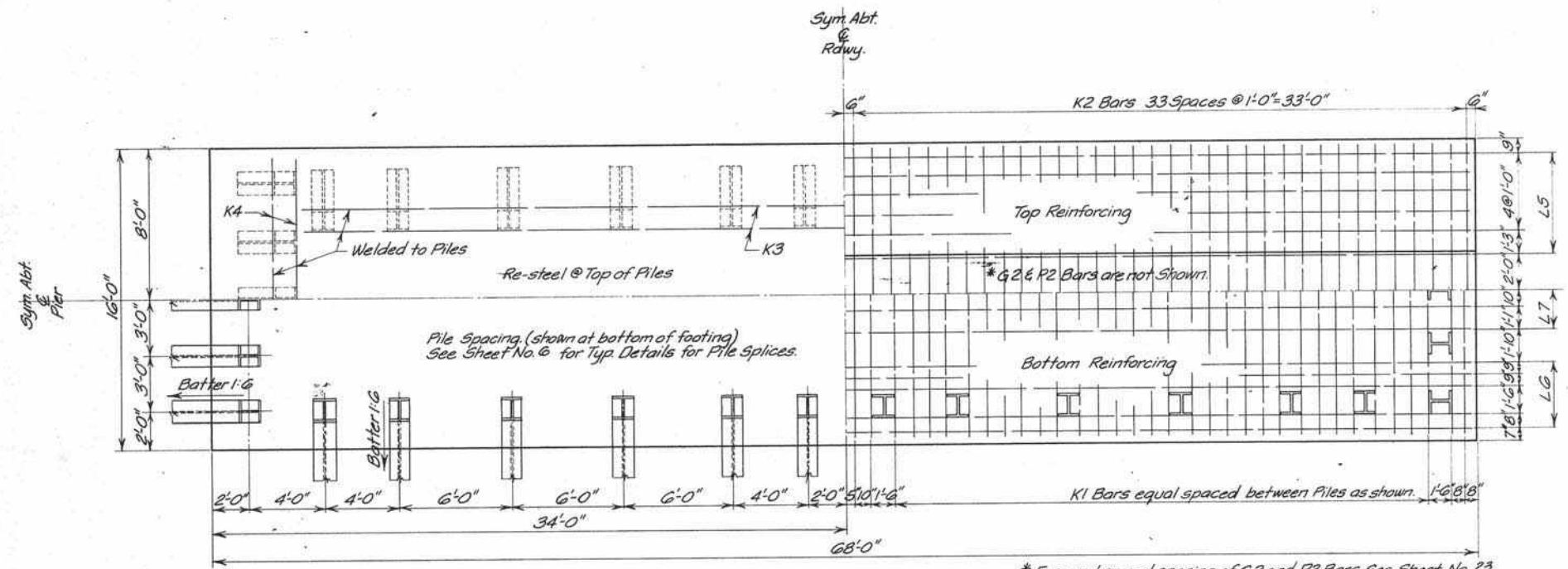
FOOTING DETAILS OF PIER NO. 9
FOR
1659'-0" BRIDGE OVER MISSOURI RIVER
TWO 28'-0" ROADWAYS 4'-0" MEDIAN
STA. 18+37.75 TO 34+96.75 F 030-1(2)
ON U.S. HWYS. 14 & 83 STANLEY-HUGHES COUNTIES
SOUTH DAKOTA H20-S16-44
DEPARTMENT OF HIGHWAYS
MAY 1960 (24) OF (26)

DESIGNED BY E.K.	DRAWN BY E.K. Tr. by D.P.	CHECKED BY K.C.W.	APPROVED R.A. Beers BRIDGE ENGINEER
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GENERAL NOTES—
 1. All edges on bent cap shall be chamfered 1".
 2. Use 2" clear cover on all reinforcing steel except as shown.

DETAILS OF PIER NO. 10
 FOR
1659'-0" BRIDGE OVER MISSOURI RIVER
 TWO 28'-0" ROADWAYS 4'-0" MEDIAN
 STA. 18+37.75 TO 34+96.75 F 030-1(2)
 ON US HWYS 14 & 83 STANLEY-HUGHES COUNTIES
 SOUTH DAKOTA H20-S16-44
 DEPARTMENT OF HIGHWAYS
 MAY 1960 (25) OF (26)
 DESIGNED BY H.C.W. DRAWN BY H.C.W. CHECKED BY E.H. APPROVED [Signature] BRIDGE ENGINEER



PLAN OF FOOTING
See Sheet No. 8 for typical details for welding of Re-bars to Piles.

* For number and spacing of G2 and P2 Bars See Sheet No. 23

ESTIMATED QUANTITIES		
ITEM	UNIT	QUANTITIES
Class "A" Concrete	Cu. Yds.	335.3
Reinforcing Steel	Lbs.	47,840
Driving Steel Bearing Piles 14 BPB9	Lin. Ft.	34 @ 49' = 1530
Structure Excavation	Cu. Yds.	600 660.80

Note: See Sheet No. 4 for Pile Splice quantities.

	Piling	Splice	Total
Pier No. 10	1619	100	1719

REINFORCING SCHEDULE

Mark	No.	Size	Length	Type	
F1	20	11	17'-3"	Str.	
F2	10	11	35'-0"	Str.	
F3	2	11	12'-9"	Ga	
F4	2	11	14'-9"	Ga	
F5	2	11	28'-0"	4a	
F6	4	8	32'-9"	Str.	
G1	G2	5	12'-3"	T1	
Col.	P1	80	11	40'-0"	Str.
	S1	556	5	10'-3"	Ring*
Wall	L1	16	11	22'-3"	Str.
	L2	8	11	25'-0"	Str.
	L3	4	6	33'-3"	Str.
	L4	4	6	34'-0"	Str.
	P2	80	11	6'-9"	20
	S2	24	5	11'-0"	Ring*
Footing	L5	24	5	34'-6"	Str.
	L6	20	8	34'-9"	Str.
	L7	8	10	35'-0"	Str.
	K1	68	10	15'-6"	Str.
	K2	68	6	15'-6"	Str.
	K3	8	8	29'-6"	Str.
	K4	4	8	15'-6"	Str.
	G2	G2	5	26'-0"	T1

Bar Bends
Note: All dimensions are out to out of bars.

* Welded Spiral Rings. See Welding Details.

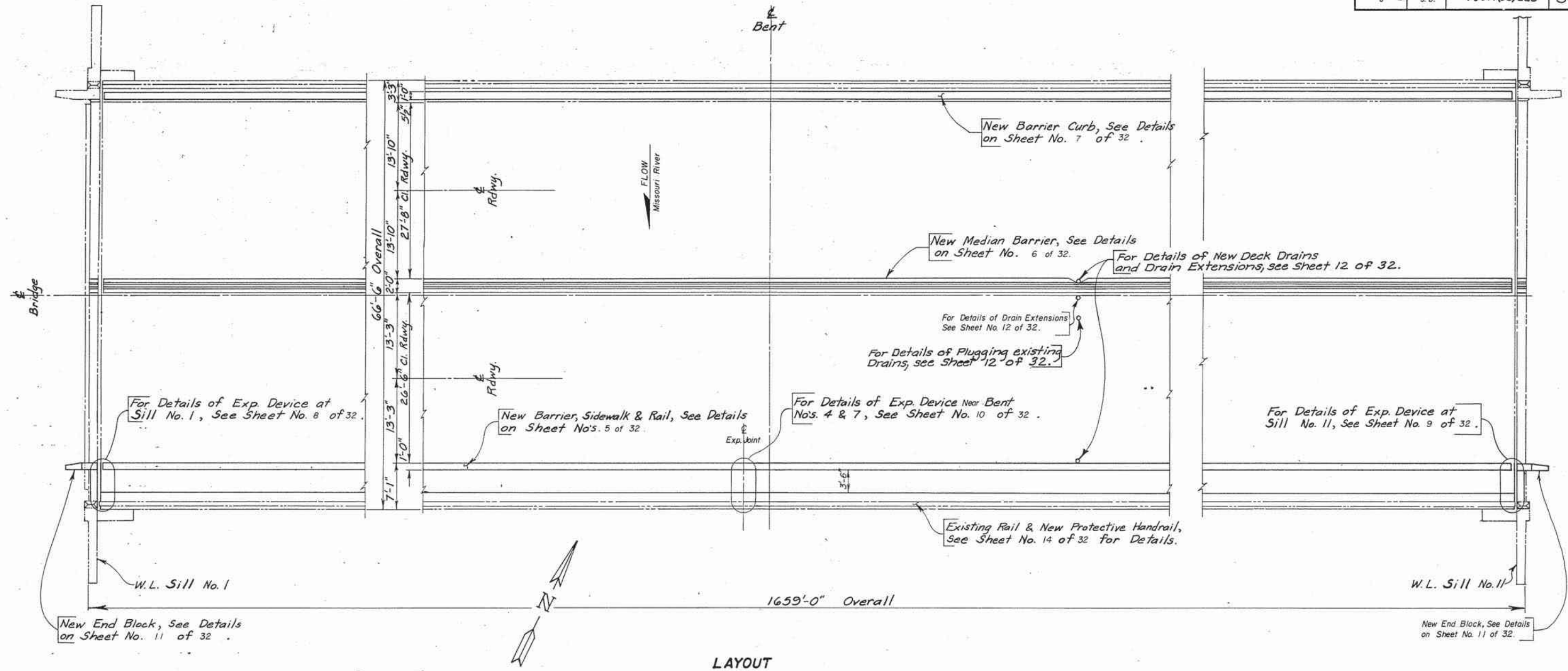
Continuous Spirals may be substituted for the circularly Welded Rings, at the option of the contractor. Payment will be based on Circular Ring Weight.
Use 4 Vertical Spacer Bars for all Columns. Weight of Spacer Bars included in Re-Steel Estimate.

SPIRAL RING WELDING DETAILS
See Fillets 2 3/4" Long

FOOTING DETAILS OF PIER NO. 10
FOR
1659'-0" BRIDGE OVER MISSOURI RIVER
TWO 28'-0" ROADWAYS 4'-0" MEDIAN
STA. 18+37.75 TO 34+96.75 F 030-(12)
ON U.S. HWYS. 14 & 83 STANLEY-HUGHES COUNTIES
SOUTH DAKOTA H 20-S16-44
DEPARTMENT OF HIGHWAYS
MAY 1960 26 OF 26

DESIGNED BY K.C.W.	DRAWN BY E.H. Tr. by R.C.M.	CHECKED BY K.C.W.	APPROVED BRIDGE ENGINEER
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33-355



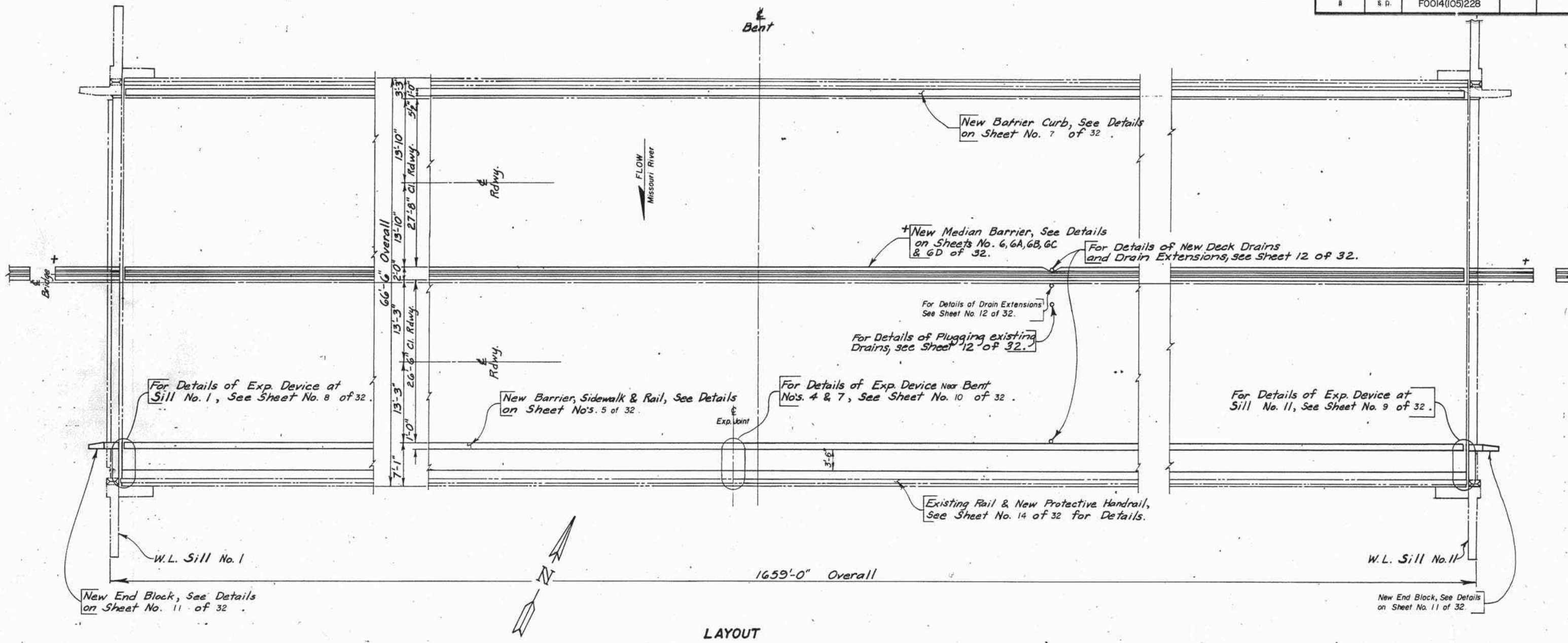
LAYOUT

INDEX OF SHEETS —

- SHEET NO. 1 - LAYOUT
- SHEET NOS. 2, 2A & 3 - ESTIMATE OF STRUCTURE QUANTITIES AND NOTES
- SHEET NO. 4 - ROADWAY CROSS SECTIONS
- SHEET NO. 5 - SIDEWALK AND BARRIER DETAILS
- SHEET NO. 6 - MEDIAN BARRIER DETAILS
- SHEET NO. 7 - LEFT CURB BARRIER DETAILS
- SHEET NO. 8 - SIDEWALK AND BARRIER EXPANSION DEVICE @ SILL NO. 1
- SHEET NO. 9 - SIDEWALK AND BARRIER EXPANSION DEVICE @ SILL NO. 11
- SHEET NO. 10 - SIDEWALK AND BARRIER EXPANSION DEVICE NEAR BENTS NO. 4 & 7
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- SHEET NO. 13 - EXISTING RAIL MODIFICATION
- SHEET NO. 14 - DETAILS OF BRIDGE SIDEWALK CHAIN LINK FENCE
- SHEET NO. 15 - DETAILS FOR SPECIAL STEEL RAILING
- SHEET NO. 16 - LAYOUT OF EXISTING RAILPOST SPACING FOR SPECIAL STEEL RAILING
- SHEET NO. 17 - DETAILS OF 4-BOLT INSERT ASSEMBLY
- SHEET NOS. 18-32 - ORIGINAL CONSTRUCTION PLANS

LAYOUT
FOR
1659'-0" BRIDGE OVER MISSOURI RIVER
27'-8" AND 26'-6" ROADWAY
 STA. 18+37.75 TO 34+96.75 F0014(00)228
 ON U.S. HWYS. 14 & 83 HS 20-44
 STR. NO. 33-100-118 (& ALT.)
HUGHES COUNTY
 S. D. DEPT. OF TRANSPORTATION
 NOV. 1985 1 OF 32

DESIGNED BY	DRAWN BY	CHECKED BY	APPROVED
	C.D.	T.D.W.	



LAYOUT

INDEX OF SHEETS —

- SHEET NO. 1 - LAYOUT
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- SHEET NO. 5 - SIDEWALK AND BARRIER DETAILS
- *SHEET NO. 6, 6A, 6B, 6C & 6D - MEDIAN BARRIER DETAILS
- SHEET NO. 7 - LEFT CURB BARRIER DETAILS
- SHEET NO. 8 - SIDEWALK AND BARRIER EXPANSION DEVICE @ SILL NO. 1
- SHEET NO. 9 - SIDEWALK AND BARRIER EXPANSION DEVICE @ SILL NO. 11
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- SHEET NOS. 18-32 - ORIGINAL CONSTRUCTION PLANS

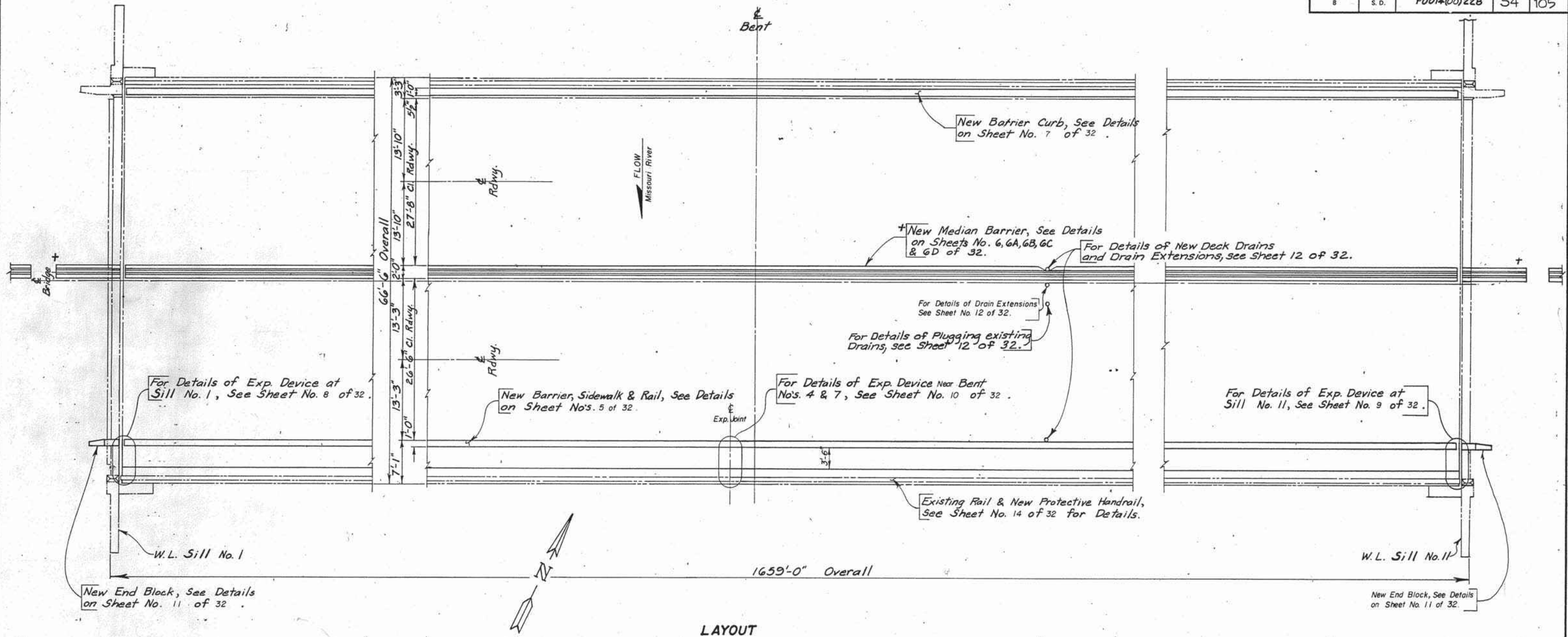
ORIGINAL CONSTRUCTION PLANS

CONSTRUCTION CHANGE

LAYOUT
FOR
1659'-0" BRIDGE OVER MISSOURI RIVER
27'-8" AND 26'-6" ROADWAY
STA. 18+37.75 TO 34+96.75 F0014(00)228,
ON U.S. HWYS. 14, & 83 HS 20-44
STR. NO. 33-100-118 (8 ALT.)
HUGHES COUNTY
S. D. DEPT. OF TRANSPORTATION
NOV. 1985 OF

DESIGNED BY	DRAWN BY	CHECKED BY	APPROVED
	C.D.	T.D.W.	

*CONSTRUCTION CHANGE 7-7-86



LAYOUT

INDEX OF SHEETS —

- SHEET NO. 1 - LAYOUT
- SHEET NOS. 2, 2A & 3 - ESTIMATE OF STRUCTURE QUANTITIES AND NOTES
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CONSTRUCTION CHANGE

LAYOUT
FOR
1659'-0" BRIDGE OVER MISSOURI RIVER
27'-8" AND 26'-6" ROADWAY
STA. 18+37.75 TO 34+96.75 F 0014(00)228,
ON U.S. HWYS. 14, & 83 HS 20-44
STR. NO. 33-100-118 (& ALT.)

HUGHES COUNTY
S. D. DEPT. OF TRANSPORTATION
NOV. 1985

1 OF 32

DESIGNED BY	DRAWN BY	CHECKED BY	APPROVED
	C.D.	T.D.W.	

†CONSTRUCTION CHANGE 7-7-86

NOTE REGARDING DETAILS AND DIMENSIONS OF THE EXISTING BRIDGE

All details and dimensions of the existing bridge, contained in these plans, are provided as information only. It is the contractor's responsibility to field inspect and verify the actual field conditions and any necessary dimensions affecting his satisfactory completion of the work required for this project.

NOTES REGARDING SPECIFICATIONS

- Design Specifications: AASHTO Specifications for Highway Bridges, 1983 Edition with Interims thru 1984 using Working Stress Design.
- Construction Specifications: South Dakota Standard Specifications for Roads and Bridges, 1985 Edition, and required Provisions, Supplemental Specifications and/or Special Provisions as included in the Proposal.

NOTES REGARDING DESIGN MIX OF CONCRETE

- All concrete shall be Class "A45".
- Mix shall be designed to produce a concrete having a minimum 28 day compressive strength of 4,500 p.s.i.
- Coarse Aggregate to be used in concrete for curb barrier, sidewalk, median, barrier and end blocks shall consist of crushed quartzite or other crushed quarry stone. If crushed quarry stone other than quartzite is to be used, it shall be from a source approved by the Engineer.

GENERAL NOTES REGARDING DESIGN AND CONSTRUCTION

- Curb barrier, median barrier, and sidewalk design unit stresses:
Concrete $f_c = 1800$ p.s.i.
 $f'_c = 4500$ p.s.i.
- All exposed concrete corners and edges shall be chamfered 3/4" unless otherwise noted.
- Use 2" clear cover on all reinforcing steel except as shown.
- Reinforcing steel shall conform to ASTM-A615, Grade 60.
- All broken out concrete shall be disposed of at a site obtained by the Contractor and approved by the Engineer.
- The area of the top of the existing curbs on the upstream side which will be in contact with the new concrete shall be sand blasted or roughened by other approved means to the satisfaction of the Engineer.
- The curb barrier shall be chamfered at the bents with the cost being absorbed in the Bid Item for "Class A45 Concrete, Bridge Repair".
- The silicon sealer to be used in the sidewalk shall conform to Sec. 870, and shall be applied according to Sec. 380 of the Standard Specs.

- The existing curbs have curb drains which are of variable width. See Sheet 25 of 32 for size and location. These drains shall be plugged during concrete placement of the sidewalk. The formwork will be removed after the proper concrete curing time. The Contractor shall supply details of proposed formwork for plugging these curb drains to the Office of Bridge Design for their approval before construction begins.
- The cost of sawcutting and breaking out the deck 1 inch under the new median barrier shall be included in the unit price bid for "Class A45 Concrete, Bridge Repair".

WELDING NOTE

All welding and weld inspection shall be in accordance with the American Welding Society Specification D1.1-80 Structural Welding Code as modified by the 1981 Edition of the Standard Specifications for Welding Structural Steel Highway Bridges by AASHTO.

NOTES REGARDING SCOPE OF WORK

For informational purposes, the bridge work to be done on this project includes the following:

- Add sidewalk, curb barrier, rail, and chain link fence to the downstream curb.
- Add a rectangular curb barrier to the upstream curb.
- Breakout the downstream endblocks and replace.
- Breakout the 4'-0" median.
- Extend the deck drains, plug the existing drains and drill new drains.
- Relocate the existing rail at the ends of the bridge and modify the existing downstream rail.
- Add a median barrier.
- Paint girders at Bents No. 4 and 7.

NOTES REGARDING RUBBERIZED ASPHALT CHIP SEAL REMOVAL

- The existing bridge deck has a Rubberized Asphalt Chip Seal (RACS). It will be removed in the area of the new sidewalk and curb barrier prior to their placement. This area shall also be scarified 1/4" using Type 1A Removal according to Section 550 of the Standard Specifications. Other types of removal are not anticipated, however, if the Engineer determines that some other types of removal are necessary they shall be accomplished in accordance with the aforementioned Standard Specifications.
- The area of the deck exposed by the existing median removal shall be patched with RACS by State Forces after the new median barrier has been placed.
- Payment for scarifying the bridge deck in the designated areas, including sawing, cleaning, disposal of removed material, equipment and incidental work, shall be included in the unit price bid for "Type 1A Removal".

NOTES REGARDING NEW SLIDING PLATE EXPANSION DEVICES

- The edges of the sliding plates and bars shall be built flush with the concrete.
- All plates and bars used to shape the sliding plate expansion devices shall conform to ASTM A36.
- The expansion plates for the median barrier may be welded or bent into shape. The contractor will submit details in the shop plans for the method used for approval by the Office of Bridge Design.
- Payment for the new sliding plate expansion devices including all materials, tools, labor and incidental work shall be included in the lump sum price bid for Structural Steel.
- New expansion Devices shall be cleaned and painted to provide a uniform appearance in accordance with Sec. 411 of the Standard Specifications. Shop coat the new expansion device with one coat of Red Lead Paint (AASHTO M-72, Type I) or Red Lead Iron Oxide Paint (AASHTO M-72, Type III). Apply one field coat of gray intermediate paint, followed by a coat of aluminum bridge paint. Paint shall be in accordance with Sec. 980 of the Standard Specs.

NOTES REGARDING BREAKOUT STRUCTURAL CONCRETE

- Breakout the existing curb, median and end blocks to the lines and limits shown in the details of these plans.
- When breaking out concrete, care shall be taken not to cut or damage the existing reinforcing steel which is to be re-used in the construction work. Any reinforcing steel cut or damaged during this operation shall be repaired or replaced as directed by the Engineer. The repairing or replacing of these bars shall be done by the Contractor at no cost to the State. All reinforcing steel to be reused in the construction work shall be cleaned and straightened (or bent) to the satisfaction of the Engineer.
- The cost for sawing, breaking out concrete, cleaning and straightening reinforcing steel and disposal of all broken out material shall be included in the Unit Price Bid for "Breakout Structural Concrete". Payment shall be based on the Plans Quantity and shall be full compensation for all materials, equipment and incidentals.
- All broken out concrete, cut reinforcing bars and cut bolts shall be disposed of at a site obtained by the Contractor and approved by the Engineer.

1659'-0" BRIDGE OVER MISSOURI RIVER

STA. 18+37.75 TO 34+96.75 F 0014(00)228

STR. NO. 33-100-118

HUGHES COUNTY

2 OF 32

ESTIMATE OF STRUCTURE QUANTITIES

SPECIFICATION REFERENCES		I10 & NOTES	SEE NOTES	SEE NOTES	460	470 & NOTES	480	500	550	930												
BID ITEM NUMBERS		I10.0024	460.0009	460.0031	460.1013	470.0003	480.0004	500.0001	550.0001	621.0010												
FROM	TO	LENGTH	REMOVAL OF CONCRETE MEDIAN	INSTALL DOWELS IN CONCRETE	BREAKOUT STRUCTURAL CONCRETE	CLASS A45 CONCRETE, BRIDGE REPAIR	SPECIAL STEEL RAILING	EPOXY COATED REINFORCEMENT FOR CONCRETE MASONRY	STRUCTURAL STEEL	TYPE 1A REMOVAL	BRIDGE SIDEWALK CHAIN LINK FENCE											
L. F.			SQ. YD.	EACH	CU. YD.	CU. YD.	L. F.	LBS.	L. S.	SQ. YD.	L. F.											
18+37.75	34+96.75	1659	737.3	708	39.0	690.1	1652.5	79,981	L. S.	826.3	1655.0											

NOTE REGARDING DETAILS AND DIMENSIONS OF THE EXISTING BRIDGE

All details and dimensions of the existing bridge, contained in these plans, are provided as information only. It is the contractor's responsibility to field inspect and verify the actual field conditions and any necessary dimensions affecting his satisfactory completion of the work required for this project.

NOTES REGARDING SPECIFICATIONS

- Design Specifications: AASHTO Specifications for Highway Bridges, 1983 Edition with Interims thru 1984 using Working Stress Design.
- Construction Specifications: South Dakota Standard Specifications for Roads and Bridges, 1985 Edition, and required Provisions, Supplemental Specifications and/or Special Provisions as included in the Proposal.

NOTES REGARDING DESIGN MIX OF CONCRETE

- All concrete shall be Class "A45".
- Mix shall be designed to produce a concrete having a minimum 28 day compressive strength of 4,500 p.s.i.
- Coarse Aggregate to be used in concrete for curb barrier, sidewalk, median, barrier and end blocks shall consist of crushed quartzite or other crushed quarry stone. If crushed quarry stone other than quartzite is to be used, it shall be from a source approved by the Engineer.

GENERAL NOTES REGARDING DESIGN AND CONSTRUCTION

- Curb barrier, median barrier, and sidewalk design unit stresses:
Concrete $f_c = 1800$ p.s.i.
 $f'_c = 4500$ p.s.i.
- All exposed concrete corners and edges shall be chamfered 3/4", unless otherwise noted.
- Use 2" clear cover on all reinforcing steel except as shown.
- Reinforcing steel shall conform to ASTM-A615, Grade 60.
- All broken out concrete shall be disposed of at a site obtained by the Contractor and approved by the Engineer.
- The area of the top of the existing curbs on the upstream side which will be in contact with the new concrete shall be sand blasted or roughened by other approved means to the satisfaction of the Engineer.
- The curb barrier shall be chamfered at the bents with the cost being absorbed in the Bid Item for "Class A45 Concrete, Bridge Repair".
- The silicon sealer to be used in the sidewalk shall conform to Sec. 870, and shall be applied according to Sec. 380 of the Standard Specs.

- The existing curbs have curb drains which are of variable width. See Sheet 25 of 32 for size and location. These drains shall be plugged during concrete placement of the sidewalk. The formwork will be removed after the proper concrete curing time. The Contractor shall supply details of proposed formwork for plugging these curb drains to the Office of Bridge Design for their approval before construction begins.
- The cost of sawcutting and breaking out the deck 1 inch under the new median barrier shall be included in the unit price bid for "Class A45 Concrete, Bridge Repair".

WELDING NOTE

All welding and weld inspection shall be in accordance with the American Welding Society Specification D1.1-80 Structural Welding Code as modified by the 1981 Edition of the Standard Specifications for Welding Structural Steel Highway Bridges by AASHTO.

NOTES REGARDING SCOPE OF WORK

For informational purposes, the bridge work to be done on this project includes the following:

- Add sidewalk, curb barrier, rail, and chain link fence to the downstream curb.
- Add a rectangular curb barrier to the upstream curb.
- Breakout the downstream endblocks and replace.
- Breakout the 4'-0" median.
- Extend the deck drains, plug the existing drains and drill new drains.
- Relocate the existing rail at the ends of the bridge and modify the existing downstream rail.
- Add a median barrier.
- Paint girders at Bents No. 4 and 7.

NOTES REGARDING RUBBERIZED ASPHALT CHIP SEAL REMOVAL

- The existing bridge deck has a Rubberized Asphalt Chip Seal (RACS). It will be removed in the area of the new sidewalk and curb barrier prior to their placement. This area shall also be scarified 1/4" using Type IA Removal according to Section 550 of the Standard Specifications. Other types of removal are not anticipated, however, if the Engineer determines that some other types of removal are necessary they shall be accomplished in accordance with the aforementioned Standard Specifications.
- The area of the deck exposed by the existing median removal shall be patched with RACS by State Forces after the new median barrier has been placed.
- Payment for scarifying the bridge deck in the designated areas, including sawing, cleaning, disposal of removed material, equipment and incidental work, shall be included in the unit price bid for "Type IA Removal".

NOTES REGARDING NEW SLIDING PLATE EXPANSION DEVICES

- The edges of the sliding plates and bars shall be built flush with the concrete.
- All plates and bars used to shape the sliding plate expansion devices shall conform to ASTM A36.
- The expansion plates for the median barrier may be welded or bent into shape. The contractor will submit details in the shop plans for the method used for approval by the Office of Bridge Design.
- Payment for the new sliding plate expansion devices including all materials, tools, labor and incidental work shall be included in the lump sum price bid for Structural Steel.
- New expansion Devices shall be cleaned and painted to provide a uniform appearance in accordance with Sec. 411 of the Standard Specifications. Shop coat the new expansion device with one coat of Red Lead Paint (AASHTO M-72, Type I) or Red Lead Iron Oxide Paint (AASHTO M-72, Type III). Apply one field coat of gray intermediate paint, followed by a coat of aluminum bridge paint. Paint shall be in accordance with Sec. 980 of the Standard Specs.

NOTES REGARDING BREAKOUT STRUCTURAL CONCRETE

- Breakout the existing curb, median and end blocks to the lines and limits shown in the details of these plans.
- When breaking out concrete, care shall be taken not to cut or damage the existing reinforcing steel which is to be re-used in the construction work. Any reinforcing steel cut or damaged during this operation shall be repaired or replaced as directed by the Engineer. The repairing or replacing of these bars shall be done by the Contractor at no cost to the State. All reinforcing steel to be reused in the construction work shall be cleaned and straightened (or bent) to the satisfaction of the Engineer.
- The cost for sawing, breaking out concrete, cleaning and straightening reinforcing steel and disposal of all broken out material shall be included in the Unit Price Bid for "Breakout Structural Concrete". Payment shall be based on the Plans Quantity and shall be full compensation for all materials, equipment and incidentals.
- All broken out concrete, cut reinforcing bars and cut bolts shall be disposed of at a site obtained by the Contractor and approved by the Engineer.

CONSTRUCTION CHANGE
1659'-0" BRIDGE OVER MISSOURI RIVER
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2 OF 32

ESTIMATE OF STRUCTURE QUANTITIES

*Construction Change 7-11-86

SPECIFICATION REFERENCES			110 & NOTES		SEE NOTES	SEE NOTES	460	470 & NOTES		480	500	550	930								
BID ITEM NUMBERS			110.0024		460.0009	460.0031	460.1013	470.0003		480.0004	500.0001	550.0001	621.0010								
STATION																					
FROM	TO	LENGTH	REMOVAL OF CONCRETE MEDIAN		INSTALL DOWELS IN CONCRETE	BREAKOUT STRUCTURAL CONCRETE	CLASS A45 CONCRETE, BRIDGE REPAIR	SPECIAL STEEL RAILING		EPOXY COATED REINFORCEMENT FOR CONCRETE MASONRY	STRUCTURAL STEEL	TYPE IA REMOVAL	BRIDGE SIDEWALK CHAIN LINK FENCE								
		L. F.	SQ. YD.		EACH	CU. YD.	CU. YD.	L. F.		LBS.	L. S.	SQ. YD.	L. F.								
18+37.75	34+96.75	1659	737.3		708	39.6 +39.3	690.4 +676.2	1652.5		79.981 +80.726	L. S.	826.3	1655.0								

NOTE REGARDING EPOXY COATING OF EXISTING REINFORCING STEEL

The existing reinforcing steel to be retained in the sidewalk and median shall be blast cleaned. This steel shall then be epoxy coated with a suitable material, inert in concrete, that is compatible with the coating applied to the new epoxy coated reinforcing steel. This coating shall be supplied by the epoxy resin manufacturer who will be supplying coating material for the new epoxy coated reinforcing steel. The sandblasted steel must be coated promptly and before detrimental oxidation occurs. These bars shall be clean and free from all surface contaminants before coating. The Contractor has the option of supplying new epoxy coated reinforcing steel for the various existing longitudinal C bars in the sidewalk instead of cleaning and painting the existing resteel at no additional cost to the State. The existing concrete shall be protected from epoxy paint drips during resteel coating. The cost of all labor, equipment, tools and materials to clean and epoxy coat the resteel shall be included in the unit price bid for "Epoxy Coated Reinforcement for Concrete Masonry".

NOTES REGARDING PAINTING OF WEST BOUND CURB EXPANSION PLATES

- West Bound Lane curb plates shall be repainted to provide a uniform appearance. Plates shall be thoroughly cleaned by solvents and sandblasting as necessary to remove grease oil, dirt, rust, old paint scale, and rubberized asphalt. All areas shall be primed and painted as specified in Sec. 411 of the Standard Specifications. Edges of existing tight adherent paint must be feathered so that repainted surfaces will have a smooth appearance. The finish coat should be aluminum bridge paint.
- The cost of repainting the West Bound Lane curb expansion plates shall be absorbed in the lump sum price bid for "Structural Steel".

NOTE REGARDING INSTALLING DOWELS IN CONCRETE

The epoxy resin mixture for cementing the Dowels in place shall conform to requirements for bonding steel to hardened concrete as approved by the Engineer. To qualify the epoxy resin adhesive for approval the Contractor shall obtain from the manufacturer and submit to the Engineer certification that the dowel bar of 60 Grade deformed reinforcement steel with 10 diameter embedment or the 4,500 p.s.i. compressive strength concrete will fail before the epoxy resin fill when tested in tension. Prior approved epoxy resin adhesive already on a list maintained by the State need not re-qualify.

The diameter of the drilled holes in the concrete for the re-bar dowels shall not be less than 1/8 inch nor more than 3/8 inch greater than the overall diameter of the dowels.

The epoxy resin adhesive shall be mixed and applied as recommended by the manufacturer. Special attention must be given to the elimination of voids by using effective grouting procedures as approved by the Engineer.

Cost of the epoxy resin adhesive, drilling, dowels, installation of dowels and all other items incidental to the installation of the dowels in concrete shall be included in the unit price bid for the item "Install Dowels in Concrete".

NOTE REGARDING DRILLING HOLES FOR INSTALLING DOWELS IN CONCRETE CURB

Holes drilled in the existing concrete shall be true and normal or as shown on the plans. Care shall be taken not to damage the existing reinforcing steel. It is likely that some of the existing steel, as shown on the original construction plans, may have been placed out of position during construction. Therefore, prior to the start of drilling any holes in the concrete curbs an effort will be made by the State Forces to determine and mark on the curb surface any locations of the in-place reinforcing bars. In spite of this precaution, the Contractor can still expect to encounter and have to drill thru resteel and is advised that "Install Dowels in Concrete" shall be full compensation for this work.

NOTES REGARDING END BLOCKS (EAST BOUND LANES)

- The in-place concrete end blocks on the East Bound Lane shall be removed according to the Limits of Concrete Breakout on Sheet 11 of 32 and disposed of at a site as approved by the Engineer. These end blocks built on the bridge ends, may be removed as a unit or broken off the 6 ft. concrete piles and the concrete piles left in the ground. Any depressions or holes left in the ground shall be filled and compacted with granular fill material, as approved by the Engineer. All costs for labor, materials and incidentals associated with the removal and disposal of concrete end blocks shall be included in the unit price bid for "Breakout Structural Concrete".
- The new end blocks shall be built normal to grade.
- For "Notes Regarding 4-Bolt Insert Assembly", see Sheet 17 of 32.
- Use 1 1/2 inch Clear Cover on all bars except as shown.
- The 3/4" diameter concrete insert shall be internally threaded for use with a standard cap screw and shall be capable of sustaining an ultimate load in tension of 17000 pounds. The insert shall be either hot-dip galvanized or made of corrosion resistant material. The insert shall be complete with hot dip galvanized washer and a cap screw. The 3/4" diameter insert shall be placed on the Begin Bridge end block only.

NOTES REGARDING REMOVAL OF MEDIAN

- This work shall consist of removing the median to the limits shown in the Plans.
- Cut existing reinforcement, not to be reused, flush with the given Limit of Concrete Breakout as shown on the Plans Sheet 6 of 32.
- All broken out concrete shall be disposed of at a site provided by the Contractor and approved by the Engineer.
- The cost of removing the median shall be included in the price bid for "Removal of Concrete Median". Payment shall be based on the Plans Quantity and shall be full compensation for all materials, equipment, tools, labor and incidental work needed to complete the work.

NOTES REGARDING DECK DRAINS

- The drains are located in the center of each panel, except as shown. See Sheet No. 12 and 24 of 32.
- All angles, pipes, and plates shall conform to ASTM A36 and shall be hot-dip galvanized according to ASTM A-123. Galvanize the 1/2" diameter x 2 1/2" A307 Bolts, washers and nuts according to ASTM A-153.
- The existing drains in the East Bound Lanes that are to be plugged shall be filled with non-shrink grout.
- Material for the 3/8" diameter x 2 3/4" commercially available steel wedge-type anchor bolts, nuts and washers shall be at the option of the contractor. The bolts, nuts and washers shall be either hot-dipped galvanized according to ASTM-A153 or made of corrosion resistant material. The wedge-type anchors shall be installed in accordance with the manufacturer's recommendations.
- Care shall be taken during the drilling of holes for deck drains to prevent the concrete from spalling out.
- The location of the new deck drains will be verified by the Engineer. Care shall be taken when drilling new drains so that the existing reinforcing steel in the deck will not be drilled thru and damaged.
- All costs incurred while installing the drain extensions, drilling new drains, and plugging the existing drains as shown in the Plans shall be absorbed in the lump sum price bid for "Structural Steel". Payment shall be full compensation for all materials, equipment and incidentals necessary to complete the work.

NOTES REGARDING SPECIAL STEEL RAILING

- All rail posts shall be built vertical.
- All structural steel tubes shall conform to ASTM Specification A500, Grade B.
- All other structural steel for the Special Steel Railing shall conform to ASTM Specification A36.
- The 5/8 inch diameter anchor bolts and the 1/2" dia. carriage bolts shall conform to ASTM Specification A307. The anchor bolts, carriage bolts, nuts, and washers shall be galvanized in accordance with AASHTO Specification M232 (ASTM 153).
- The cost of welding, anchor bolts, nuts, washers, painting and all other material, equipment, and labor needed to satisfactorily complete the work, shall be included in the unit price bid for "Special Steel Railing".

NOTES REGARDING PAINTING THE NEW RAILS

- Shop coat the new rail with one coat of Red Lead Paint (AASHTO M-72, Type I) or Red Lead Iron Oxide Paint (AASHTO M72, Type III). Apply one field coat of gray intermediate paint followed by a coat of aluminum bridge paint. Paint shall be in accordance to Sec. 980 of the Standard Specifications. The paint shall be applied according to Sec. 411 of the Standard Specifications.
- All field welds and adjacent heat affected areas shall be given one coat of Red Lead Paint or Red Lead Iron Oxide Paint conforming to the requirements in Note 1 above prior to the application of the prescribed field coats of paint.
- After the rail posts have been installed and the nuts tightened, the projecting bolts and nuts shall receive a prime coat of Red Lead or Red Lead Iron Oxide Paint prior to the application of prescribed field coats of paint.
- Care shall be taken during the entire construction project to prevent damage to the existing rail. It will not be repainted. If the rail is damaged, it will be repaired and repainted at no cost to the State.
- Payment shall include all materials, tools, equipment, labor and incidental work needed to complete the work, and shall be absorbed in the unit bid price for "Special Steel Railing".

1659'-0" BRIDGE OVER MISSOURI RIVER
 STA. 18+37.75 TO 34+96.75 F0014(00)228
 STR. NO. 33-100-118
 HUGHES COUNTY 3 OF 32

FED. HWY. ADMIN. NO.	STATE OF	PROJECT	SHEET NO.	TOTAL SHEETS
8	S.D.	F0014(00)228	57	105

NOTES REGARDING PAINTING GIRDERS

- The girders shall be spot painted for + or - 10 ft. either side of Bents No. 4 and 7 as approved by the Engineer where water runs on them from the expansion device. They shall be prepared for painting and painted according to Sec. 411 of the South Dakota Standard Specs., except that the areas shall be blast cleaned to a near white metal finish, SSFC-SP10-82, and the primer shall be an aluminum filled epoxy mastic.
- The aluminum filled epoxy mastic shall be Carbomastic 96 obtained from the Carbolite Co., 1401 S. Hanley Rd., St. Louis, Mo. 63144, Phone 314-644-100; or an approved equal.
- The epoxy shall be mixed, thinned and applied according to manufacturer's recommendations. It shall be applied at the recommended dry film thickness per coat.
- The finish coat shall be an aluminum bridge paint that meets the South Dakota Standard Specifications.
- All costs incurred in spot painting the girders at Bents 4 and 7, including labor, materials, and incidentals shall be absorbed in the lump sum price bid for "Structural Steel".

- The item "Bridge Sidewalk Chain Link Fence" shall be paid for by the lineal foot. This payment shall be full compensation for furnishing all materials, labor, tools and equipment necessary or incidental to the construction of the Chain Link Fence, including end posts, line posts, brace rails, fence post caps, chain link fence fabric, wire ties, new railposts, base plates, angles, bolts, drilling for anchor bolts, welding, cutting existing rails, and painting, all to satisfactorily complete this work.

NOTES REGARDING UTILITIES

- Beneath the bridge deck there are a number of utilities. Prior to the start of construction, the Contractor shall contact the following people:

Lonnie Schumacher
Chief Tech.
Pierre Cable T.V.
Pierre, South Dakota 57501
Phone 224-8833

Brian Raecke
City Engineer
Ft. Pierre, South Dakota 57532
Phone 223-2508

Dave Lekness
Design Engineer
Northwestern Bell Telephone Co.
P. O. Box 100
Rapid City, South Dakota 57709-0100
Phone 394-4570

- The Contractor shall remove the dead electrical cables under the median in order to facilitate deck drain placement. These cables will not be replaced. The Contractor shall contact Brian Raecke, City Engineer of Ft. Pierre, to negotiate payment for this item. The Ft. Pierre City Council will reserve the right to reject this bid. The cables and hanging brackets shall be disposed of by the Contractor at a site approved by the Engineer. See Sheet No. 4 of 32 for location of dead electrical cables.

NOTES REGARDING CHAIN LINK FENCE

- The Chain Link Fence Fabric and supports shall conform to the South Dakota Standard Spec. Section 930.
- The chain link fence fabric shall be galvanized AASHTO M181, Type 1, 9 gauge, wire woven in a 2 inch mesh.
- Any areas of galvanized steel that have been welded, shall be painted with an approved Cold Galvanizing Compound.
- Chain Link Fence posts and brace rails shall comply with the Provisions of ASTM-A120 for weight and coating.
- New railposts, base plates, and angles shall be ASTM-A36 steel. They shall be painted with one shop coat of Red Lead Paint (AASHTO M72 Type I) or Red Lead Iron Oxide Paint (AASHTO M72 Type III) and one field coat of Gray Paint followed by a coat of Aluminum Paint to match the existing rail elements.
- The 1" dia. x 8" Anchor Bolts and 5/8" dia. x 1 1/2" bolts with heavy hex nuts and hardened steel washers shall conform to ASTM-A 307, and shall be galvanized to conform to ASTM-A153.
- 1 1/8" dia. holes shall be drilled thru the deck to facilitate anchor bolt placement for the new railposts. Care shall be taken to prevent coning or spalling of the concrete. If spalling of the concrete occurs, it shall be patched to its original shape using an epoxy grout at no cost to the State.
- The existing rails shall be cut at the lightpoles and at expansion points near Bents 4 and 7 to facilitate the placement of the new railposts. Drill 3/4" dia. holes thru the C 6 x 12 rails for the placement of the 5/8" dia. bolts.
- Where the chain link fence posts are to be welded to the railposts, air carbon arc shall be used to remove the tack welds that hold the 6" x 1/8" plates to the top of the railposts. Cut the C 8 x 11.5 as shown on the Plans.
- The 6" x 8" plates, C 6 x 12 and C 8 x 11.5 rails, and the rail panels that are to be removed shall be disposed of at a site obtained by the Contractor and approved by the Engineer.

1659'-0" BRIDGE OVER MISSOURI RIVER

STA. 18+37.75 TO 34+96.75

F 0014(00)228

STR. NO. 33-100-118

HUGHES COUNTY

3A

OF

32

FED. HWY. ADMIN. NO.	STATE OF	PROJECT	SHEET NO.	TOTAL SHEETS
8	S. D.	FOO14(00)228	57	105

NOTES REGARDING PAINTING GIRDERS

- The girders shall be spot painted for + or - 10 ft. either side of Bents No. 4 and 7 as approved by the Engineer where water runs on them from the expansion device. They shall be prepared for painting and painted according to Sec. 411 of the South Dakota Standard Specs., except that the areas shall be blast cleaned to a near white metal finish, SSFC-SP10-82, and the primer shall be an aluminum filled epoxy mastic.
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- The 1" dia. x 8" Anchor Bolts and 5/8" dia. x 1 1/2" bolts with heavy hex nuts and hardened steel washers shall conform to ASTM-A 307, and shall be galvanized to conform to ASTM-A153.
- 1 1/8" dia. holes shall be drilled thru the deck to facilitate anchor bolt placement for the new railposts. Care shall be taken to prevent coning or spalling of the concrete. If spalling of the concrete occurs, it shall be patched to its original shape using an epoxy grout at no cost to the State.
- The existing rails shall be cut at the lightpoles and at expansion points near Bents 4 and 7 to facilitate the placement of the new railposts. Drill 3/4" dia. holes thru the C 6 x 12 rails for the placement of the 5/8" dia. bolts.
- Where the chain link fence posts are to be welded to the railposts, air carbon arc shall be used to remove the tack welds that hold the 6" x 1/8" plates to the top of the railposts. Cut the C 8 x 11.5 as shown on the Plans.
- The 6" x 8" plates, C 6 x 12 and C 8 x 11.5 rails, and the rail panels that are to be removed shall be disposed of at a site obtained by the Contractor and approved by the Engineer.

- The item "Bridge Sidewalk Chain Link Fence" shall be paid for by the lineal foot. This payment shall be full compensation for furnishing all materials, labor, tools and equipment necessary or incidental to the construction of the Chain Link Fence, including end posts, line posts, brace rails, fence post caps, chain link fence fabric, wire ties, new railposts, base plates, angles, bolts, drilling for anchor bolts, welding, cutting existing rails, and painting, all to satisfactorily complete this work.

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Dave Lekness
Design Engineer
Northwestern Bell Telephone Co.
P. O. Box 100
Rapid City, South Dakota 57709-0100
Phone 394-4570

- The Contractor shall remove the dead electrical cables under the median in order to facilitate deck drain placement. These cables will not be replaced. The Contractor shall contact Brian Raecke, City Engineer of Ft. Pierre, to negotiate payment for this item. The Ft. Pierre City Council will reserve the right to reject this bid. The cables and hanging brackets shall be disposed of by the Contractor at a site approved by the Engineer. See Sheet No. 4 of 32 for location of dead electrical cables.

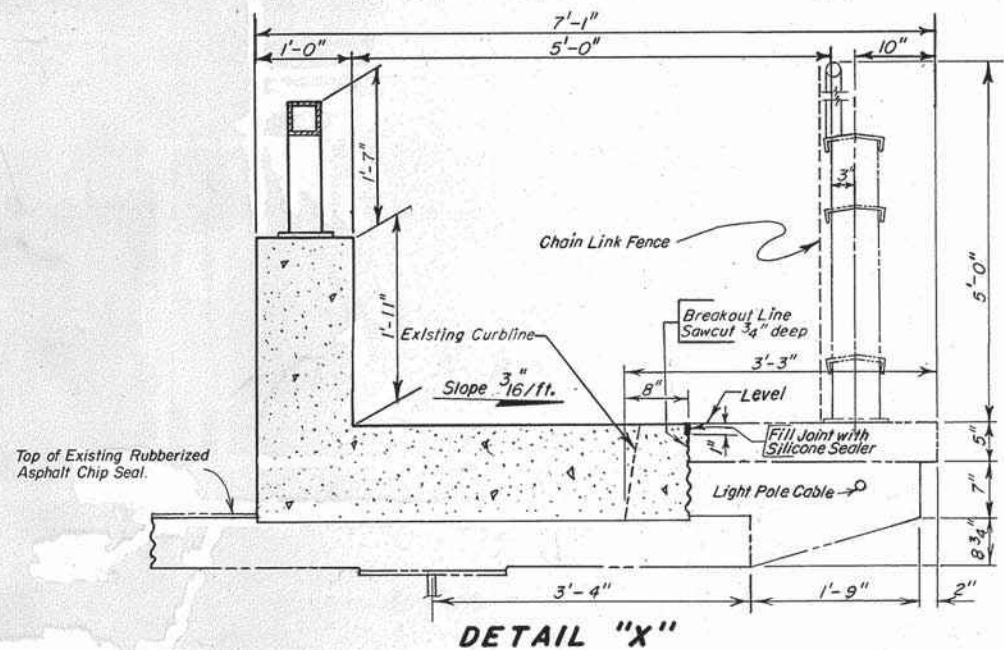
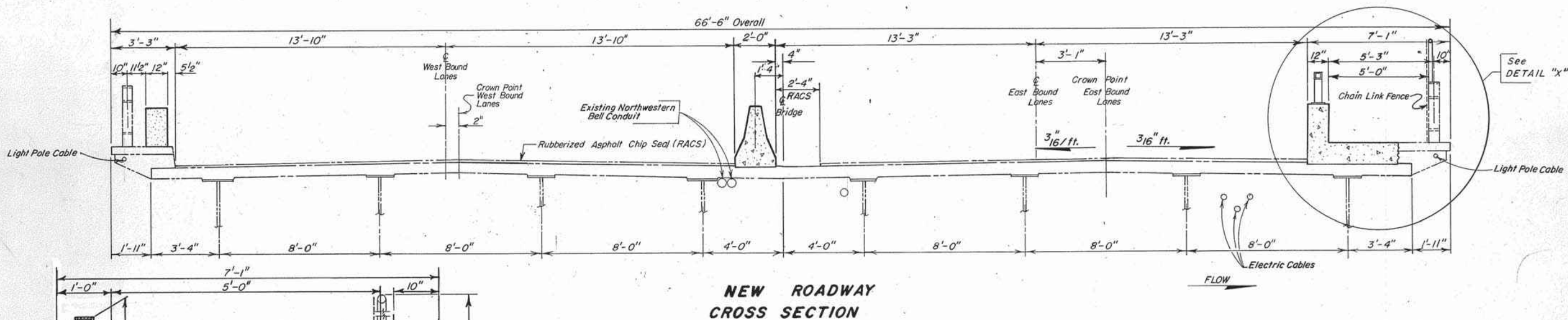
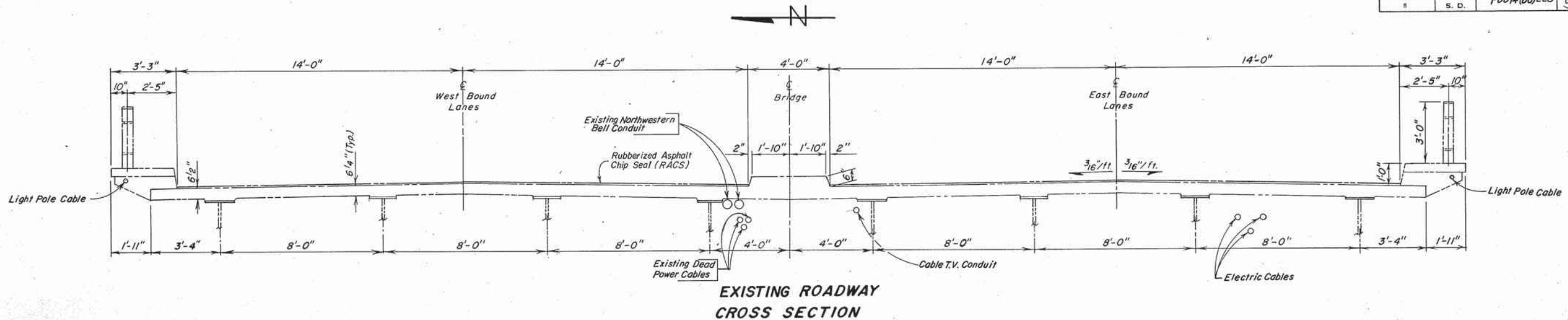
NOTES REGARDING NORTHWESTERN BELL MANHOLE

- In place at Sta. 25+44, at the centerline of the bridge is a Northwestern Bell manhole. This manhole is to be broken out and removed. Additional concrete shall be broken out in order to place a new manhole 1'-4" left at the same location. (See notes 2-4 of NOTES REGARDING BREAKOUT STRUCTURAL CONCRETE.)
- The median barrier shall have 4'-0" gaps provided at the manhole on the bridge and the manholes off the ends of the bridge. These gaps shall be covered with removable steel covers as shown in the plans.
- The fabrication of the steel barrier covers may either be from welded or bent plates with details provided in the shop plans.
- All plates, bars, and angles used to fabricate the steel barrier covers, end dams, and fabricated manhole shall conform to ASTM A36. After fabrication, they shall be painted according to South Dakota Standard Spec. 410 with a finish coat of aluminum bridge paint.
- The 1/2" dia. FHMS (Flat Head Machine Screw), 1/2" dia. concrete inserts, and nuts shall be stainless steel. The 1/2" dia. U-Bolts and washers shall be zinc-plated.
- The barrier covers and end dams shall be assembled prior to drilling the holes for the 1/2" dia. FHMS's to ensure proper fit.
- The barrier cover and end dams shall be assembled prior to concrete placement in the barrier. They shall be used as forms for the ends of the barriers.
- For informational purposes, the estimated weight of 3 removable steel covers, 6 steel end dams and 1 fabricated manhole is 2186 lbs.

CONSTRUCTION CHANGE

1659'-0" BRIDGE OVER MISSOURI RIVER
STA. 18+37.75 TO 34+96.75 FOO14(00)228
STR. NO. 33-100-118
HUGHES COUNTY

3A OF 32



ROADWAY CROSS SECTIONS
 FOR
1659'-0" BRIDGE OVER MISSOURI RIVER
 STA. 18+37.75 TO 34+96.75 27'-8" & 26'-6" ROADWAYS
 ON U.S. HWYS. 14 & 83 F0014(00)228
 STR. NO. 33-100-118 HS20-44 (& ALT.)
 HUGHES COUNTY
 S. D. DEPT. OF TRANSPORTATION

DESIGNED BY LAS	DRAWN BY D.A.H.	CHECKED BY TDW	APPROVED BRIDGE ENGINEER
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APPENDIX D
US14 Missouri River Replacement Study

- LEGEND:**
- STUDY AREA BOUNDARY
 - EXISTING PROPERTY BOUNDARIES
 - EXISTING ACQUIRED PROPERTY
 - PRELIMINARY BRIDGE LOCATION
 - POTENTIAL ACCESS IMPROVEMENTS
 - PRELIMINARY HIGHWAY APPROACH CONFIGURATION
 - EXISTING WATER LINE
 - EXISTING COMMUNICATION LINE
 - EXISTING GAS LINE
 - EXISTING SEWER LINE
 - EXISTING POWER LINE



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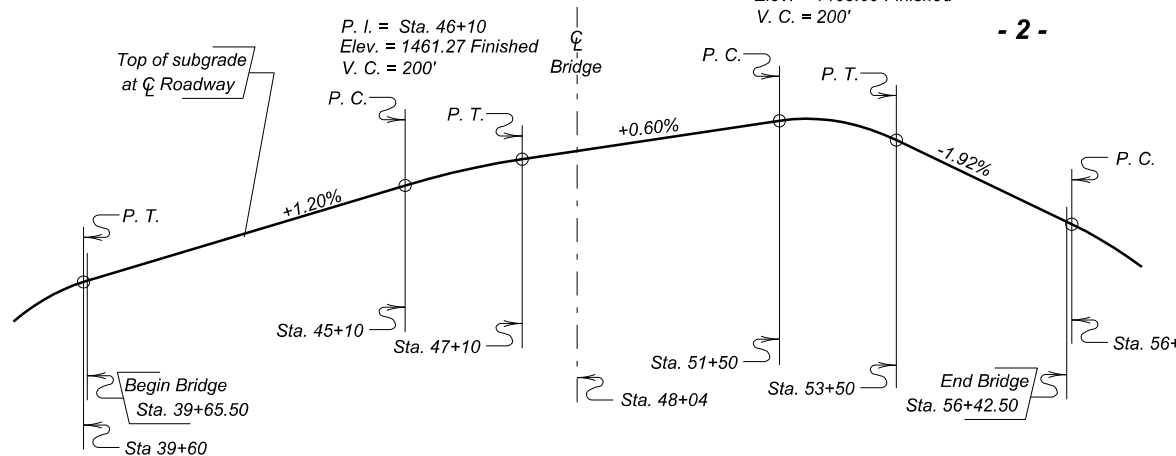
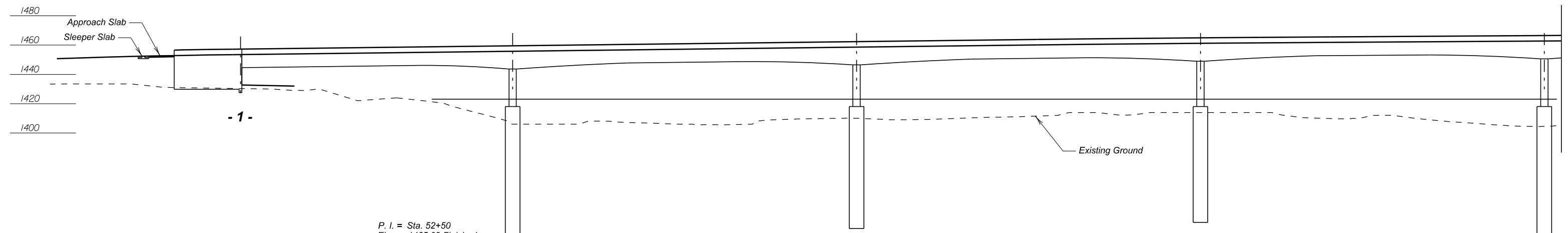
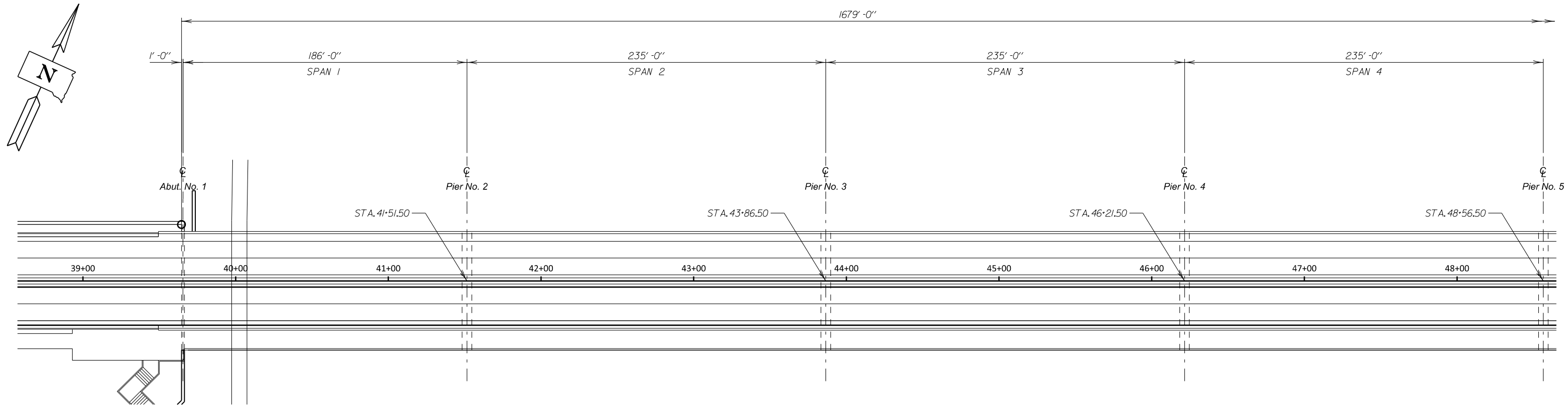
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US14/US83/SD34 MISSOURI RIVER BRIDGE REPLACEMENT STUDY
ALTERNATIVE N1 - PROPOSED ALIGNMENT TO NORTH OF EXISTING (ADJACENT)
 New bridge is constructed north of the existing alignment (10 ft. gap).



The elevations shown in these plans are based on the National Geodetic Survey (NGS) North American Vertical Datum of 1988 (NAVD88).

STATE OF	PROJECT	SHEET NO.	TOTAL SHEETS
S.D.	PROJECT		



VERTICAL CURVE DATA

HYDRAULIC DATA - TBD

Q_d	XXXX
A_d	XXXX
V_d	XXXX
Q_F	XXXX
Q_{100}	XXXX
$Q_{OT_{fr}}$	XXXX

Q_d = Design discharge for the proposed bridge based on XX year frequency. El. XXXX
 Q_{OT} = Overtopping discharge and frequency XX year recurrence interval. El. XXXX
 Q_F = Designated peak discharge for the basin approaching proposed project based on XX year frequency.
 Q_{100} = Computed discharge for the basin approaching proposed project based on 100 year frequency. El. XXXX

PLAN & PROFILE - WEST APPROACH
 FOR
1675'-0" PRESTRESSED CONC. BEAM BRIDGE
 OVER MISSOURI RIVER
 STA. 39+66.50
 STR. NO. F-030-1
 PCN 8028/03WM

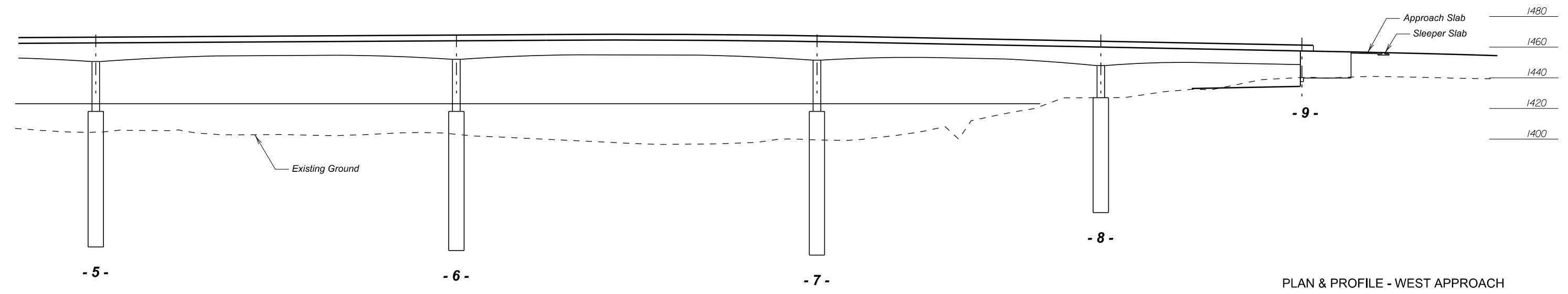
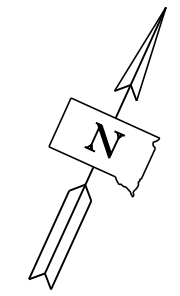
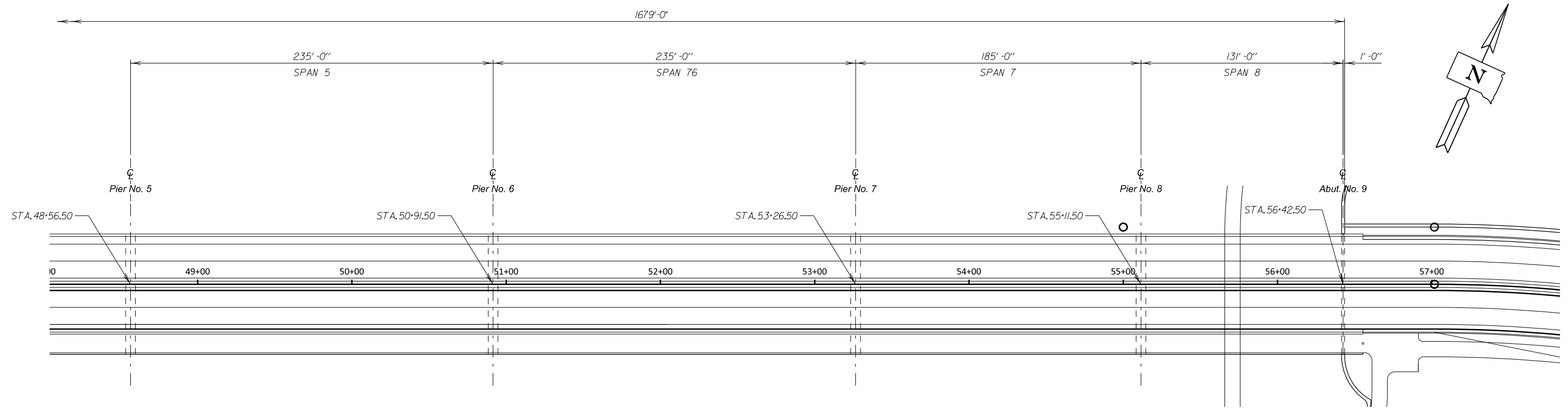
0° SKEW
 SEC. 28-T5N-R31E
 PROJECT NUMBER
 HP-5596(16)

HUGHES COUNTY
 S. D. DEPT. OF TRANSPORTATION
 MAY, 2016

C2
 1 OF 2

DESIGNED BY TK	CK. DES. BY RA	DRAFTED BY JAS	BRIDGE ENGINEER
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STATE OF	PROJECT	SHEET NO.	TOTAL SHEETS
S.D.	PROJECT		



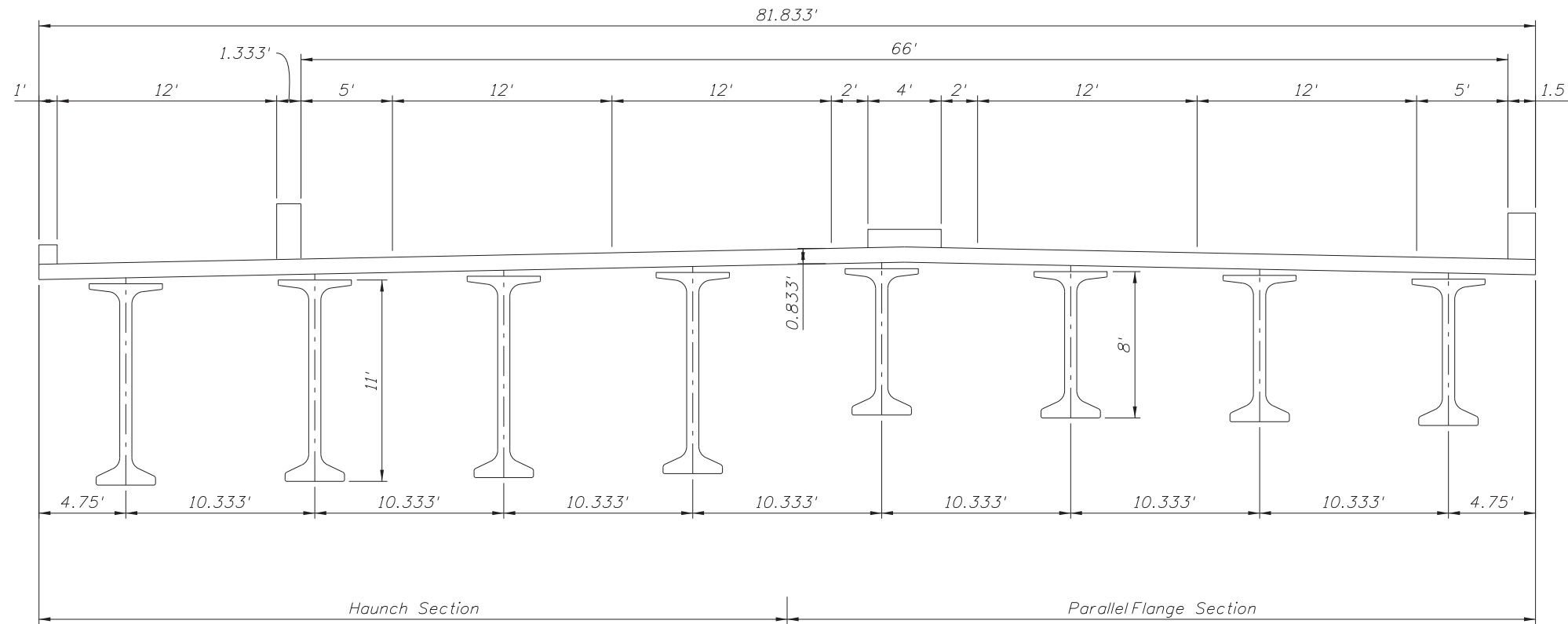
PLAN & PROFILE - WEST APPROACH
 FOR
1675'-0" PRESTRESSED CONC. BEAM BRIDGE
 OVER MISSOURI RIVER 0° SKEW
 STA. 39+66.50 SEC. 28-T5N-R31E
 STR. NO. F-030-1 PROJECT NUMBER
 PCN 8028/03WM HP-5596(16)

HUGHES COUNTY
 S. D. DEPT. OF TRANSPORTATION
 MAY, 2016

C3
 2 OF 2

DESIGNED BY TK	CK. DES. BY RA	DRAFTED BY JAS	Appendix D - Page 24
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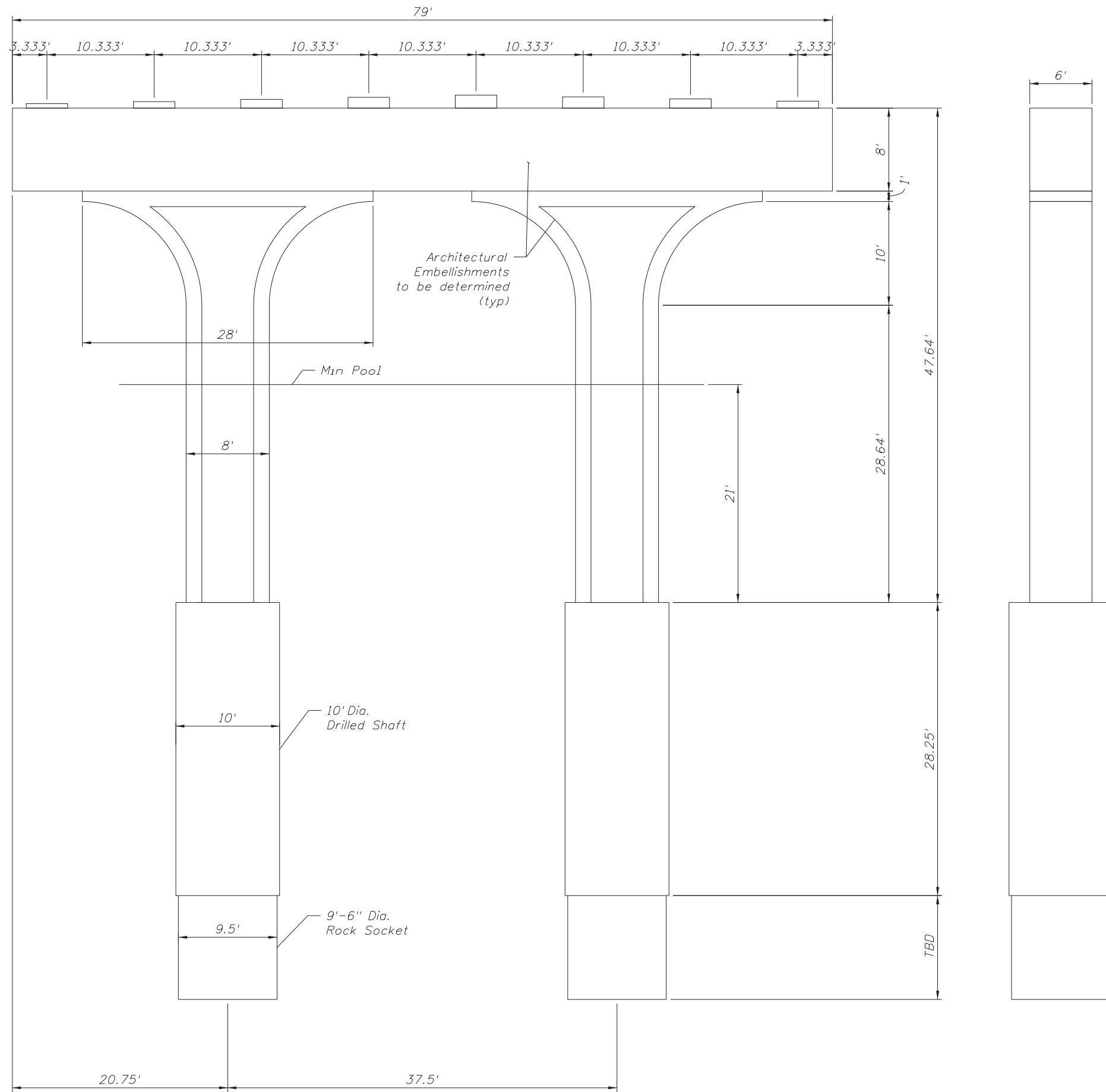
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US14/US83/SD34 MISSOURI RIVER BRIDGE
REPLACEMENT STUDY: CONCRETE GIRDER
230 FT MAIN SPAN, 30 FT CLEAR

DRW: JAA	DATE: 5/3/16	PROJECT NO.	FIG NO.
CHK: CO	DATE: 5/3/16	31811343	C4

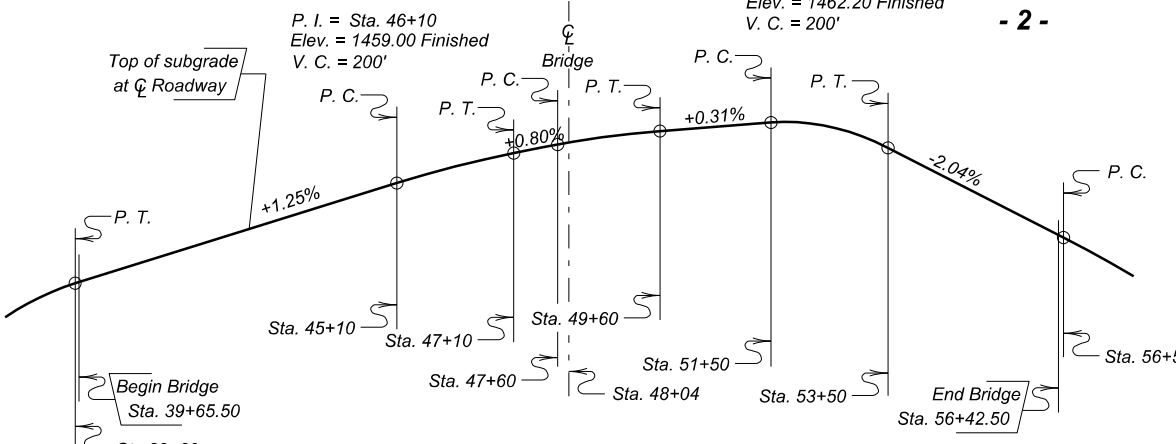
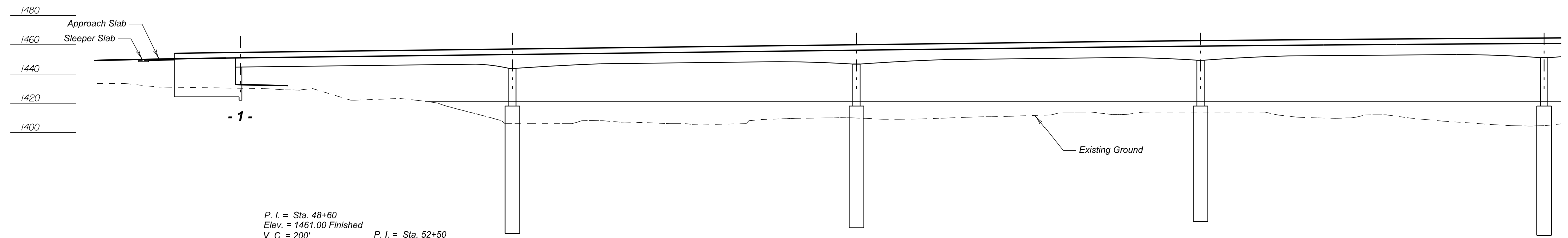
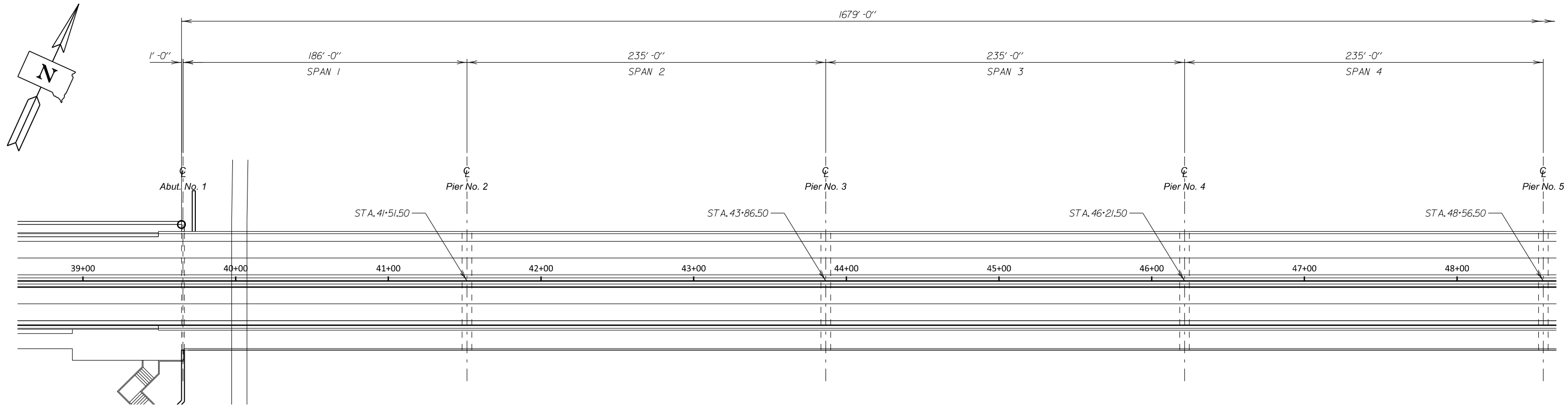
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		US14/US83/SD34 MISSOURI RIVER BRIDGE REPLACEMENT STUDY: CONCRETE GIRDER 230 FT MAIN SPAN, 30 FT CLEAR	
DRW: JAA	DATE: 5/3/16	PROJECT NO.	FIG NO.
CHK: CO	DATE: 5/3/16	31811343	C5

The elevations shown in these plans are based on the National Geodetic Survey (NGS) North American Vertical Datum of 1988 (NAVD88).

STATE OF	PROJECT	SHEET NO.	TOTAL SHEETS
S.D.	PROJECT		



HYDRAULIC DATA - TBD

Q_d	XXXX
A_d	XXXX
V_d	XXXX
Q_F	XXXX
Q_{100}	XXXX
$Q_{OT_{fr}}$	XXXX

Q_d = Design discharge for the proposed bridge based on XX year frequency. El. XXXX
 Q_{OT} = Overtopping discharge and frequency XX year recurrence interval. El. XXXX
 Q_F = Designated peak discharge for the basin approaching proposed project based on XX year frequency.
 Q_{100} = Computed discharge for the basin approaching proposed project based on 100 year frequency. El. XXXX

PLAN & PROFILE - WEST APPROACH
 FOR
1675'-0" CONT. STEEL BEAM BRIDGE
 OVER MISSOURI RIVER
 STA. 39+66.50
 STR. NO. F-030-1
 PCN 8028/03WM

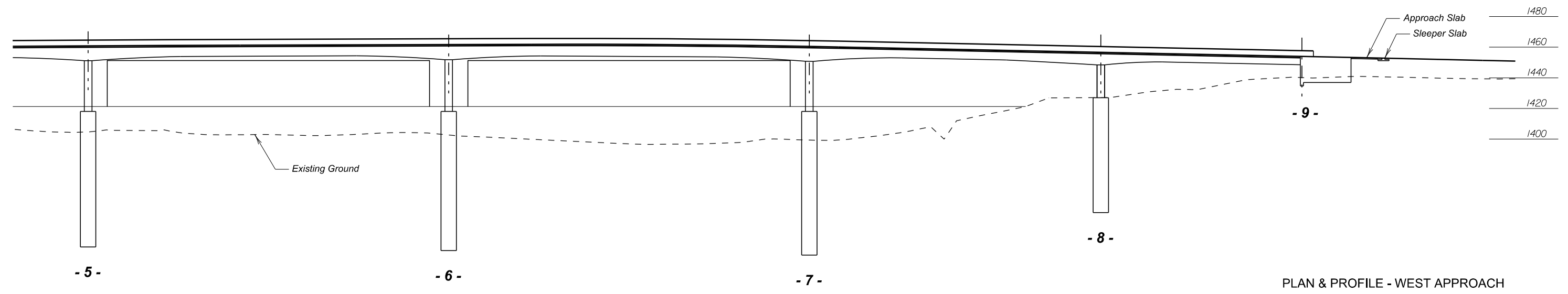
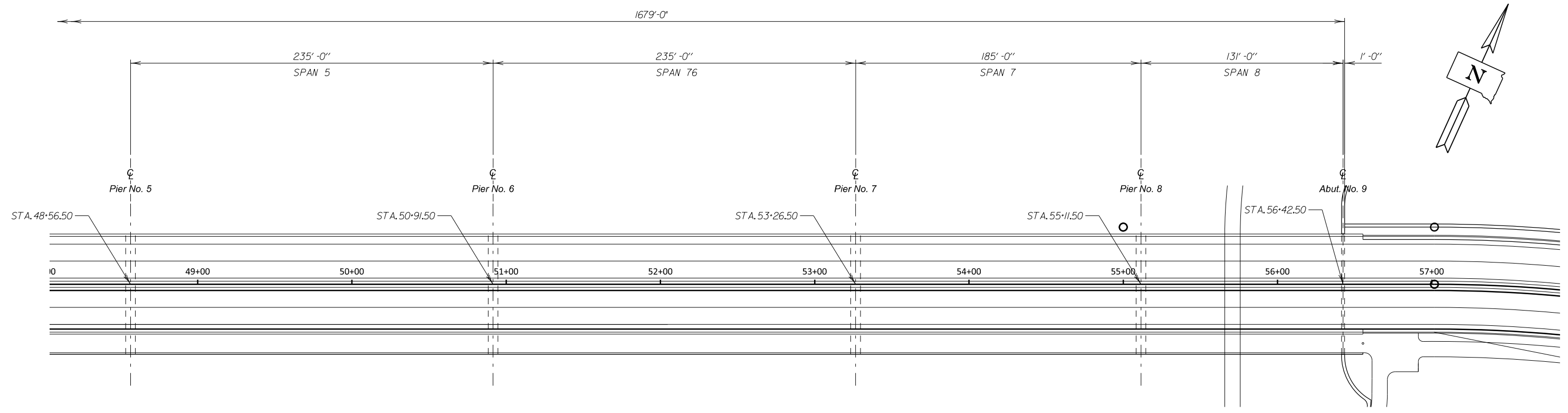
0° SKEW
 SEC. 28-T5N-R31E
 PROJECT NUMBER
 HP-5596(16)

HUGHES COUNTY
 S. D. DEPT. OF TRANSPORTATION
 MAY, 2016

VERTICAL CURVE DATA

DESIGNED BY TK	CK. DES. BY RA	DRAFTED BY JAS
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STATE OF	PROJECT	SHEET NO.	TOTAL SHEETS
S.D.	PROJECT		



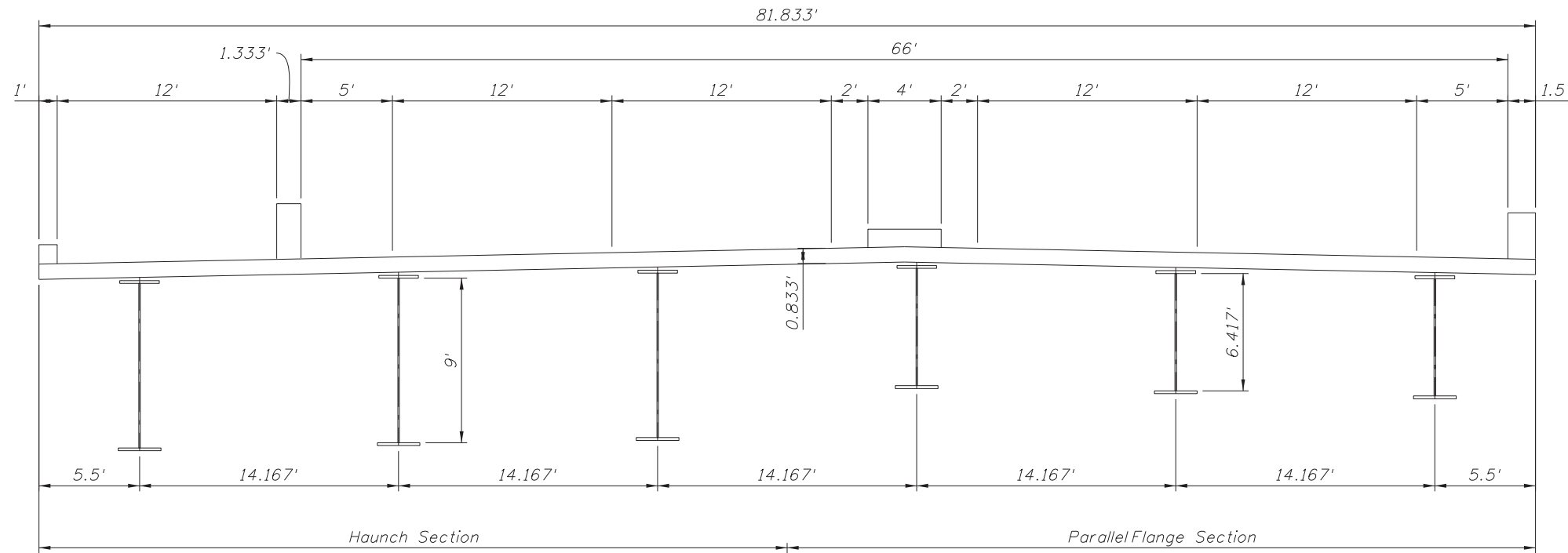
PLAN & PROFILE - WEST APPROACH
 FOR
1675'-0" CONT. STEEL BEAM BRIDGE
 OVER MISSOURI RIVER 0° SKEW
 STA. 39+66.50 SEC. 28-T5N-R31E
 STR. NO. F-030-1 PROJECT NUMBER
 PCN 8028/03WM HP-5596(16)

HUGHES COUNTY
 S. D. DEPT. OF TRANSPORTATION
 MAY, 2016

C7
 2 OF 2

DESIGNED BY TK	CK. DES. BY RA	DRAFTED BY JAS	Appendix D - Page 88
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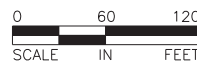
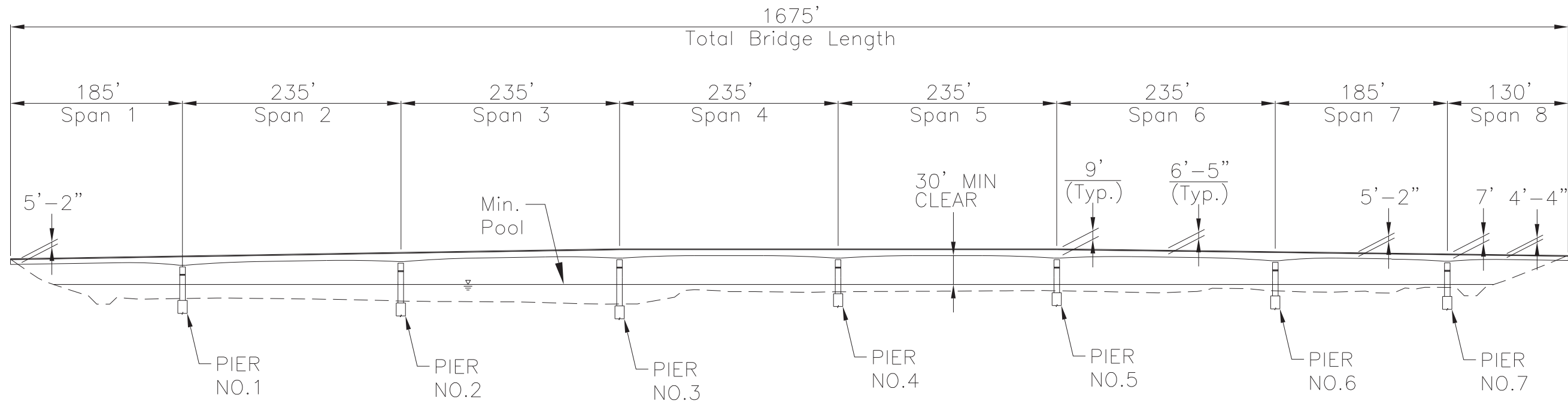
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US14/US83/SD34 MISSOURI RIVER BRIDGE
 REPLACEMENT STUDY: STEEL PLATE GIRDER
 230FT MAIN SPAN, 30 FT CLEAR

DRW: JAA	DATE: 5/3/16	PROJECT NO.	FIG NO.
CHK: CO	DATE: 5/3/16	31811343	C8

DATE: 10/1/13 TIME: 11:11:37 AM FILENAME: s:\projects\brgstruct\bridges\sodak_missouri_river_crossing\08_report\000_body\05_alternatives_analysis\figures\elevations



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US14/US83/SD34 MISSOURI RIVER BRIDGE
REPLACEMENT STUDY: STEEL PLATE GIRDER
230FT MAIN SPAN, 30 FT CLEAR

DRW: JAA	DATE: 5/3/16	PROJECT NO.	FIG NO.
CHK: CO	DATE: 5/3/16	31811343	C9

APPENDIX E

Cost Estimates



**Table 1.1: Option 2A - SD (8-Girder Concrete Haunched)
 Unit Price - Cost Evaluation**

by CBO date 16-Dec-14
 Rev TJK date 16-Mar-16
 chk _____ date _____

BRIDGE GEOMETRY	LENGTH	WIDTH	AREA
	(feet)	(feet)	(ft ²)
Option Layout	1675	81.83	137,071

Item	Unit	Quantity	Unit Price	Subtotal	Total
Superstructure					
Girder and Deck					
Structural Steel 50W - Diaphragms	LB	75,600	\$ 1.97	\$ 148,932	
Class A45 Concrete, Deck, Haunch	CY	4,562	\$ 600	\$ 2,737,200	
Class A45 Concrete, Deck Median	CY	248	\$ 600	\$ 148,800	
Class A45 Concrete, Pier Diaphragms	CY	871	\$ 600	\$ 522,667	
Shrinkage Reducing Admixture, Concrete Deck (0.5 gal/CYD)	CY	4,562	\$ 25	\$ 114,050	
Glass Fibers Reinforcement, Concrete Deck	CY	-	\$ 10	\$ -	
Special Surface Finish - Concrete, Deck (texturing)	SF	137,071	\$ 1.10	\$ 150,778	
Low Slump Dense Concrete Overlay (2")	CY	-	\$ 270	\$ -	
Polymer Overlay (3/8", applied 1 year after bridge opening, ie Sikadur 22 Lo Mod)	SY	-	\$ 5.50	\$ -	
Penetrating Protective Surface Treatment - Concrete Deck and Railings	SY	15,285	\$ 6.00	\$ 91,708	
Reinforcing Steel - Epoxy Coated (310#/CY)	LB	1,704,333	\$ 1.20	\$ 2,045,200	
Reinforcing Steel - Solid Stainless (310#/CY)	LB	-	\$ 3.10	\$ -	
Reinforcing Steel - Stainless Plated (310#/CY)	LB	-	\$ 2.60	\$ -	
Reinforcing Steel - Galvanized (310#/CY)	LB	-	\$ 1.30	\$ -	
Reinforcing Steel - ZBAR (310#/CY)	LB	-	\$ 2.00	\$ -	
Reinforcing Steel - Purple Epoxy Coated (310#/CY)	LB	-	\$ 1.85	\$ -	
96MW PS Girder	LF	6,820	\$ 475	\$ 3,239,500	
96MW PS w/ Variable Flange	LF	6,580	\$ 600	\$ 3,948,000	
Post-Tensioning Strand Longitudinal	LB	1,131,324	\$ 5.00	\$ 5,656,620	
Post-Tensioning Strand Transverse	LB	2,200	\$ 8.00	\$ 17,600	
Post-Tensioning Bar - Erection	LB	2,016	\$ 7.50	\$ 15,120	
Post-Tensioning Bar - Vertical	LB	-	\$ 7.50	\$ -	
Temporary Works - Shoring Systems	EA	8	\$ 60,000	\$ 480,000	
Girder and Deck Subtotal:				\$ 19,316,174	
Misc. Appurtenances					
Expansion Joints (Finger with trough)	LF	246	\$ 2,100	\$ 515,550	
Ornamental Steel Railing Type Special (54" with flag mounts)	LF	1,715	\$ 170	\$ 291,550	
Install Chain Link Fence	LF	-	\$ 35	\$ -	
Concrete Traffic Railing (TL-2) (at traffic side - north)	LF	1,715	\$ 90	\$ 154,350	
Modified Concrete Railing (TL-2) (at trail side)	LF	1,715	\$ 100	\$ 171,500	
Metal Pedestrian Railing (on pedestrian concrete railing, 42" combined height)	LF	1,675	\$ 70	\$ 117,250	
Electrical, Traffic Lighting (HPS 50' pole, 250 ft spacing), Lightning Protection, etc.	LS	1	\$ 97,880	\$ 97,880	
Electrical, Traffic Lighting (LED 50' pole, 250 ft spacing), Lightning Protection, etc.	LS	-	\$ 113,780	\$ -	
2" Rigid NonMetallic Schedule 40 Conduit (1 run in each barrier for traffic lighting)	LF	3,430	\$ 4	\$ 13,720	
2" Rigid NonMetallic Schedule 40 Conduit (1 run in each barrier for future use)	LF	3,430	\$ 4	\$ 13,720	
2" Rigid NonMetallic Schedule 40 Conduit (1 run each fascia for aesthetic lighting)	LF	3,430	\$ 4	\$ 13,720	
Elastomeric Bearings (Expansion)	EA	-	\$ 8,000	\$ -	
Elastomeric Bearings (Fixed)	EA	-	\$ 9,000	\$ -	
Disk or Pot Bearings	EA	80	\$ 16,500	\$ 1,320,000	
Painting of Structural Steel (diaphragms)	SF	4,032	\$ 6.00	\$ 24,192	
Concrete Surface Treatments (acid etch or paint fascia girders and bottom flanges)	SF	97,150	\$ 6.00	\$ 582,900	
Deck Drains (grated to not allow cans or bottles blockage)	EACH	64	\$ 425.00	\$ 27,200	
Belvidere (Bump outs)	EACH	4	\$ 7,500.00	\$ 30,000	
Miscellaneous Items	LS	1	\$ 40,000	\$ 40,000	
Misc. Appurtenances Subtotal:				\$ 3,413,532	
Superstructure Subtotal (1)					\$ 22,729,706
Substructure					
Piers					
Class A45 Concrete, Bridge	CY	2,197.30	\$ 575	\$ 1,263,448	
Reinforcing Steel - Epoxy (275#/CY)	LB	769,055	\$ 1.20	\$ 922,866	
Reinforcing Steel - Solid Stainless (275#/CY)	LB	-	\$ 3.10	\$ -	
Reinforcing Steel - Stainless Plated (275#/CY)	LB	-	\$ 2.60	\$ -	
Reinforcing Steel - Galvanized (275#/CY)	LB	-	\$ 1.30	\$ -	
Reinforcing Steel - ZBAR (275#/CY)	LB	-	\$ 2.00	\$ -	
Reinforcing Steel - Purple Epoxy Coated (275#/CY)	LB	-	\$ 1.85	\$ -	
Post-Tensioning Steel	LB	-	\$ 7.00	\$ -	
Pier Concrete - Architectural Treatments (\$15/SF)	LS	1	\$ 274,960	\$ 274,960	
Piers Subtotal:				\$ 2,461,274	



**Table 1.1: Option 2A - SD (8-Girder Concrete Haunched)
 Unit Price - Cost Evaluation**

by CBO date 16-Dec-14
 Rev TJK date 16-Mar-16
 chk _____ date _____

Pier Foundations						
Foundation Preparation (Cofferdam - Reused)	EA	-	\$ 750,000	\$ -		
Foundation Preparation (Tremie Seal)	CY	-	\$ 475	\$ -		
Class A45 Concrete, Footing	CY	-	\$ 575	\$ -		
Footing and Drilled Shaft Reinforcing - Black (250#/CY)	LB	1,055,250	\$ 1.20	\$ 1,266,300		
8 ft. Drilled Shaft - Perm. Cased Portion	LF	-	\$ 600	\$ -		
8 ft. Drilled Shaft Excavation	CY	-	\$ 700	\$ -		
Class A45 (A31) Concrete, 8 ft. Drilled Shaft	CY	-	\$ 675	\$ -		
10 ft. Drilled Shaft - Perm. Cased Portion	LF	525	\$ 750	\$ 393,750		
10 ft. Drilled Shaft Excavation	CY	3,066	\$ 700	\$ 2,146,200		
Class A45 Concrete, 10 ft. Drilled Shaft	CY	4,221	\$ 675	\$ 2,849,175		
12 ft. Drilled Shaft - Perm. Cased Portion	LF	-	\$ 900	\$ -		
12 ft. Drilled Shaft Excavation	CY	-	\$ 700	\$ -		
Class A45 Concrete, 12 ft. Drilled Shaft	CY	-	\$ 675	\$ -		
Drill Shaft Testing	LS	1	\$ 160,000	\$ 160,000		
Pier Foundations Subtotal:					\$ 6,815,425	
Approaches and Abutments						
Approach Slabs - Concrete	SY	121	\$ 235	\$ 28,490		
Approach Slabs - Epoxy Reinforcing (200#/CY)	LB	8,082	\$ 1.20	\$ 9,699		
Abutment Foundation Prep, Excavation and Backfill	CY	991	\$ 55	\$ 54,510		
Abutment Drainage System	LF	244	\$ 25	\$ 6,092		
Class A45 Concrete, Abutment	CY	382	\$ 575	\$ 219,586		
Class A45 Concrete, Abutment Footings	CY	327	\$ 575	\$ 188,217		
Abutment Footing Reinforcing, Black (250#/CY)	LB	81,833	\$ 1.10	\$ 90,017		
Abutment Wall Reinforcing, Epoxy (250#/CY)	LB	95,472	\$ 1.20	\$ 114,567		
HP 12x53 Bearing Pile (furnished and installed)	LF	7,500	\$ 55	\$ 412,500		
HP 12x53 Test Pile (furnished and installed)	LF	340	\$ 75	\$ 25,500		
Dynamic Pile Test (during driving)	EACH	4	\$ 4,000	\$ 16,000		
Wingwall Foundation Prep, Excavation and Backfill	CY	440	\$ 55	\$ 24,200		
Class A45 Concrete, Wingwalls	CY	122	\$ 575	\$ 70,278		
Class A45 Concrete, Wingwall Footings	CY	89	\$ 575	\$ 51,111		
Wingwall Reinforcement, Epoxy (220#/CY)	LB	26,888.89	\$ 1.20	\$ 32,267		
Wingwall Reinforcement, Black (250#/CY)	LB	22,222.22	\$ 1.10	\$ 24,444		
Rubberized Membrane Waterproofing	SY	453	\$ 27.00	\$ 12,220		
Rock Riprap, Class B	TON	306	\$ 36	\$ 10,998		
Concrete - Architectural Treatments (\$20/SFT)	LS	1	\$ 51,555	\$ 51,555		
Approaches and Abutments Subtotal:					\$ 1,442,250	
Retaining Walls						
Retaining Walls Foundation Prep, Excavation and Backfill	CY	1,871	\$ 55	\$ 102,921		
MSE Large Panel (Tall Wall)	SF	3,750	\$ 37.00	\$ 138,750		
MSE Large Panel (Short Wall)	SF	5,600	\$ 35.00	\$ 196,000		
Class A45 Concrete, Footing	CY	-	\$ 575.00	\$ -		
Class A45 Concrete, Walls	CY	-	\$ 575.00	\$ -		
Wall Reinforcement, Epoxy (220#/CY)	LB	-	\$ 1.20	\$ -		
Footing Reinforcement, Black (250#/CY)	LB	-	\$ 1.10	\$ -		
Retaining Wall - Architectural Treatments	LS	-	\$ 15,000	\$ -		
Retaining Walls Subtotal:					\$ 437,671	
Substructure Subtotal (2)						\$ 11,156,620
Supplemental Items						
General Aesthetic Enhancement (copings, concrete coatings, ect.)	LS	1	\$ 50,000	\$ 50,000		
Concrete Stairs and Landings	EA	2	\$ 40,000.00	\$ 80,000		
River Navigation Lighting System	LS	-	\$ 40,600	\$ -		
Concrete Slope Protection (concrete plaza slab)	SY	-	\$ 60	\$ -		
Fascia Girder Architectural Lighting System (multi color LED)	LS	-	\$ 335,000	\$ -		
Pier Architectural Lighting System (multi color LED)	LS	-	\$ 315,000	\$ -		
Removal of Old Bridge	LS	1	\$ 2,500,000	\$ 2,500,000		
Supplemental Items Subtotal (3)						\$ 2,630,000
Main Bridge Quantities Subtotal (1) + (2) + (3)						
Mobilization (Includes Barge Access)	5%			\$ 1,825,816		
Design Contingency	20%			\$ 7,303,265		
Construction Contingency	20%			\$ 7,303,265.21		
Escalation (3% x 2 years = 6%)	6%			\$ 2,190,980		
Bridge Grand Total					\$ 55,139,652	
Square Foot Total					\$ 402.27	
Square Foot Total - excluding Demo					\$ 384.03	



Table B.4
100-Year Life Cycle Cost Estimate: Concrete Alternative

by TJK date 3-Jun-16
 chk _____ date _____

Geometry	Length (ft)	Bridge Width (ft)	Bridge Area (ft ²)
Unit 1	1675	81.83	137,071
Totals	1675		137,071

Item	Year of Occurrence	Units	Quantity	Unit Cost	Initial Cost
Maintenance & Inspection	Annual	ft ²	137,071	\$ 0.25	\$ 34,268
Deck Rehabilitation	25, 50 & 75	ft ²	137,071	\$ 2.50	\$ 342,677
Bearing Replacement	50	ea.	80	\$ 16,500.00	\$ 1,320,000
Expansion Joint Replacement	25, 50 & 75	ft	246	\$ 2,100.00	\$ 516,600
Concrete Surface Treatment	25, 50 & 75	ft ²	97,150	\$ 6.00	\$ 582,900
				\$ -	\$ -
				\$ -	\$ -

Item	Life Cycle = 100 yrs		Present Value			Equal Uniform Annual Cost (EUAC)		
	Initial Cost	Year	Real Discount Rate			Real Discount Rate		
			2.0%	4.0%	6.0%	2.0%	4.0%	6.0%
Initial Construction	\$ 55,139,652	0	\$ 55,139,652	\$ 55,139,652	\$ 55,139,652	\$ 1,279,391	\$ 2,250,139	\$ 3,318,159
Maintenance & Inspection	\$ 35,640	Annual	\$ 1,536,025	\$ 873,358	\$ 592,249	\$ 35,640	\$ 35,640	\$ 35,640
Deck Rehabilitation								
Deck Rehabilitation	\$ 342,677	25	\$ 208,872	\$ 128,544	\$ 79,843	\$ 4,846	\$ 5,246	\$ 4,805
Deck Rehabilitation	\$ 342,677	50	\$ 127,314	\$ 48,219	\$ 18,603	\$ 2,954	\$ 1,968	\$ 1,120
Deck Rehabilitation	\$ 342,677	75	\$ 77,602	\$ 18,088	\$ 4,335	\$ 1,801	\$ 738	\$ 261
Bearing Replacement								
Bearing Replacement	\$ 1,320,000	50	\$ 490,417	\$ 185,741	\$ 71,661	\$ 11,379	\$ 7,580	\$ 4,312
Expansion Joint Replacement								
Expansion Joint Replacement	\$ 516,600	25	\$ 314,884	\$ 193,785	\$ 120,367	\$ 7,306	\$ 7,908	\$ 7,243
Expansion Joint Replacement	\$ 516,600	50	\$ 191,931	\$ 72,692	\$ 28,045	\$ 4,453	\$ 2,966	\$ 1,688
Expansion Joint Replacement	\$ 516,600	75	\$ 116,988	\$ 27,268	\$ 6,535	\$ 2,714	\$ 1,113	\$ 393
Concrete Surface Treatment								
Concrete Surface Treatment	\$ 582,900	25	\$ 355,296	\$ 218,656	\$ 135,815	\$ 8,244	\$ 8,923	\$ 8,173
Concrete Surface Treatment	\$ 582,900	50	\$ 216,564	\$ 82,021	\$ 31,645	\$ 5,025	\$ 3,347	\$ 1,904
Concrete Surface Treatment	\$ 582,900	75	\$ 132,002	\$ 30,768	\$ 7,373	\$ 3,063	\$ 1,256	\$ 444
Life Cycle Cost Totals			\$ 58,907,547	\$ 57,018,792	\$ 56,236,123	\$ 1,366,817	\$ 2,326,823	\$ 3,384,141
Square Foot Totals			\$ 430	\$ 416	\$ 410	\$ 10	\$ 17	\$ 25



**Table 1.1: Option 2A - SD
 Unit Price - Cost Evaluation**

by CBO date 16-Dec-14
 Rev TJK date 16-Mar-16
 chk _____ date _____

BRIDGE GEOMETRY	LENGTH	WIDTH	AREA
	(feet)	(feet)	(ft ²)
Option Layout	1675	81.83	137,071

Item	Unit	Quantity	Unit Price	Subtotal	Total
Superstructure					
Girder and Deck					
Structural Steel 50W - Girders and Diaphragms	LB	6,204,120	\$ 1.97	\$ 12,222,116	
Class A45 Concrete, Deck, Haunch	CY	4,365	\$ 600	\$ 2,619,240	
Class A45 Concrete, Deck Median	CY	248	\$ 600	\$ 148,800	
Shrinkage Reducing Admixture, Concrete Deck (0.5 gal/CYD)	CY	4,365	\$ 25	\$ 109,135	
Glass Fibers Reinforcement, Concrete Deck	CY	-	\$ 10	\$ -	
Special Surface Finish - Concrete, Deck (texturing)	SF	137,071	\$ 1.10	\$ 150,778	
Low Slump Dense Concrete Overlay (2")	CY	-	\$ 270	\$ -	
Polymer Overlay (3/8", applied 1 year after bridge opening, ie Sikadur 22 Lo Mod)	SY	-	\$ 5.50	\$ -	
Penetrating Protective Surface Treatment - Concrete Deck and Railings	SY	15,285	\$ 6.00	\$ 91,708	
Reinforcing Steel - Epoxy Coated (310#/CY)	LB	1,384,020	\$ 1.20	\$ 1,660,824	
Reinforcing Steel - Solid Stainless (310#/CY)	LB	-	\$ 3.10	\$ -	
Reinforcing Steel - Stainless Plated (310#/CY)	LB	-	\$ 2.60	\$ -	
Reinforcing Steel - Galvanized (310#/CY)	LB	-	\$ 1.30	\$ -	
Reinforcing Steel - ZBAR (310#/CY)	LB	-	\$ 2.00	\$ -	
Reinforcing Steel - Purple Epoxy Coated (310#/CY)	LB	-	\$ 1.85	\$ -	
Temporary Works - Shoring Systems	EA	1	\$ 60,000	\$ 60,000	
Girder and Deck Subtotal:				\$ 17,062,601	
Misc. Appurtenances					
Expansion Joints (Finger with trough)	LF	164	\$ 2,100	\$ 343,700	
Ornamental Steel Railing Type Special (54" with flag mounts)	LF	1,715	\$ 170	\$ 291,550	
Install Chain Link Fence	LF	-	\$ 35	\$ -	
Concrete Traffic Railing (TL-2) (at traffic side - north)	LF	1,715	\$ 90	\$ 154,350	
Modified Concrete Railing (TL-2) (at trail side)	LF	1,715	\$ 100	\$ 171,500	
Metal Pedestrian Railing (on pedestrian concrete railing, 42" combined height)	LF	1,675	\$ 70	\$ 117,250	
Electrical, Traffic Lighting (HPS 50' pole, 250 ft spacing), Lightning Protection, etc.	LS	1	\$ 97,880	\$ 97,880	
Electrical, Traffic Lighting (LED 50' pole, 250 ft spacing), Lightning Protection, etc.	LS	-	\$ 113,780	\$ -	
2" Rigid NonMetallic Schedule 40 Conduit (1 run in each barrier for traffic lighting)	LF	3,430	\$ 4	\$ 13,720	
2" Rigid NonMetallic Schedule 40 Conduit (1 run in each barrier for future use)	LF	3,430	\$ 4	\$ 13,720	
2" Rigid NonMetallic Schedule 40 Conduit (1 run each fascia for aesthetic lighting)	LF	3,430	\$ 4	\$ 13,720	
Elastomeric Bearings (Expansion)	EA	-	\$ 8,000	\$ -	
Elastomeric Bearings (Fixed)	EA	-	\$ 9,000	\$ -	
Disk or Pot Bearings	EA	54	\$ 16,500	\$ 891,000	
Painting of Structural Steel (at piers)	SF	276,811	\$ 6.00	\$ 1,660,866	
Deck Drains (grated to not allow cans or bottles blockage)	EACH	64	\$ 425.00	\$ 27,200	
Belvidere (Bump outs)	EACH	4	\$ 7,500.00	\$ 30,000	
Miscellaneous Items	LS	1	\$ 40,000	\$ 40,000	
Misc. Appurtenances Subtotal:				\$ 3,866,456	
Superstructure Subtotal (1)					\$ 20,929,057
Substructure					
Piers					
Class A45 Concrete, Bridge	CY	2,195.20	\$ 575	\$ 1,262,240	
Reinforcing Steel - Epoxy (250#/CY)	LB	548,800	\$ 1.20	\$ 658,560	
Reinforcing Steel - Solid Stainless (250#/CY)	LB	-	\$ 3.10	\$ -	
Reinforcing Steel - Stainless Plated (250#/CY)	LB	-	\$ 2.60	\$ -	
Reinforcing Steel - Galvanized (250#/CY)	LB	-	\$ 1.30	\$ -	
Reinforcing Steel - ZBAR (250#/CY)	LB	-	\$ 2.00	\$ -	
Reinforcing Steel - Purple Epoxy Coated (250#/CY)	LB	-	\$ 1.85	\$ -	
Post-Tensioning Steel	LB	-	\$ 7.00	\$ -	
Pier Concrete - Architectural Treatments (\$15/SF)	LS	1	\$ 274,960	\$ 274,960	
Piers Subtotal:				\$ 2,195,760	



**Table 1.1: Option 2A - SD
 Unit Price - Cost Evaluation**

by CBO date 16-Dec-14
 Rev TJK date 16-Mar-16
 chk _____ date _____

Pier Foundations						
Foundation Preparation (Cofferdam - Reused)	EA	-	\$ 750,000	\$ -		
Foundation Preparation (Tremie Seal)	CY	-	\$ 475	\$ -		
Class A45 Concrete, Footing	CY	-	\$ 575	\$ -		
Footing and Drilled Shaft Reinforcing - Black (250#/CY)	LB	1,004,500	\$ 1.20	\$ 1,205,400		
8 ft. Drilled Shaft - Perm. Cased Portion	LF	-	\$ 600	\$ -		
8 ft. Drilled Shaft Excavation	CY	-	\$ 700	\$ -		
Class A45 (A31) Concrete, 8 ft. Drilled Shaft	CY	-	\$ 675	\$ -		
10 ft. Drilled Shaft - Perm. Cased Portion	LF	525	\$ 750	\$ 393,750		
10 ft. Drilled Shaft Excavation	CY	2,870	\$ 700	\$ 2,009,000		
Class A45 Concrete, 10 ft. Drilled Shaft	CY	4,018	\$ 675	\$ 2,712,150		
12 ft. Drilled Shaft - Perm. Cased Portion	LF	-	\$ 900	\$ -		
12 ft. Drilled Shaft Excavation	CY	-	\$ 700	\$ -		
Class A45 Concrete, 12 ft. Drilled Shaft	CY	-	\$ 675	\$ -		
Drill Shaft Testing	LS	1	\$ 160,000	\$ 160,000		
Pier Foundations Subtotal:				\$ 6,480,300		
Approaches and Abutments						
Approach Slabs - Concrete	SY	121	\$ 235	\$ 28,490		
Approach Slabs - Epoxy Reinforcing (200#/CY)	LB	8,082	\$ 1.20	\$ 9,699		
Abutment Foundation Prep, Excavation and Backfill	CY	955	\$ 55	\$ 52,510		
Abutment Drainage System	LF	244	\$ 25	\$ 6,092		
Class A45 Concrete, Abutment	CY	364	\$ 575	\$ 209,130		
Class A45 Concrete, Abutment Footings	CY	291	\$ 575	\$ 167,304		
Abutment Footing Reinforcing, Black (220#/CY)	LB	64,012	\$ 1.10	\$ 70,413		
Abutment Wall Reinforcing, Epoxy (250#/CY)	LB	90,926	\$ 1.20	\$ 109,111		
HP 12x53 Bearing Pile (furnished and installed)	LF	6,500	\$ 55	\$ 357,500		
HP 12x53 Test Pile (furnished and installed)	LF	300	\$ 75	\$ 22,500		
Dynamic Pile Test (during driving)	EACH	4	\$ 4,000	\$ 16,000		
Wingwall Foundation Prep, Excavation and Backfill	CY	440	\$ 55	\$ 24,200		
Class A45 Concrete, Wingwalls	CY	122	\$ 575	\$ 70,278		
Class A45 Concrete, Wingwall Footings	CY	89	\$ 575	\$ 51,111		
Wingwall Reinforcement, Epoxy (220#/CY)	LB	26,888.89	\$ 1.20	\$ 32,267		
Wingwall Reinforcement, Black (250#/CY)	LB	22,222.22	\$ 1.10	\$ 24,444		
Rubberized Membrane Waterproofing	SY	453	\$ 27.00	\$ 12,220		
Rock Riprap, Class B	TON	306	\$ 36	\$ 10,998		
Concrete - Architectural Treatments (\$20/SFT)	LS	1	\$ 51,555	\$ 51,555		
Approaches and Abutments Subtotal:				\$ 1,325,821		
Retaining Walls						
Retaining Walls Foundation Prep, Excavation and Backfill	CY	1,871	\$ 55	\$ 102,921		
MSE Large Panel (Tall Wall)	SF	3,750	\$ 37.00	\$ 138,750		
MSE Large Panel (Short Wall)	SF	5,600	\$ 35.00	\$ 196,000		
Class A45 Concrete, Footing	CY	-	\$ 575.00	\$ -		
Class A45 Concrete, Walls	CY	-	\$ 575.00	\$ -		
Wall Reinforcement, Epoxy (220#/CY)	LB	-	\$ 1.20	\$ -		
Footing Reinforcement, Black (250#/CY)	LB	-	\$ 1.10	\$ -		
Retaining Wall - Architectural Treatments	LS	-	\$ 15,000	\$ -		
Retaining Walls Subtotal:				\$ 437,671		
Substructure Subtotal (2)						\$ 10,439,552
Supplemental Items						
General Aesthetic Enhancement (triple washed structural steel, copings, ect.)	LS	1	\$ 50,000	\$ 50,000		
Concrete Stairs and Landings	EA	2	\$ 40,000.00	\$ 80,000		
River Navigation Lighting System	LS	-	\$ 40,600	\$ -		
Concrete Slope Protection (concrete plaza slab)	SY	-	\$ 60	\$ -		
Fascia Girder Architectural Lighting System (multi color LED)	LS	-	\$ 335,000	\$ -		
Pier Architectural Lighting System (multi color LED)	LS	-	\$ 315,000	\$ -		
Removal of Old Bridge	LS	1	\$ 2,500,000	\$ 2,500,000		
Supplemental Items Subtotal (3)						\$ 2,630,000
Main Bridge Quantities Subtotal (1) + (2) + (3)						
Mobilization (Includes Barge Access)	5%			\$ 33,998,609		
Design Contingency	20%			\$ 1,699,930		
Construction Contingency	20%			\$ 6,799,722		
Escalation (3% x 2 years = 6%)	6%			\$ 6,799,721.85		
				\$ 2,039,917		
Bridge Grand Total					\$ 51,337,900	
Square Foot Total					\$ 374.54	
Square Foot Total - excluding Demo					\$ 356.30	



Table B.4
100-Year Life Cycle Cost Estimate: Steel Alternative

by TJK date 3-Jun-16
 chk _____ date _____

Geometry	Length (ft)	Bridge Width (ft)	Bridge Area (ft ²)
Unit 1	1675	81.83	137,071
Totals	1675		137,071

Item	Year of Occurrence	Units	Quantity	Unit Cost	Initial Cost
Maintenance & Inspection	Annual	ft ²	137,071	\$ 0.25	\$ 34,268
Deck Rehabilitation	25, 50 & 75	ft ²	137,071	\$ 2.50	\$ 342,677
Bearing Replacement	50	ea.	54	\$ 16,500.00	\$ 891,000
Expansion Joint Replacement	25, 50 & 75	ft	164	\$ 2,100.00	\$ 344,400
Steel Surface Treatment	25, 50 & 75	ft ²	276,811	\$ 6.00	\$ 1,660,866
				\$ -	\$ -
				\$ -	\$ -

Item	Life Cycle = 100 yrs		Present Value			Equal Uniform Annual Cost (EUAC)		
	Initial Cost	Year	Real Discount Rate			Real Discount Rate		
			2.0%	4.0%	6.0%	2.0%	4.0%	6.0%
Initial Construction	\$ 51,337,900	0	\$ 51,337,900	\$ 51,337,900	\$ 51,337,900	\$ 1,191,180	\$ 2,094,997	\$ 3,089,379
Maintenance & Inspection	\$ 35,640	Annual	\$ 1,536,025	\$ 873,358	\$ 592,249	\$ 35,640	\$ 35,640	\$ 35,640
Deck Rehabilitation								
Deck Rehabilitation	\$ 342,677	25	\$ 208,872	\$ 128,544	\$ 79,843	\$ 4,846	\$ 5,246	\$ 4,805
Deck Rehabilitation	\$ 342,677	50	\$ 127,314	\$ 48,219	\$ 18,603	\$ 2,954	\$ 1,968	\$ 1,120
Deck Rehabilitation	\$ 342,677	75	\$ 77,602	\$ 18,088	\$ 4,335	\$ 1,801	\$ 738	\$ 261
Bearing Replacement								
Bearing Replacement	\$ 891,000	50	\$ 331,031	\$ 125,375	\$ 48,371	\$ 7,681	\$ 5,116	\$ 2,911
Expansion Joint Replacement								
Expansion Joint Replacement	\$ 344,400	25	\$ 209,922	\$ 129,190	\$ 80,245	\$ 4,871	\$ 5,272	\$ 4,829
Expansion Joint Replacement	\$ 344,400	50	\$ 127,954	\$ 48,461	\$ 18,697	\$ 2,969	\$ 1,978	\$ 1,125
Expansion Joint Replacement	\$ 344,400	75	\$ 77,992	\$ 18,179	\$ 4,356	\$ 1,810	\$ 742	\$ 262
Steel Surface Treatment								
Steel Surface Treatment	\$ 1,660,866	25	\$ 1,012,349	\$ 623,019	\$ 386,980	\$ 23,489	\$ 25,424	\$ 23,287
Steel Surface Treatment	\$ 1,660,866	50	\$ 617,058	\$ 233,705	\$ 90,166	\$ 14,317	\$ 9,537	\$ 5,426
Steel Surface Treatment	\$ 1,660,866	75	\$ 376,116	\$ 87,667	\$ 21,008	\$ 8,727	\$ 3,577	\$ 1,264
	Life Cycle Cost Totals		\$ 56,040,137	\$ 53,671,704	\$ 52,682,753	\$ 1,300,285	\$ 2,190,235	\$ 3,170,309
	Square Foot Totals		\$ 409	\$ 392	\$ 384	\$ 9	\$ 16	\$ 23

APPENDIX F
River Navigation Correspondence



MEMORANDUM

Fifth Street Towers
Suite 1500
100 South Fifth Street
Minneapolis, MN 55402
Phone: (612) 370-0700
Fax: (612) 370-1378

To: Steve Gramm, SDDOT
From: Carl Osberg, URS
Date: August 14, 2014
Subject: Pierre US 14 Bridge Navigational Design Parameters

Introduction

This memorandum summarizes the restrictions and river parameters that guide navigational design criteria for the US14/83 Missouri River Bridge Replacement Study.

Table 1: Summary of US 14 Bridge Navigational Design Parameters

Vertical Navigational Parameters				Horizontal Navigational Parameters	
Structure	BRP Elevation	Vertical Clearance	Meet USCG Requirement	Horizontal Clearance	Meet USCG Requirement
Existing US 14 Missouri River Bridge	1425.8'	28.7'	NO	210'	YES
Future Replacement Bridge	1421.3'	30'	YES	235'	YES

Existing US 14 Missouri River Bridge Navigational Clearances

The existing US 14 Missouri River Bridge was designed with two navigational lanes underneath span 8 and span 9 on the eastern side of the bridge. The navigational lanes were naturally located where the riverbed contours provided the deepest channel for safer navigation. Each lane was designed with a horizontal clearance of 210 feet and a vertical clearance of 28.7 feet. The vertical clearance was calculated using a Bridge Reference Plane (BRP) elevation of 1425.8 feet.

Replacement Structure Design Parameters

The minimal vertical clearance allowed by the United States Coast Guard (USCG) and the Army Corp of Engineers (ACOE) is 30 feet above the BRP. However, neither the current US 14 highway bridge nor the existing railroad bridge meets this requirement using the existing plan elevation of 1425.8 feet. After consulting with ACOE, USCG approved a 30' clearance measurement from the Normal Pool Elevation of 1421.3 feet, which is based on the 1929 Datum. The South Dakota Department of Transportation accepted this measurement; therefore all preliminary plans for a bridge replacement

meet the necessary vertical clearances. Please see the attached emails from USCG and SDDOT regarding this issue.

The minimal horizontal clearance allowed by USCG was 210 feet. Preliminary layouts for the replacement structure show multiple spans that meet or exceed this requirement.

In studying span layouts for the US 14 Missouri River Bridge Replacement Study, URS inquired USCG and SDDOT as to the possibility of moving the navigational lanes from their current location at the eastern end of the bridge. A study performed by URS indicated that western-central and eastern-central spans accommodated the highest levels of boat traffic (Figure 1). Additionally, the existing railroad bridge has its largest spans on the western side so moving the navigational lanes seemed a natural choice given that there is no commercial traffic on this section of the Missouri River.

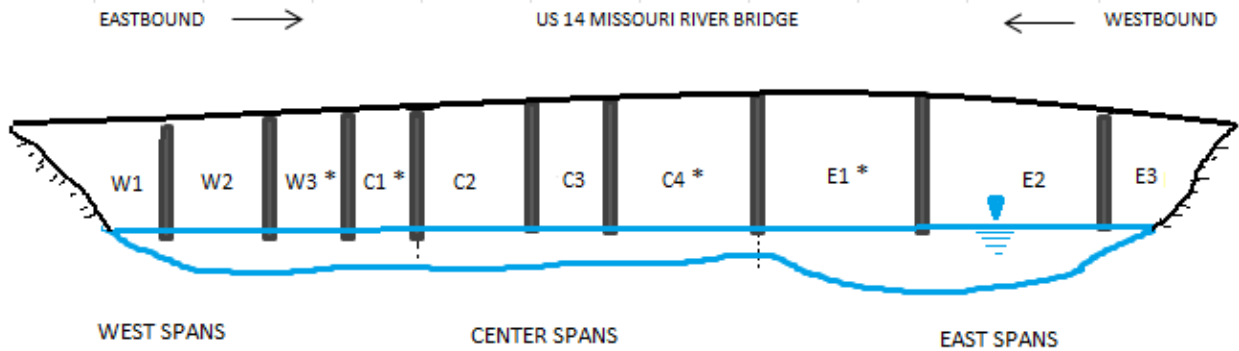


Figure 1: Current US 14 Missouri River Bridge Span Layout. Starred Spans indicate the locations with the highest observed boat traffic in the URS study.

Finally, regarding demolition of the existing structure, USCG requires that a 150 foot wide channel be cleared for river navigation within 24 hours of demolition.

Conclusions and Recommendations

All preliminary designs for a replacement bridge meet the required vertical and horizontal navigational clearance requirements established by the US Coast Guard and Army Corp of Engineers. URS recommends moving the location of the navigational lanes to match the peak use lanes determined in the observational boat traffic study.

Vermace, Charles

From: Osberg, Carl
Sent: Wednesday, August 13, 2014 10:49 AM
To: Vermace, Charles
Subject: FW: SDDOT Missouri River Bridge Replacement Study

-----Original Message-----

From: Rob.E.McCaskey@USCG.MIL [mailto:Rob.E.McCaskey@USCG.MIL]
Sent: Thursday, December 05, 2013 8:58 AM
To: Osberg, Carl
Subject: RE: SDDOT Missouri River Bridge Replacement Study

Carl

We are gathering the answers to your questions and will get back to you as soon as we can. In the mean time. Would you please send me the pictures and you reference in your Sep 23 email below.

Very Respectfully
Rob McCaskey
Bridge Management Specialist
USCG District Eight Bridge Branch
314-269-2381 Desk

-----Original Message-----

From: carl.osberg@urs.com [mailto:carl.osberg@urs.com]
Sent: Wednesday, December 04, 2013 12:02 PM
To: McCaskey, Rob E
Cc: Anderson, Bob; Brown, Greg S
Subject: SDDOT Missouri River Bridge Replacement Study

Rob,

We are looking for navigational requirements for this bridge.

Can you let us know what the current clearance requirements are? Can you let us know if there is a potential to modify these clearance requirements and locations in the future? If the answer to the latter is yes, please let me know how we can assist in this process. Changes could result in improvements for boaters, vehicles, pedestrians, aesthetics and reduce costs.

We know what the existing bridge's navigation clearances are, but we are unsure if they exceeded your original requirements and any possible modifications since the original was constructed or in the near future.

I suspect the existing vertical clearance does exceed your requirements as it has an unorthodox vertical clearance of 28.7' above the reference plan of 1425.8 ft (while maximum operating pool elevation is at 1420.0 ft). In addition to the dam about 5 miles north, in very close proximity (0.25 miles north of existing bridge) there is a historic train bridge with a much smaller vertical clearance (roughly 15' from normal pool). The existing bridge's navigation horizontal clearance is 210', which appears more logical than the vertical. Moreover, there are currently two navigational openings/spans, when perhaps just one opening is adequate.

We are also looking at our options to move the navigational opening(s) to reside closer to the center of the river, instead of the current position near the east bank. Since the time the existing bridge was constructed a cause-way was added downstream and the river channel was "moved" west of LaFrambois Island instead of east - so the river channel location downstream was modified since the existing bridge was erected.

Current boat traffic counts will likely show that the western and center portions of the bridge have the most boat traffic, while the eastern side is more frequented by drifting fishing boats. No commercial traffic is presently using this section of the river. Also, the train bridge to the north has its longer spans on the west side, so modification of navigational openings may be warranted.

Thanks in advance.

Carl Osberg, PE | Structural Engineer | URS Mpls | office 612-373-6394 | carl.osberg@urs.com

-----Original Message-----

From: Osberg, Carl

Sent: Monday, September 23, 2013 10:21 AM

To: 'Rob.E.McCaskey@uscg.mil'

Cc: Anderson, Bob; Brown, Greg S

Subject: RE: SDDOT Missouri River Bridge Replacement Study

Rob,

Attached is a graphic (aerial photo taken during flood of 2011) we put together showing:

- 1) the existing bridge substructure locations,
- 2) the original bridge (blasted in 1987 +/-) substructure locations - span location needs fine tuning
- 3) the existing RR bridge substructure locations

I would like to point out that although the navigation channel is on the east side of the existing bridge, the majority of the boat traffic uses the middle to western half of the river (where the RR bridge has its longest spans).

As I come across information I will send it your way.

Carl Osberg, PE | Structural Engineer | URS Mpls | office 612-373-6394 | carl.osberg@urs.com

-----Original Message-----

From: Rob.E.McCaskey@uscg.mil [<mailto:Rob.E.McCaskey@uscg.mil>]

Sent: Monday, September 23, 2013 9:07 AM
To: Osberg, Carl
Cc: Anderson, Bob; Brown, Greg S
Subject: RE: SDDOT Missouri River Bridge Replacement Study

Thank you for the info carl. Looking forward to working with you on this project.

Very Respectfully
Rob McCaskey
Bridge Management Specialist
USCG District Eight Bridge Branch
314-269-2381 Desk

-----Original Message-----

From: carl.osberg@urs.com [mailto:carl.osberg@urs.com]
Sent: Monday, September 23, 2013 9:01 AM
To: McCaskey, Rob E
Cc: Anderson, Bob; Brown, Greg S
Subject: SDDOT Missouri River Bridge Replacement Study

Rob,

Thank you for the call, we appreciate any assistance you can lend.
Attached you will find:

- 1) SDDOT RFP
- 2) URS' preliminary schedule

Please let me know what other information you might need. We are particularly interested in the navigational channel location, horizontal clearance requirements, and vertical clearance requirements.
Construction is tentatively set for 2023-2025. We are looking to get you involved and start the dialogue.

Carl Osberg, PE | Structural Engineer | URS Mpls | office 612-373-6394 | carl.osberg@urs.com
<mailto:joe_sharbono@urscorp.com>

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Vermace, Charles

From: Osberg, Carl
Sent: Wednesday, August 13, 2014 10:48 AM
To: Vermace, Charles
Subject: FW: SDDOT Missouri River Bridge Replacement Study

-----Original Message-----

From: Eric.Washburn@uscg.mil [mailto:Eric.Washburn@uscg.mil]
Sent: Thursday, December 05, 2013 3:33 PM
To: Osberg, Carl
Subject: FW: SDDOT Missouri River Bridge Replacement Study

Good afternoon Carl. I imagine you are getting some weather right now.

Can I get a copy of the photo you mention in your 23 Sep letter to Rob McCaskey? Thanks.

We'll get an answer within 2 weeks.

Respectfully,

Eric Washburn
USCG Bridge Administrator, Western Rivers STL
314-269-2378

-----Original Message-----

From: Osberg, Carl
Sent: Monday, September 23, 2013 10:21 AM
To: 'Rob.E.McCaskey@uscg.mil'
Cc: Anderson, Bob; Brown, Greg S
Subject: RE: SDDOT Missouri River Bridge Replacement Study

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Carl Osberg, PE | Structural Engineer | URS Mpls | office 612-373-6394 | carl.osberg@urs.com

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Sent: Monday, September 23, 2013 9:07 AM

To: Osberg, Carl

Cc: Anderson, Bob; Brown, Greg S

Subject: RE: SDDOT Missouri River Bridge Replacement Study

Thank you for the info carl. Looking forward to working with you on this project.

Very Respectfully

Rob McCaskey

Bridge Management Specialist

USCG District Eight Bridge Branch

314-269-2381 Desk

-----Original Message-----

From: carl.osberg@urs.com [mailto:carl.osberg@urs.com]

Sent: Monday, September 23, 2013 9:01 AM

To: McCaskey, Rob E

Cc: Anderson, Bob; Brown, Greg S

Subject: SDDOT Missouri River Bridge Replacement Study

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- 1) SDDOT RFP
- 2) URS' preliminary schedule

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Carl Osberg, PE | Structural Engineer | URS Mpls | office 612-373-6394 | carl.osberg@urs.com
<mailto:joe_sharbono@urscorp.com>

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Vermace, Charles

From: Osberg, Carl
Sent: Wednesday, August 13, 2014 10:48 AM
To: Vermace, Charles
Subject: FW: SDDOT Missouri River Bridge Replacement Study

-----Original Message-----

From: Eric.Washburn@uscg.mil [mailto:Eric.Washburn@uscg.mil]
Sent: Tuesday, December 10, 2013 3:27 PM
To: Osberg, Carl
Subject: RE: SDDOT Missouri River Bridge Replacement Study

Good graphic, will help in our review. Looks like existing bridge navigation channels are close to left descending bank to match up with channels of the old draw spans. Since draw spans not in use, I'm assuming low steel is same all the way across on rr bridge. Will check with ACOE on water depths to see if boats are to avoid any areas like right descending area, etc.. I'm assuming old hwy piers were all removed as well.

What is owner preference: two spans near center, closer to right descending bank, one large span, etc.. We have some flexibility I'm sure as long as good water thruout and RR Bridge low steel is constant.

Will continue to research.

Eric

-----Original Message-----

From: carl.osberg@urs.com [mailto:carl.osberg@urs.com]
Sent: Friday, December 06, 2013 9:23 AM
To: McCaskey, Rob E; Washburn, Eric CIV
Subject: RE: SDDOT Missouri River Bridge Replacement Study

Rob and Eric,

Attached is the graphic from the Sept 23rd email. Since this graphic was created, it was discovered that the old bridge (torn down in 1987) was more parallel to the train bridge. The eastern abutment is in the right location, but the west abutment should be further to the north.

The project website is www.us14missouririverbridge.com. It contains a powerpoint presentation and graphics from our first public meeting.

Let me know if you need anything else. I am more than happy to assist.

Carl Osberg, PE | Structural Engineer | URS Mpls | office 612-373-6394 | carl.osberg@urs.com

-----Original Message-----

From: Rob.E.McCaskey@uscg.mil [mailto:Rob.E.McCaskey@uscg.mil]
Sent: Thursday, December 05, 2013 12:18 PM
To: Osberg, Carl
Subject: RE: SDDOT Missouri River Bridge Replacement Study

Thank you

-----Original Message-----

From: carl.osberg@urs.com [mailto:carl.osberg@urs.com]
Sent: Thursday, December 05, 2013 11:18 AM
To: McCaskey, Rob E
Subject: Re: SDDOT Missouri River Bridge Replacement Study

I am in a conference today, but will send when I am back in the office tomorrow.

Sent from mobile phone.

Carl Osberg, PE
Structural Engineer
URS Corp - Minneapolis
carl.osberg@urs.com
Office: 612-373-6394
Cell: 612-816-2533

On Dec 5, 2013, at 8:59 AM, "McCaskey, Rob E" <Rob.E.McCaskey@USCG.MIL>
wrote:

> Carl
>
> We are gathering the answers to your questions and will get back to
> you as soon as we can. In the mean time. Would you please send me the
> pictures and you reference in your Sep 23 email below.

>
> Very Respectfully
> Rob McCaskey
> Bridge Management Specialist
> USCG District Eight Bridge Branch
> 314-269-2381 Desk

>
>
>
>
>

> -----Original Message-----

> From: carl.osberg@urs.com [mailto:carl.osberg@urs.com]
> Sent: Wednesday, December 04, 2013 12:02 PM
> To: McCaskey, Rob E

- > Cc: Anderson, Bob; Brown, Greg S
- > Subject: SDDOT Missouri River Bridge Replacement Study
- >
- > Rob,
- >
- > We are looking for navigational requirements for this bridge.
- >
- > Can you let us know what the current clearance requirements are? Can
- > you let us know if there is a potential to modify these clearance
- > requirements and locations in the future? If the answer to the latter
- >
- > is yes, please let me know how we can assist in this process. Changes
- >
- > could result in improvements for boaters, vehicles, pedestrians,
- > aesthetics and reduce costs.
- >
- > We know what the existing bridge's navigation clearances are, but we
- > are unsure if they exceeded your original requirements and any
- > possible modifications since the original was constructed or in the
- > near future.
- >
- >
- > I suspect the existing vertical clearance does exceed your
- > requirements as it is has an unorthodox vertical clearance of 28.7'
- > above the reference plan of 1425.8 ft (while maximum operating pool
- > elevation is at 1420.0 ft). In addition to the dam about 5 miles
- > north, in very close proximity (0.25 miles north of existing bridge)
- > there is a historic train bridge with a much smaller vertical
- > clearance (roughly
- > 15' from normal pool). The existing bridge's navigation horizontal
- > clearance is 210', which appears more logical than the vertical.
- > Moreover, there are currently two navigational openings/spans, when
- > perhaps just one opening is adequate.
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- > We are also looking at our options to move the navigational opening(s)
- >
- > to reside closer to the center of the river, instead of the current
- > position near the east bank. Since the time the existing bridge was
- > constructed a cause-way was added downstream and the river channel was
- >
- > "moved" west of LaFrambois Island instead of east - so the river
- > channel location downstream was modified since the existing bridge was
- > erected.
- > Current boat traffic counts will likely show that the western and
- > center portions of the bridge have the most boat traffic, while the
- > eastern
- > side is more frequented by drifting fishing boats. No commercial
- > traffic is presently using this section of the river. Also, the train
- >
- > bridge to the north has it's longer spans on the west side, so
- > modification of navigational openings may be warranted.
- >

> Thanks in advance.
>
>
> Carl Osberg, PE |Structural Engineer | URS Mpls | office 612-373-6394
> | carl.osberg@urs.com
>
>
>
>
>
> -----Original Message-----
> From: Osberg, Carl
> Sent: Monday, September 23, 2013 10:21 AM
> To: 'Rob.E.McCaskey@uscg.mil'
> Cc: Anderson, Bob; Brown, Greg S
> Subject: RE: SDDOT Missouri River Bridge Replacement Study
>
> Rob,
>
> Attached is a graphic (aerial photo taken during flood of 2011) we put

> together showing:
> 1) the existing bridge substructure locations,
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> Carl Osberg, PE |Structural Engineer | URS Mpls | office 612-373-6394
> | carl.osberg@urs.com
>
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> From: Rob.E.McCaskey@uscg.mil [mailto:Rob.E.McCaskey@uscg.mil]
> Sent: Monday, September 23, 2013 9:07 AM
> To: Osberg, Carl
> Cc: Anderson, Bob; Brown, Greg S
> Subject: RE: SDDOT Missouri River Bridge Replacement Study
>
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> this project.
>
> Very Respectfully
> Rob McCaskey

> Bridge Management Specialist
> USCG District Eight Bridge Branch
> 314-269-2381 Desk
>
>
>
>
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> -----Original Message-----
> From: carl.osberg@urs.com [mailto:carl.osberg@urs.com]
> Sent: Monday, September 23, 2013 9:01 AM
> To: McCaskey, Rob E
> Cc: Anderson, Bob; Brown, Greg S
> Subject: SDDOT Missouri River Bridge Replacement Study
>
> Rob,
>
>
>
> Thank you for the call, we appreciate any assistance you can lend.
> Attached you will find:
>
> 1) SDDOT RFP
>
> 2) URS' preliminary schedule
>
>
>
> Please let me know what other information you might need. We are
> particularly interested in the navigational channel location,
> horizontal clearance requirements, and vertical clearance
> requirements.
> Construction is tentatively set for 2023-2025. We are looking to get
> you involved and start the dialogue.
>
>
>
> Carl Osberg, PE | Structural Engineer | URS Mpls | office 612-373-6394
> | carl.osberg@urs.com <mailto:joe_sharbono@urscorp.com>
>
>
>
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Vermace, Charles

From: Osberg, Carl
Sent: Wednesday, August 13, 2014 10:48 AM
To: Vermace, Charles
Subject: FW: FORT PIERRE

-----Original Message-----

From: Eric.Washburn@uscg.mil [mailto:Eric.Washburn@uscg.mil]
Sent: Tuesday, December 10, 2013 3:10 PM
To: Osberg, Carl
Subject: FORT PIERRE

Good afternoon. We are in the process of contacting the ACOE to gather info on navigation as well as up to date numbers on pool, brp, etc..

Also, will contact the RR to get low steel elevation there. Plans look like the RR Bridge has a vertical clearance that is 8' less then the hwy bridge. Plans are from 1902 so hard to read.

We passed a regulation back in 1977 stating the RR Bridge does not have to open - hasn't operated since the mid-60s' minimum.

Our minimum vertical clearance requirement is actually 30' above the brp. However, if brp is 1425.7' - then neither bridge meets that and we will not be requiring a higher bridge. We will examine the possibility of a slightly lower bridge though horizontal clearance will still need to be reviewed. Certainly nothing wider then existing.

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From: Osberg, Carl
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To: Vermace, Charles
Subject: FW: FORT PIERRE

-----Original Message-----

From: Eric.Washburn@uscg.mil [mailto:Eric.Washburn@uscg.mil]
Sent: Tuesday, December 10, 2013 4:00 PM
To: Osberg, Carl
Subject: RE: FORT PIERRE

No problem, will stay within the office.

-----Original Message-----

From: carl.osberg@urs.com [mailto:carl.osberg@urs.com]
Sent: Tuesday, December 10, 2013 3:41 PM
To: Washburn, Eric CIV
Subject: RE: FORT PIERRE

Eric,

Great, thanks for your reply. I will check back in a week or two.

Please also look at the possibility or flexibility of moving or "declaring" the navigational channel further to the west - closer to center of bridge. In the attached, you will see that part of Span 9 has silted in while Spans 6-8 and a portion of Span 9 have scoured since original.

The attachment is a portion of an underwater investigation under the bridge. It gives the bottom of river elevations along the fascia of the bridge at different dates as well as a contour map.

Some of the ramifications on the main span location are: river navigation, drainage, traffic site lines, future scour and sedimentation, abutment heights, and aesthetics.

P.S. The attached may be a sensitive document, so please use care when storing and sharing.

Carl Osberg, PE | Structural Engineer | URS Mpls | office 612-373-6394 | carl.osberg@urs.com

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Vermace, Charles

From: Osberg, Carl
Sent: Wednesday, August 13, 2014 10:48 AM
To: Vermace, Charles
Subject: FW: FORT PIERRE

-----Original Message-----

From: Rob.E.McCaskey@uscg.mil [<mailto:Rob.E.McCaskey@uscg.mil>]
Sent: Tuesday, January 07, 2014 9:01 AM
To: Osberg, Carl
Subject: RE: FORT PIERRE

Carl

We are currently working with the Army Corps to collect data necessary to make a decision. We apologize for the inconvenience and will get back to you soon.

Very Respectfully
Rob McCaskey
Bridge Management Specialist
USCG District Eight Bridge Branch
314-269-2381 Desk

-----Original Message-----

From: Osberg, Carl [carl.osberg@urs.com]
Sent: Monday, January 06, 2014 11:14 AM Eastern Standard Time
To: Washburn, Eric CIV
Subject: RE: FORT PIERRE

Eric,

Has there been any progress on navigation requirements (horizontal, vertical, location in river) for the South Dakota Bridge over the Missouri River?

Carl Osberg, PE | Structural Engineer | URS Mpls | office 612-373-6394 | carl.osberg@urs.com

-----Original Message-----

From: Eric.Washburn@uscg.mil [<mailto:Eric.Washburn@uscg.mil>]

Sent: Tuesday, December 10, 2013 4:00 PM

To: Osberg, Carl

Subject: RE: FORT PIERRE

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Carl Osberg, PE | Structural Engineer | URS Mpls | office 612-373-6394 | carl.osberg@urs.com

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Sent: Tuesday, December 10, 2013 3:10 PM

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Vermace, Charles

From: Osberg, Carl
Sent: Wednesday, August 13, 2014 10:52 AM
To: Vermace, Charles
Subject: FW: FORT PIERRE

-----Original Message-----

From: Rob.E.McCaskey@uscg.mil [mailto:Rob.E.McCaskey@uscg.mil]
Sent: Thursday, April 17, 2014 8:56 AM
To: Osberg, Carl
Subject: RE: FORT PIERRE

Carl
After speaking with the Bridge Administrator, our office intended to communicate that option B was our preferred option.
V/r
Rob

-----Original Message-----

From: carl.osberg@urs.com [mailto:carl.osberg@urs.com]
Sent: Wednesday, April 16, 2014 2:28 PM
To: McCaskey, Rob E
Subject: RE: FORT PIERRE

Rob,

See the attached letter. I am a little new to working with Missouri River navigational requirements, but the question I was proposing is:

According to your letter, is the replacement bridge to have 30 ft min vertical clearance:

- a) above 1425.7' (Bridge Plane Reference Plane, 1929 Datum), or
- b) above 1421.3' (Normal Pool Elevation, 1929 Datum), or
- c) above both

I think the SDDOT can live with option b. Both options are based on 1929 Datum.

Carl Osberg, PE | Structural Engineer | URS Mpls | office 612-373-6394 | carl.osberg@urs.com

-----Original Message-----

From: Rob.E.McCaskey@uscg.mil [mailto:Rob.E.McCaskey@uscg.mil]
Sent: Wednesday, April 16, 2014 1:32 PM
To: Osberg, Carl
Subject: RE: FORT PIERRE

Carl

Just got off the phone with our contact at the Army Corps regarding the Pierre SD Highway bridge project. Regarding your concern about using the 1929 datum vs the gavins point, Mr. Jerry Tworek of the Army Corp Omaha office, Sedimentation and Stabilization Section confirms that the measurements are taken from the 1929 datum. Please let me know if I am properly addressing your question.

Very Respectfully
Rob McCaskey
Bridge Management Specialist
USCG District Eight Bridge Branch
314-269-2381 Desk

-----Original Message-----

From: carl.osberg@urs.com [mailto:carl.osberg@urs.com]
Sent: Tuesday, January 07, 2014 9:38 AM
To: McCaskey, Rob E
Cc: Washburn, Eric CIV
Subject: RE: FORT PIERRE

Rob,

No problem, I was just checking in. If I don't hear from you, I will check back in early February to see if any movement has occurred. Thanks for your help.

Carl Osberg, PE | Structural Engineer | URS Mpls | office 612-373-6394 | carl.osberg@urs.com

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Very Respectfully
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USCG District Eight Bridge Branch
314-269-2381 Desk

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Sent: Monday, January 06, 2014 11:14 AM Eastern Standard Time

To: Washburn, Eric CIV

Subject: RE: FORT PIERRE

Eric,

Has there been any progress on navigation requirements (horizontal, vertical, location in river) for the South Dakota Bridge over the Missouri River?

Carl Osberg, PE | Structural Engineer | URS Mpls | office 612-373-6394 | carl.osberg@urs.com

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Vermace, Charles

From: Osberg, Carl
Sent: Wednesday, August 13, 2014 10:52 AM
To: Vermace, Charles
Subject: FW: FORT PIERRE

From: Goeden, Kevin [mailto:Kevin.Goeden@state.sd.us]
Sent: Thursday, April 17, 2014 1:16 PM
To: Osberg, Carl; Anderson, Bob; Gramm, Steve
Cc: Brown, Greg S; Johnson, Steve (DOT)
Subject: RE: FORT PIERRE

I am inclined to accept the USCG recommended "low steel" elevation of 1451.3 (1929 datum). As Carl mentions, this is 3.2 feet lower than the existing bridge provides at the limits of the 210 feet wide approved navigational opening.

That combined with the potential for a shallower superstructure than existing, should enable us to significantly lower the proposed profile grade (perhaps by four feet or more from existing high point). That should greatly improve proposed bridge/approach profile grades over what exists today.

We have not had much luck on getting variance to the 30' vertical requirement imposed on other recent crossings. Rather than risk antagonizing the USGS by fighting for another 1.3 feet of vertical relief, I am thinking we perhaps should go with the current requirement.

Kevin Goeden, PE
Chief Bridge Engineer
South Dakota Department of Transportation
605.773.3285 - Phone
605.773.2614 - Fax
<mailto:kevin.goeden@state.sd.us>

-----Original Message-----

From: Osberg, Carl [mailto:carl.osberg@urs.com]
Sent: Thursday, April 17, 2014 9:25 AM
To: Goeden, Kevin; Anderson, Bob; Gramm, Steve
Cc: Brown, Greg S; Johnson, Steve (DOT)
Subject: FW: FORT PIERRE

Steve and Kevin,

I received the email below from the USCG. They are allowing us to go with bottom of structure at 1421.3' + 30'. This is 3.2 ft lower than the existing requirement. With this in mind and knowing that our beams may be slightly shallower, should we let it lie or should we move forward with our letter and ask for more? Realistically I think we have a 50/50 shot at skimming off another 1.3 ft.

I can go either way, please chime in with your thoughts.

Carl Osberg, PE | Structural Engineer | URS Mpls | office 612-373-6394 | carl.osberg@urs.com

-----Original Message-----

From: Rob.E.McCaskey@uscg.mil [mailto:Rob.E.McCaskey@uscg.mil]
Sent: Thursday, April 17, 2014 8:56 AM
To: Osberg, Carl
Subject: RE: FORT PIERRE

Carl
After speaking with the Bridge Administrator, our office intended to communicate that option B was our preferred option.
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To: McCaskey, Rob E
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a) above 1425.7' (Bridge Plane Reference Plane, 1929 Datum), or
b) above 1421.3' (Normal Pool Elevation, 1929 Datum), or
c) above both a & b

Carl Osberg, PE | Structural Engineer | URS Mpls | office 612-373-6394 | carl.osberg@urs.com

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From: Rob.E.McCaskey@uscg.mil [mailto:Rob.E.McCaskey@uscg.mil]
Sent: Wednesday, April 16, 2014 1:32 PM
To: Osberg, Carl
Subject: RE: FORT PIERRE

Carl
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Rob McCaskey
Bridge Management Specialist
USCG District Eight Bridge Branch
314-269-2381 Desk

-----Original Message-----

From: carl.osberg@urs.com [mailto:carl.osberg@urs.com]
Sent: Tuesday, January 07, 2014 9:38 AM
To: McCaskey, Rob E
Cc: Washburn, Eric CIV
Subject: RE: FORT PIERRE

Rob,

No problem, I was just checking in. If I don't hear from you, I will check back in early February to see if any movement has occurred. Thanks for your help.

Carl Osberg, PE | Structural Engineer | URS Mpls | office 612-373-6394 | carl.osberg@urs.com

-----Original Message-----

From: Rob.E.McCaskey@uscg.mil [mailto:Rob.E.McCaskey@uscg.mil]
Sent: Tuesday, January 07, 2014 9:01 AM
To: Osberg, Carl
Subject: RE: FORT PIERRE

Carl

We are currently working with the Army Corps to collect data necessary to make a decision. We apologize for the inconvenience and will get back to you soon.

Very Respectfully

Rob McCaskey
Bridge Management Specialist
USCG District Eight Bridge Branch
314-269-2381 Desk

-----Original Message-----

From: Osberg, Carl [carl.osberg@urs.com]
Sent: Monday, January 06, 2014 11:14 AM Eastern Standard Time
To: Washburn, Eric CIV
Subject: RE: FORT PIERRE

Eric,

Has there been any progress on navigation requirements (horizontal, vertical, location in river) for the South Dakota Bridge over the Missouri River?

Carl Osberg, PE | Structural Engineer | URS Mpls | office 612-373-6394 | carl.osberg@urs.com

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Vermace, Charles

From: Osberg, Carl
Sent: Wednesday, August 13, 2014 10:53 AM
To: Vermace, Charles
Subject: FW: Oahe Deg X-Sections (UNCLASSIFIED)
Attachments: 2014_Stasch_2.zip

-----Original Message-----

From: Stasch, Eric D NWO [<mailto:Eric.D.Stasch@usace.army.mil>]
Sent: Monday, March 24, 2014 11:55 AM
To: Osberg, Carl
Subject: FW: Oahe Deg X-Sections (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

-----Original Message-----

From: Morong, Larry J NWO
Sent: Monday, March 10, 2014 1:28 PM
To: Stasch, Eric D NWO
Cc: Pridal, Daniel B NWO
Subject: RE: Oahe Deg X-Sections (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

I was mildly surprised while plotting the cross sections how little degradation has occurred.

-----Original Message-----

From: Stasch, Eric D NWO
Sent: Saturday, March 08, 2014 3:50 PM
To: Morong, Larry J NWO
Subject: RE: Oahe Deg X-Sections (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Hey Larry,

This is perfect. I hate to ask but, could I get the same data lines for the ranges down to Antelope Creek RM 1055. I have a lot of people wondering what happened to the river due to the flood. No hurry in getting them to me. I have a talk on the 21st with the SD Professional Engineers and know they would be interested.

Thanks

Eric

-----Original Message-----

From: Morong, Larry J NWO
Sent: Friday, March 07, 2014 12:07 PM
To: Stasch, Eric D NWO
Cc: Boyd, Paul M NWO
Subject: Oahe Deg X-Sections (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Attached.

Classification: UNCLASSIFIED
Caveats: NONE

Classification: UNCLASSIFIED
Caveats: NONE

Classification: UNCLASSIFIED
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Classification: UNCLASSIFIED
Caveats: NONE

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Vermace, Charles

From: Osberg, Carl
Sent: Wednesday, August 13, 2014 10:51 AM
To: Vermace, Charles
Subject: FW: RIVER BRIDGE DEMOLITION

From: Costello, Donald
Sent: Tuesday, April 15, 2014 6:50 AM
To: Osberg, Carl
Subject: RE: RIVER BRIDGE DEMOLITION

Carl: I have not proceeded with anything on this project. Today, I will contact the CG and the ACOE to inquire. It is typically decided on a case-by-case basis.

Donald R. Costello, P.E.
Bridge Department Manager

URS Corporation
500 Enterprise Dr., Suite 3B
Rocky Hill, CT 06067
Direct – 860.990.6731
Cell – 860.308.4252
Office – 860.529.8882
Fax – 860.529.3991
www.urs.com

From: Osberg, Carl
Sent: Monday, April 14, 2014 4:29 PM
To: Costello, Donald
Cc: steve.gramm@state.sd.us; Brown, Greg S; kevin.goeden@state.sd.us
Subject: FW: RIVER BRIDGE DEMOLITION
Importance: High

Donald,

I sent you some bridge plans earlier about the demolition of the Missouri River Bridge in South Dakota. Will you please contact me to discuss any progress you have made?

Also, please review the email string below. SDDOT is wondering if we have contacted the USCG and/or the USACE. If you haven't contacted them yet, please do so. If you know their standards for foundation removal, please let me know what that is. Earlier you had suggested something like 5'-10' below mudline might be suffice.

Carl Osberg, PE | Structural Engineer | **URS Mpls** | office 612-373-6394 | carl.osberg@urs.com

From: Gramm, Steve [<mailto:Steve.Gramm@state.sd.us>]
Sent: Monday, April 14, 2014 3:17 PM
To: Brown, Greg S
Cc: Osberg, Carl; Goeden, Kevin
Subject: FW: RIVER BRIDGE DEMOLITION
Importance: High

Greg,

Have anyone on your team contacted the Corp or Coast Guard regarding any requirements they may have in regards to removal of the existing bridge? See below for details.

Thanks,

Steve

Steven Gramm, P.E.
Data Analysis Engineer
605-773-6641
steve.gramm@state.sd.us

From: Goeden, Kevin
Sent: Monday, April 14, 2014 8:49 AM
To: Gramm, Steve
Subject: FW: RIVER BRIDGE DEMOLITION
Importance: High

Hi Steve,

Has URS looked into this with the Corps and/or Coast Guard yet for the Pierre-Ft. Pierre bridge?

kng

From: Mark.Clausen@dot.gov [<mailto:Mark.Clausen@dot.gov>]
Sent: Monday, April 14, 2014 7:59 AM
To: Goeden, Kevin
Subject: FW: RIVER BRIDGE DEMOLITION
Importance: High

Kevin,

Do you have any information to add regarding these questions asked below???

Mark

From: Mihalek, Bob (FHWA)
Sent: Monday, April 14, 2014 6:21 AM
To: BRIDGE_DIVISION; BRIDGE_FLH; BRIDGE_HQ; BRIDGE HYDRAULICS
Subject: RIVER BRIDGE DEMOLITION
Importance: High

All,

DC is preparing to award the South Capitol Street major project.

This project will replace the existing South Capitol Street bridge. One of the uncertainties we have is how far down to remove the existing foundations.

We know we have to remove the foundations to some depth below the river bed. If the depth is excessive the cost will be unreasonable. DDOT needs to indicate depth of removal in the RFP.

If you or your state have any information regarding policies or requirements of the Corp of Engineers and/or the Coast Guard regarding removal of old bridge foundations (particularly depth of removal) I would really appreciate it.

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Vermace, Charles

From: Osberg, Carl
Sent: Wednesday, August 13, 2014 10:54 AM
To: Vermace, Charles
Subject: FW: SDDOT - Coast Guard

From: Costello, Donald
Sent: Wednesday, April 16, 2014 8:38 AM
To: Osberg, Carl
Cc: Sacchi, Ron
Subject: SDDOT - Coast Guard

Carl:

I spoke to Bill Knudsen at US Coast Guard in St. Louis. He indicated the cutoff elevation needs to be El. 1403.7. Demolition may include dropping the structure into the water, they require a 150-foot wide channel to be cleared within 24 hours. Since there is only recreational traffic at this location, these criteria are flexible. There is no commercial navigation at this location. He indicated that they have already sent you a letter with the required opening size for the new bridge.

Have you had any contact with ACOE on this project? If so, I would like to start with your primary contact person at the Corps. Please provide that name and number.

Donald R. Costello, P.E.
Bridge Department Manager

URS Corporation
500 Enterprise Dr., Suite 3B
Rocky Hill, CT 06067
Direct – 860.990.6731
Cell – 860.308.4252
Office – 860.529.8882
Fax – 860.529.3991
www.urs.com

From: Osberg, Carl
Sent: Tuesday, April 15, 2014 6:32 PM
To: Costello, Donald
Subject: SDDOT - 1959 Bridge Over Missouri River Design Study

Donald,

There is some information here near the end about the demo of the original bridge in 1986.

Carl Osberg, PE | Structural Engineer | **URS Mpls** | office 612-373-6394 | carl.osberg@urs.com

From: Osberg, Carl
Sent: Thursday, April 10, 2014 9:29 AM
To: Cooper, Carrie; Anderson, Bob
Subject: FW: 1959 Bridge Over Missouri River Design Study

fyi

From: Gramm, Steve [<mailto:Steve.Gramm@state.sd.us>]
Sent: Thursday, April 10, 2014 9:07 AM
To: Brown, Greg S
Cc: Osberg, Carl; Goeden, Kevin
Subject: 1959 Bridge Over Missouri River Design Study

Greg,

For some more historical context, attached is a scan of the study conducted prior to the building of the current bridge over the Missouri River. Kevin found this in the archives of the Bridge Office and I tried my best to make a clear scan of the document (some of the hand drawings towards the end of the document are faded and didn't scan too well). Also looks to be missing some of Appendices related to the Corp permits.

Steve

Steven Gramm, P.E.
Data Analysis Engineer
SDDOT - Project Development
700 E. Broadway Ave.
Pierre, SD 57501
605-773-6641
steve.gramm@state.sd.us

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Vermace, Charles

From: Osberg, Carl
Sent: Wednesday, August 13, 2014 10:53 AM
To: Vermace, Charles
Subject: FW: US14/US83/SD34 Over Missouri River - Demo of Existing Bridge (UNCLASSIFIED)

-----Original Message-----

From: Barker, Kevin
Sent: Tuesday, April 22, 2014 7:03 AM
To: Costello, Donald; Osberg, Carl
Subject: FW: US14/US83/SD34 Over Missouri River - Demo of Existing Bridge (UNCLASSIFIED)

Don & Carl, see below for ACOE response.

Kevin

-----Original Message-----

From: Stasch, Eric D NWO [<mailto:Eric.D.Stasch@usace.army.mil>]
Sent: Monday, April 21, 2014 9:33 AM
To: Barker, Kevin
Cc: Breckenridge, Jeff L NWO
Subject: FW: US14/US83/SD34 Over Missouri River - Demo of Existing Bridge (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Good Morning Kevin,

The only issues that will need to be addressed from the Corps of Engineers will be covered in the required Regulatory Permit. Jeff Breckenridge in the email response just below this presents a couple of the items that will need to be address in that Permit Application. Mr. Breckenridge's office will be processing the application.

Eric Stasch
Operations Project Manager
Oahe Project Office

-----Original Message-----

From: Breckenridge, Jeff L NWO
Sent: Monday, April 21, 2014 8:20 AM
To: Stasch, Eric D NWO
Cc: Naylor, Steven E NWO
Subject: RE: US14/US83/SD34 Over Missouri River - Demo of Existing Bridge (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Eric,

More than likely some portion of the bridge demolition will require Section 404 of the Clean Water Act permitting. Possible issues associated with the existing bridge demolition requiring Section 404 of the Clean Water Act any discharge of fill material such as the construction of temporary work platforms for equipment, temporary isolation/diversion of portions of the river, and the discharge of bridge debris into the river. At this point, without knowing the details of the dropping of the bridge structure into the river, it is difficult to determine whether or not it is permissible from an environmental or public interest standpoint. Especially when considering that there may be less environmentally damaging practicable alternatives, some possible options to evaluate would be dropping it on a barge, piecing it out, etc...

Jeffrey L. Breckenridge, P.E.
Regulatory Project Manager
South Dakota Regulatory Office

-----Original Message-----

From: Stasch, Eric D NWO
Sent: Friday, April 18, 2014 12:51 PM
To: Breckenridge, Jeff L NWO
Subject: FW: US14/US83/SD34 Over Missouri River - Demo of Existing Bridge (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Is there any Regulatory issues I need to include in a response to this??

-----Original Message-----

From: Barker, Kevin [<mailto:kevin.barker@urs.com>]
Sent: Friday, April 18, 2014 11:58 AM
To: Stasch, Eric D NWO
Cc: Costello, Donald; Osberg, Carl
Subject: [EXTERNAL] US14/US83/SD34 Over Missouri River - Demo of Existing Bridge

Mr. Stasch:

URS is developing the conceptual means and methods for the removal of the existing US14/US83/SD34 over the Missouri River between Pierre and Fort Pierre. We are initiating contact to discuss the ACOE requirements for the bridge removal.

We have had discussions with the Coast Guard regarding removal of the existing bridge and they have indicated that dropping the structure into the water is acceptable to them. There will be a requirement to provide a 150' wide cleared channel within 24 hours. Is this alternative acceptable to the ACOE? Will the Coast Guard requirements be sufficient or will there be additional requirements or limitations, such as time of year, this activity could be performed?

For removal of the bridge substructure, the Coast Guard has indicated that the cutoff elevation needs to be El. 1403.7. Does ACOE have any other criteria which needs to be met or a more restrictive elevation?

Feel free to call or reply to discuss.

Thank you,

Kevin Barker, P.E.

Bridge Engineer

URS Corporation

500 Enterprise Drive, Suite 3B

Rocky Hill, CT 06067

Direct: 860-990-6722

Office: 860-529-8882

Fax: 860-529-3991

E-mail: Kevin.Barker@urs.com <<mailto:Kevin.Barker@urs.com>>

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Classification: UNCLASSIFIED

Caveats: NONE

Classification: UNCLASSIFIED

Caveats: NONE

Classification: UNCLASSIFIED

Caveats: NONE

Vermace, Charles

From: Osberg, Carl
Sent: Wednesday, August 13, 2014 10:50 AM
To: Vermace, Charles
Subject: FW: Information: Departmental/USCG MOU and FHWA/USCG MOA
Attachments: MOA Final Signed.pdf; MOU FINAL Signed.pdf

Importance: High

From: Gramm, Steve [mailto:Steve.Gramm@state.sd.us]
Sent: Wednesday, January 22, 2014 1:50 PM
To: Brown, Greg S; Osberg, Carl; Cooper, Carrie
Subject: FW: Information: Departmental/USCG MOU and FHWA/USCG MOA
Importance: High

FYI in regards to the US14 Missouri River Bridge.

Steve

Steven Gramm, P.E.
Data Analysis Engineer
605-773-6641
steve.gramm@state.sd.us

From: Goeden, Kevin
Sent: Wednesday, January 22, 2014 1:39 PM
To: Marton, Kevin; Johnson, Steve (DOT); Gilsrud, Tom; Gramm, Steve; Eisenbeisz, Hadly
Subject: FW: Information: Departmental/USCG MOU and FHWA/USCG MOA
Importance: High

fyi

From: Marion.Barber@dot.gov [mailto:Marion.Barber@dot.gov]
Sent: Wednesday, January 22, 2014 11:05 AM
To: Keller, Terry; Lehmkuhl, Tom
Cc: Goeden, Kevin
Subject: FW: Information: Departmental/USCG MOU and FHWA/USCG MOA
Importance: High

Attached find the recently signed DOT MOU and FHWA MOA with U.S. Coast Guard regarding planning and permitting bridge projects.

This applies to the Pierre – Fort Pierre Bridge as well as any others structures involving navigable rivers

Marion

From: Solomon, Gerald (FHWA)
Sent: Wednesday, January 22, 2014 7:47 AM
To: FHWA-#ALLDA-OfficialMailbox; FHWA-#ALLDFS-PersonalMailbox; FHWA-#ALLFLH-OfficialMailbox; Lucero, Amy (FHWA)
Cc: Shepherd, Gloria (FHWA); Bini, Robert (FHWA); Joseph, Bianca (FHWA); HEPODs; HEPE; RC-TST-ENV

Subject: Information: Departmental/USCG MOU and FHWA/USCG MOA

Importance: High

To the Attention of: Division Administrators, Division Engineers, and Environmental staff:

The purpose of this email is to inform you that we recently completed two important efforts to improve coordination and collaboration with the U.S. Coast Guard. The Department of Transportation has developed a multimodal Memorandum of Understanding (MOU) among the U.S. Coast Guard (USCG) and FHWA, FTA, and FRA. Additionally, as a companion piece, FHWA developed an agency specific Memorandum of Agreement (MOA) with the USCG. The purpose of these documents is to integrate our efforts to expedite and inform NEPA and USCG permit decisions. These memoranda will enhance the efficiency and transparency of NEPA reviews and bridge permitting decisions by providing the means to expedite and coordinate the planning, environmental review, and decision-making for projects involving bridge permits. Copies of the MOU and the MOA are attached to this email.

The Departmental MOU provides oversight and guidance for the FHWA, FTA, and FRA in implementing strategies for compliance with Executive Order 13604 and the Presidential Memorandum on modernizing the permitting process. Additional operating administration guidance is to be consistent with the Departmental MOU. The MOA is FHWA's specific document replacing the 1981 MOU on coordination and cooperation in improving project delivery through improved permit application information, evaluation, and approval processes.

The purpose of both the MOU and MOA is to improve the efficiencies and reduce redundancies between our agencies for projects requiring USCG Bridge Permits by:

- Determining bridge design concepts that unreasonably obstruct navigation as soon as practicable and prior to or concurrent with the NEPA scoping process in order to inform project alternatives to be evaluated;
- Preparing a coordinated environmental document that satisfies both the USCG and FHWA, FTA or FRA NEPA implementing procedures, and results in a shared or joint environmental decision document; and where practicable, concurrently conducting the environmental evaluation and processing of the Bridge Permit application.

The FHWA specific MOA:

- Describes FHWA and USCG procedural responsibilities in table format and seeks to improve agency efficiencies and inform the USCG permit decision process.
- Outlines a detailed process for processing bridge permit applications for FHWA projects.
- Focuses on early engagement and full participation of the USCG in project scoping and environmental review.
- Establishes a process to identify a reasonable range of design alternatives that do not unreasonably obstruct navigation.
- Calls for navigation surveys and evaluations to be conducted early in the process so bridge design concepts which unreasonably obstruct navigation can be identified as soon as practicable and prior to or concurrent with the NEPA scoping process.
- Calls for the identification, consideration and screening of alternatives to be an early cooperative process requiring engaging navigational users and stakeholders in public involvement.
- Facilitates preparation of coordinated environmental document that avoids consecutive agency review, and supports concurrent review of Bridge Permit application materials where possible.
- Identifies the USCG role in improving coordination and early review of information for issue identification and resolution prior to the formal permit application process.

Please share the attached MOU and MOA with your State Department of Transportation partners.

Additionally, please be advised that an FHWA only webinar to discuss implementation of the MOU and MOA is scheduled for Thursday, February 27th at 2-3:30 (Eastern).

To register for the webinar, please go to the following link:

<https://www.nhi.fhwa.dot.gov/resources/webconference/viewconference.aspx?webconfid=27282>. A second webinar that will be available to state DOT partners is being scheduled, and information will be provided by separate email.

Should you have questions on the attached MOU and MOA, please contact Mike Ruth at mike.ruth@dot.gov or Susan Jones at susan.jones@dot.gov.

Thank you.

Gerry Solomon

Director

FHWA Office of Project Development and Environmental Review

1200 New Jersey Ave SE

Washington DC 20590

202 366-2037

gerald.solomon@dot.gov

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MEMORANDUM OF AGREEMENT
Between
The United States Coast Guard
and
The Federal Highway Administration
To Coordinate and Improve Bridge Planning and Permitting

I. Parties

The Parties to this Memorandum of Agreement (MOA) are the U.S. Coast Guard (USCG) and the Federal Highway Administration (FHWA).

II. Purpose

The purpose of this MOA is to expedite and coordinate the planning, environmental review and decisionmaking for bridge permits by:

- a. Determining which bridge design concepts unreasonably obstruct navigation as soon as practicable and prior to or concurrent with the NEPA scoping process in order to inform project alternatives to be evaluated;
- b. Preparing a coordinated environmental document that satisfies both USCG and FHWA NEPA requirements and results in a shared, or joint environmental impact decision documents where practicable and concurrent environmental impact decision documents at all other times; and
- c. Concurrently conducting the environmental evaluation and processing of the Bridge Permit application materials, whenever possible.

III. Authorities

- a. USCG enters into this MOA pursuant to the authority of: 14 U.S.C. § 141.
- b. FHWA enters into this MOA pursuant to the authority of the Secretary of Transportation to carry out title 23, U.S.C., as delegated to the FHWA Administrator in 49 CFR 1.85, and to carry out the functions of the Secretary under NEPA and related environmental laws, as delegated in 49 CFR 1.81(a)(5).
- c. Applicable Programmatic Authorities:
 1. National Environmental Policy Act of 1969 (NEPA), Pub. L. No. 91-190, 83 Stat. 852 (1970), *as amended; classified to* 42 U.S.C. §§ 4321-4347.
 2. National Historic Preservation Act of 1966, Pub. L. No. 89-665, 80 Stat. 915 (*codified as amended by* Pub.L. No. 96-515, 94 Stat. 2987 (1980) *at* 16 U.S.C. § 470).

3. Act of Aug. 18, 1894, c. 299, § 5, 28 Stat. 362; *as amended; classified to 33 U.S.C. § 499.*
4. Act of March 3, 1899, c. 425, § 9, 30 Stat. 1151; *as amended; classified to 33 U.S.C. § 401, 406, 502 (commonly referred to as the: "Rivers and Harbors Appropriations Act of 1899").*
5. Act of March 23, 1906, c. 1130, § 1, 34 Stat. 84; *as amended; classified to 33 U.S.C. § 491-498 (commonly referred to as the: "General Bridge Act of 1906").*
6. Act of June 21, 1940, c. 409, 54 Stat. 497; *as amended; classified to 33 U.S.C. §§ 511-524; (commonly referred to as the: "Truman-Hobbs Act").*
7. Act of August 2, 1946, 60 Stat. 847; *as amended; classified to 33 U.S.C. §§ 525-533 (commonly referred to as: "the General Bridge Act of 1946").*
8. "An Act to give the consent of Congress to the construction of certain international bridges, and for other purposes," Pub. L. No. 92-434 (H.R. 15577), 86 Stat. 731-733 (September 26, 1972); *as amended; classified to 33 U.S.C. §§ 535-535i (commonly referred to as: "the International Bridge Act of 1972").*
9. Efficient Environmental Reviews for Project Decisionmaking, 23 U.S.C. § 139.
10. National Bridge and Tunnel Inventory and Inspection Standards, 23 U.S.C. § 144.

IV. Definitions

- a. State DOT/Highway Agency (HA) means that department, commission, board, or official of any State or Federal agency charged by its laws with the responsibility for highway construction.
- b. Project Sponsor means an agency or entity seeking Federal transportation funds and responsible for initiating and carrying forward the planning, design, environmental review, and construction of a project in conjunction with the State DOT/HA. This agency or entity could include a political subdivision of a State, an authority created or authorized under State law, or a private entity

V. USCG/FHWA Coordination

The table below identifies coordination procedures both for actions requiring a USCG bridge permit and projects where FHWA determines that a USCG permit is not required.

For bridges that are determined to be exempt from USCG bridge permitting pursuant to 23 U.S.C. § 144(c), the FHWA will make a preliminary permitting exemption determination during project preplanning or NEPA scoping and inform the USCG in a timely manner so USCG can

make necessary determinations regarding navigation lights and signals required by 14 U.S.C. § 85 and provide timely notice to local mariners of waterway changes.

The steps in the table are not necessarily meant to follow sequentially, but rather provide guidance for what actions FHWA and USCG may need to take, and the role of each agency at each stage.

(FHWA / State DOT/HA) Activities	U.S. Coast Guard Activities
Planning Stage	
<p>During the early planning stage, prior to the NEPA scoping process, establish an appropriate point of contact and notify USCG of projects on plan or State Transportation Improvement Program (STIP), if applicable, that may require a bridge permit and ensure that the State DOTs/HA notify the USCG during the planning phase of a project.</p>	<p>Provide timely review of FHWA/State DOT/HA notifications of projects on plans or STIP and participate in FHWA/State DOT planning and project meetings, as appropriate, providing a USCG point of contact (usually a USCG District Bridge Office).</p>
Project Initiation Stage	
<p>At the initiation of a project requiring a USCG permit, invite USCG to early coordination meetings to discuss issue identification. Consider early site visit with resource agencies.</p>	<p>Participate in early coordination meetings to discuss issue identification. Participate in site visit, as appropriate.</p>
<p>Prior to the NEPA scoping process, determine whether or not a USCG permit is required pursuant to 23 U.S.C. § 144(c) and 23 CFR part 650, Subpart H. FHWA/State DOT/HA should notify USCG in a timely manner of the preliminary determination made so that any necessary coordination with USCG can be accomplished during the environmental review. FHWA/State DOT/HA also should notify USCG whenever the proposed action may substantially affect local navigation to allow for timely notice to mariners of waterway changes and to require the establishment, maintenance, and operation of lights and signals as required under 14 U.S.C. § 85 and 33 CFR part 118.</p>	<p>Consult with FHWA/State DOT/HA early and often on permit jurisdictional issues.</p> <p>USCG will review 23 U.S.C. § 144(c) determinations by FHWA. If USCG identifies issues or concerns with the preliminary determination, USCG should timely notify the FHWA/State DOT/HA so as to not delay project advancement.</p>

<p>When serving as the lead Federal agency and prior to the NEPA scoping process, FHWA will formally request USCG be a cooperating or participating agency in the environmental review process.</p>	<p>When serving as the lead Federal agency and prior to the NEPA scoping process, USCG will formally request FHWA be a cooperating or participating agency in the environmental review process.</p>
<p>Upon receipt of invitation from USCG to become a cooperating or participating agency in the environmental analysis process, within 30 days FHWA will provide written acceptance of the appropriate status and work with USCG to prepare NEPA documentation (ROD, FONSI, CE Determination) that satisfies both the FHWA's and the USCG's NEPA requirements.</p>	<p>Upon receipt of invitation from FHWA to become a cooperating or participating agency in the environmental review process, within 30 days USCG will provide written acceptance of the appropriate status and work with the FHWA to prepare NEPA documentation (ROD, FONSI, CE Determination) that satisfies both the FHWA's and the USCG's NEPA requirements.</p>
<p>FHWA will meet and cooperate with USCG whenever requested to resolve problems and avoid unnecessary project delays.</p>	<p>USCG will meet and cooperate with the FHWA/State DOT/HA whenever requested to resolve problems and avoid unnecessary project delays.</p>
<p>Continue coordination with USCG regardless of level of environmental class of action.</p> <p>Based on project information, determine the level of NEPA Environmental Documentation (CE, EA, or EIS). Coordinate with USCG using applicable guidelines. For multi-State bridge projects, make sure that all of the affected State DOT/HAs and responsible jurisdictions and oversight agencies carry out appropriate coordination efforts. For historic bridges requiring Section 106 of the National Historic Preservation Act compliance, copy USCG on all correspondence to the State Historic Preservation Officer (SHPO) and consulting parties. If a Memorandum of Agreement (MOA) for the resolution of adverse impacts is needed, provide a draft copy of the MOA to USCG for review and provide a final copy of the MOA to USCG for their records.</p>	<p>Continue coordination with FHWA regardless of level of environmental class of action.</p> <p>For historic bridges requiring Section 106 compliance, USCG will review copies of FHWA section 106 compliance correspondence to ensure appropriate coverage of USCG bridge permit actions and comment if necessary. USCG will review a draft of any required Memorandum of Agreement (MOA) and comment if necessary. Although USCG typically will not sign the MOA where FHWA has agreed to act as lead agency on USCG's behalf based on the Advisory Council on Historic Preservation (ACHP) policy guidance, if for any reason USCG decides it is in their best interest to sign the MOA, USCG will notify FHWA during review of the draft MOA that they wish to sign the MOA.</p>

<p>For all bridge projects requiring a USCG Bridge Permit, FHWA/State DOT/HA will prior to scoping consult the USCG Bridge Permit Application Guide and meet with USCG to determine the appropriate documentation requirements for a complete bridge permit application. The FHWA/State DOT/HA and USCG will collectively determine at the earliest time practicable what navigational information each agency will provide, in accordance with USCG's guidance, in order to analyze the navigational impacts of the bridge design alternatives and prepare a navigational impact report concurrent with the NEPA scoping process whenever possible.</p>	<p>USCG will work with the FHWA/State DOT/HA/Project Sponsor to identify items needed for a complete bridge permit application and the earliest possible stage of the project planning that the FHWA/State DOT/HA/Project Sponsor should begin submitting permit application materials to the USCG. FHWA/State DOT/HA and USCG will collectively determine at the earliest time practicable what navigational information each agency will provide, in accordance with USCG's guidance. USCG shall provide to the FHWA/State DOT/HA readily available navigational information and points of contact for waterway associations and users to assist in the collection of navigational information by the FHWA/State DOT/HA.</p>
<p>Gather data and receive public comments to prepare navigational impact report prior to or concurrent with the NEPA scoping process to identify which bridge designs unreasonably obstruct navigation and therefore do not require environmental analysis¹. Compile applicable environmental information for the bridge permit application. Combine, as appropriate, preliminary public notice of project location and evaluation of impacts on navigation as part of the NEPA scoping. Respond to comments received on navigational aspects of highway bridges.</p>	<p>Assist with assessing navigational impacts and environmental documentation requirements. Respond to comments received on navigational aspects of highway bridges. USCG field bridge staff will cooperate with FHWA/State DOT/HA to ensure navigation impacts are adequately addressed. Review the navigational impact report prepared concurrent with the NEPA scoping process, and advise which bridge designs unreasonably obstruct navigation and therefore do not require environmental analysis.</p>

¹ Does not preclude the project sponsor from conducting further analysis at its own risk on an alternative that the USCG has identified as unreasonably obstructing navigation.

<p>When serving as the lead Federal agency under NEPA, FHWA will provide written notice to USCG and to the relevant regulatory agencies and associated consulting parties stating that FHWA will act as the lead Federal agency on behalf of USCG, as appropriate, for coordination with the U.S. Army Corps of Engineers and compliance with other environmental laws. In accordance with Section 1306 of MAP-21, the 180 day timeframe will commence upon the later of the following: 1) A permit application is formally submitted and determined to be complete by the USCG, or 2) A NEPA decision has been issued. FHWA shall furnish USCG with a written statement when it concludes consultations. The NEPA document shall reflect the appropriate mitigation commitments. If the consultations result in the need for additional mitigation or the need to supplement, revise or alter the signed NEPA document, FHWA will coordinate with USCG on a resolution. Significant new information or circumstances that arise and warrant consideration might result in the need to restart the 180-day timeframe in accordance with Section 1306 of MAP-21 and associated guidance.</p>	<p>Become involved early in the process upon FHWA/State DOT/HA's request. Cooperate with FHWA/State DOT/HA in determining appropriate level of environmental documentation.</p>
<p>Prepare necessary environmental documentation based on project analysis including the navigational impact report. Within the environmental document, include discussion of bridge potential impacts to the environment and a discussion of results of ongoing coordination with USCG.</p>	<p>Comment on environmental documentation within the environmental document, concentrating on the bridge(s) and approaches' environmental impacts.</p>
<p>Coordinate with USCG to determine if joint efforts for public notices, meetings, and hearing(s), especially in controversial projects, would be appropriate and would promote efficient decision-making.</p>	<p>Participate in joint public notices and meetings when requested by FHWA/State DOT/HA. When sufficient information is available on a given bridge, avoid separate USCG public meeting.</p>

<p>Continue environmental analysis, discuss preferred alternative, and complete environmental documentation. Furnish preliminary environmental documentation to USCG for review and, as appropriate, respond to comments received on environmental aspects of highway bridges. If USCG has not provided comments on aspects of the document related to the bridge permit application, contact USCG and obtain its views on the adequacy of the current bridge permit information.</p>	<p>Upon request, assist in preparing responses to any bridge related comments received on environmental document. Review preliminary environmental documentation and comment, as appropriate.</p>
<p>Coordinate with USCG to provide USCG with the documentation of navigational impacts and compliance with NEPA and other applicable Federal environmental statutes, regulations, and orders, including coordination letters from Federal and State resource and regulatory agencies. Where a combined Final Environmental Impact Statement/Record of Decision (FEIS/ROD) is anticipated under Pub. L. No. 112-141, Sec. 1319, of MAP-21, notify USCG and adjust review process of the FEIS/ROD accordingly. Prepare a consolidated and coordinated NEPA document that satisfies both USCG and FHWA NEPA requirements and issue a shared or joint environmental impact determination.</p> <p>To ensure USCG can adopt the NEPA document for its bridge permit action, the NEPA document should adequately address all comments received from the USCG as a cooperating agency.</p>	<p>If the bridges environmental impacts are adequately addressed in environmental documentation, USCG will adopt the FHWA NEPA documentation. USCG field bridge staff will cooperate with FHWA/State DOT/HA to ensure environmental impacts are adequately addressed. Prepare a consolidated and coordinated NEPA document that satisfies both USCG and FHWA NEPA requirements and issue a shared or joint environmental impact determination. Note: USCG and FHWA signatures on the NEPA document will occur before the USCG will determine the application to be complete. Consultations under other applicable environmental laws must be completed before the USCG can issue a bridge permit.</p> <p>When new navigational or environmental information is received during the permit review process, CG will consider it in accordance with the provisions of this MOA.</p>

<p>As early as practicable, submit application for USCG Bridge Permit. (Permit application(s) may include alternate bridge designs). At the request of USCG, issue certification in accordance with 23 U.S.C. § 139(h)(6)(D) when USCG has provided timely notice of incomplete application.</p> <p>Ensure that the documentation submitted to USCG with the permit application is complete with respect to documenting navigational impacts as well as compliance with NEPA and other required Federal environmental statutes, regulations, and orders. This compliance and documentation is intended to allow USCG to process the permit application as quickly as possible. The documentation shall include all coordination letters from Federal and State resource agencies, as relevant and appropriate, that the OA used to satisfy requirements under NEPA and other applicable Federal environmental statutes, regulations, and orders.</p>	<p>Continuously review permit application materials in order to determine if and when permit application is complete. Prior to determining that an application is complete, conduct concurrent processing of the environmental evaluation and the Bridge Permit application materials, whenever possible, to expedite the bridge permit decision process. USCG will advise FHWA/State DOT/HA/Project Sponsor of determination that application is complete as soon as possible, but no later than 30 days of determination. A formal public notice will be issued upon determination that application is complete. When USCG determines application is not complete, USCG will promptly advise applicant in writing that application is incomplete and provide copy of such notice to FHWA for purposes of 23 U.S.C. § 139(h)(6).</p> <p>When USCG determines an application is complete, in accordance with Section 1306 of MAP-21 and any associated guidance, USCG will recognize that the 180 day timeframe has commenced unless a final NEPA decision has not been issued.</p>
<p>Seek to resolve any outstanding issues prior to permit issuance. Discuss any extenuating circumstances with USCG so as not to delay permit issuance.</p>	<p>Seek to expedite review process where possible. Where disagreements arise over vertical and/or horizontal clearance, the USCG District Bridge Office will involve Headquarters to ensure consistency with Headquarters policy on bridge clearance issues.</p>
<p>Issue Resolution</p> <p>The following is a sequential process for resolving issues that shall apply if the dispute resolution provisions set forth in 23 U.S.C. § 139 are not applicable:</p>	
<p>Staff Level Meeting: hold meeting(s) with the parties that have day-to-day involvement in a project to attempt to resolve the issue(s)</p>	<p>Staff Level Meeting: hold meeting(s) with the parties that have day-to-day involvement in a project to attempt to resolve the issue(s)</p>
<p>If issue(s) not resolved at above level, elevate to Division Administrator.</p>	<p>If issue(s) not resolved at above level, elevate to USCG District Commander.</p>
<p>If issue(s) not resolved at above level, elevate to the Associate Administrator for Planning, Environment, and Realty.</p>	<p>If issue(s) not resolved at above level, elevate to the Director of Marine Transportation Systems.</p>

If issue(s) not resolved at above level, elevate to FHWA Administrator.	If issue(s) not resolved at above level, elevate to USCG Commandant.
If issue(s) not resolved at above level, elevate to DOT Secretary.	If issue(s) not resolved at above level, elevate to DHS Secretary.

VI. Limitations

- a. Nothing in this MOA is intended to conflict with current law or regulation or the directives of USCG or FHWA. If a term of this MOA is inconsistent with such authority, that term shall be invalid, but the remaining terms and conditions of this MOA shall remain in full force and effect.
- b. This MOA does not create any right or benefit, substantive or procedural, enforceable by law or equity, against the United States, any party, their officers or employees, or any other person. This MOA does not direct or apply to any person outside the parties to this MOA.
- c. As required by the Antideficiency Act, 31 U.S.C. §§ 1341 and 1342, all commitments made by the parties in this MOA are subject to the availability of appropriated funds and budget priorities. Nothing in this MOA, in and of itself, obligates the parties to expend appropriations or to enter into any contract, assistance agreement, interagency agreement, or incur other financial obligations. Any transaction involving transfers of funds between the parties to this MOA will be handled in accordance with applicable laws, regulations, and procedures under separate written agreements.
- d. This MOA does not limit the signatories from developing programmatic agreements for specific procedures and processes to improve efficiencies and effectiveness related to interactions between the agencies to focus on unique issues and concerns in order to facilitate permit decision making and improved project delivery.

VII. Commencement/ Duration/ Modification/ Termination

- a. This MOA is effective upon the signature of all the parties. This MOA may be extended or modified, at any time by the mutual written consent of the parties. Either party may withdraw from this MOA at any time by providing at least 90 days written notice to the other party.
- b. All Memorandums of Agreements or Interagency Agreements made between the parties in furtherance of this MOA shall be made in accordance with the Purpose and subject to all the terms and provisions of this MOA.

IX. Points of Contact

United States Coast Guard
Office of Bridge Programs (CG-BRG)
US Coast Guard Stop 7418

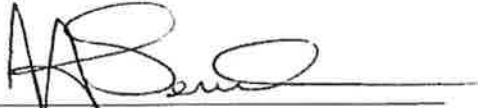
2703 Martin Luther King Jr Ave, SE
Washington, DC 20593-7418
202-372-1511

Federal Highway Administration
Office of Planning, Environment, and Realty
Office of Project Development and Environmental Review
HEPE-30
1200 New Jersey Avenue, SE
Washington, DC 20590
202-366-0116

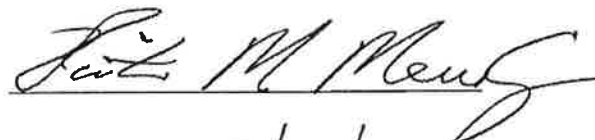
X. Signatory Authority

This MOA is approved and authorized on behalf of each party by:

J. A. Servidio
Rear Admiral, U.S. Coast Guard
Assistant Commandant for Prevention Policy


Date 01/14/2014

Victor M. Mendez
Administrator, Federal Highway Administration


Date 12/20/2013

MEMORANDUM OF UNDERSTANDING
Between the
U.S. Coast Guard
and
Federal Highway Administration
and
Federal Transit Administration
and
Federal Railroad Administration
To Coordinate and Improve Bridge Planning and Permitting

I. Parties

The Parties to this Memorandum of Understanding (MOU) are the U.S. Coast Guard (USCG), Federal Highway Administration (FHWA), Federal Transit Administration (FTA), and Federal Railroad Administration (FRA) (FHWA, FTA, and FRA are referred to collectively as the Operating Administrations (OAs)).

II. Purpose

The purpose of this MOU is to expedite and coordinate the planning, environmental review, and decision-making for bridge permits by:

- a. Determining which bridge design concepts unreasonably obstruct navigation as soon as practicable and prior to or concurrent with the scoping process carried out pursuant to the National Environmental Policy Act (NEPA) in order to inform project alternatives to be evaluated;
- b. Preparing a coordinated environmental document that satisfies both the USCG and OAs NEPA implementing procedures and results in a shared or joint environmental decision document, where practicable, and concurrent decision documents at all other times; and
- c. Concurrently conducting the environmental evaluation and processing of the Bridge Permit application materials, whenever possible.

III. Authorities

- a. USCG enters into this MOU pursuant to 14 U.S.C. § 141.
- b. FHWA, FTA, and FRA enter into this MOU pursuant to 49 U.S.C. § 301.
- c. Programmatic Authorities, where applicable:
 1. National Environmental Policy Act of 1969 (NEPA), Pub. L. No. 91-190, 83 Stat. 852 (1970), *as amended*; *classified to* 42 U.S.C. §§ 4321-4347.

2. Act of Aug. 18, 1894, c. 299, § 5, 28 Stat. 362; *as amended; classified to 33 U.S.C. § 499.*
3. Act of March 3, 1899, c. 425, § 9, 30 Stat. 1151; *as amended; classified to 33 U.S.C. § 401, 406, 502 (commonly referred to as the: "Rivers and Harbors Appropriations Act of 1899").*
4. Act of March 23, 1906, c. 1130, § 1, 34 Stat. 84; *as amended; classified to 33 U.S.C. § 491-498 (commonly referred to as the: "General Bridge Act of 1906").*
5. Act of June 21, 1940, c. 409, 54 Stat. 497; *as amended; classified to 33 U.S.C. §§ 511-524; (commonly referred to as the: "Truman-Hobbs Act").*
6. Act of August 2, 1946, 60 Stat. 847; *as amended; classified to 33 U.S.C. §§ 525-533 (commonly referred to as: "the General Bridge Act of 1946").*
7. "An Act to give the consent of Congress to the construction of certain international bridges, and for other purposes," Pub. L. No. 92-434 (H.R. 15577), 86 Stat. 731-733 (September 26, 1972); *as amended; classified to 33 U.S.C. §§ 535-535i (commonly referred to as: "the International Bridge Act of 1972").*
8. Efficient Environmental Reviews for Project Decisionmaking, 23 U.S.C. § 139.
9. Coast Guard Aids to Navigation, 14 U.S.C. §§ 81 and 85.
10. National Bridge and Tunnel Inventory and Inspection Standards, 23 U.S.C. § 144.

IV. Definitions

For the purposes of this MOU, the definitions contained in the Council on Environmental Quality (CEQ) regulations (40 CFR parts 1500-1508) and the following definitions are applicable:

- a. **Bridge** means a structure erected across navigable waters of the United States, including waters shared by Canada and Mexico, and includes causeways, approaches, fenders, and other appurtenances thereto. See 33 U.S.C. § 535 and 33 CFR § 114.05.
- b. **Bridge Permit** means the approval by USCG of the location and plans of a bridge, pursuant to the Federal Bridge Statutes listed in Section III.c.2-7, and Acts of Congress authorizing the construction of bridges, including international bridges. This does not include bridges covered by 23 U.S.C. § 144(c). Bridge permits are approvals subject to the provisions of 23 U.S.C. § 139.
- c. **Navigable Waters of the United States** means the following except where Congress has designated otherwise: "(1) Territorial seas of the United States; (2) Internal

waters of the United States that are subject to tidal influence; and (3) Internal waters of the United States not subject to tidal influence that: (i) Are or have been used, or are or have been susceptible for use, by themselves or in connection with other waters, as highways for substantial interstate or foreign commerce, notwithstanding natural or man-made obstructions that require portage; or (ii) A governmental or non-governmental body, having expertise in waterway improvement, determines to be capable of improvement at a reasonable cost (a favorable balance between cost and need) to provide, by themselves or in connection with others waters, as highways for substantial interstate or foreign commerce.” 33 CFR § 2.36(a).

- d. Project Sponsor means an agency or entity seeking Federal transportation funds and responsible for initiating and carrying forward the planning, design, environmental review, and construction of a project in conjunction with the OA. This agency or entity could include a political subdivision of a State, an authority created or authorized under State law, or a private entity such as a railroad.

V. **Responsibility of Operating Administrations (OAs)**

For any project that may require a Bridge Permit, it is the responsibility of the relevant OA in cooperation with the Project Sponsor, as appropriate, to take the following actions:

- a. Initiate early engagement with USCG, no later than commencement of the NEPA scoping process, and maintain continuing coordination throughout project development in accordance with the project plan described in (b) below.
- b. Cooperatively with the Project Sponsor and prior to starting the NEPA scoping process, consult the latest published edition of the USCG Bridge Permit Application Guide as well as regulations, orders, and guidance related to the USCG and OA NEPA processes and prepare a project plan for successful completion of the NEPA and Bridge Permit processes. This project plan will serve as a framework for both the OA and USCG throughout the project development process, and should be informed by early engagement meetings between USCG and the OA. The project plan may be integrated with the project’s coordination plan or other project management tools as appropriate. The project plan should:
 - 1. Summarize areas of lead responsibility for the OA and USCG;
 - 2. Identify issues and concerns specific to the project that could affect the Bridge Permit decision;
 - 3. Identify the need for one or more OA and USCG public meetings and hearing opportunities, and consider joint public meetings and hearings where appropriate.
 - 4. Identify the requirements for a complete Bridge Permit application and identify the earliest possible stage of the project that the Project Sponsor should submit

specific Bridge Permit application materials to USCG to allow adequate time for a reasonable review, comment, response, and revision process.

5. Include a project schedule with milestones for document submission and specific time frames for review periods and document turnaround.
- c. Acquire the information necessary to prepare a navigation impact report concurrent with the NEPA alternatives analysis.
 - d. Analyze the navigational impacts of bridge design alternatives and based on this analysis, prepare a navigational impact report concurrent with the NEPA alternatives analysis. The OA will use this information to inform the alternatives advanced for further consideration under NEPA. The OA will consider unreasonable obstruction to navigation as a reason to eliminate alternatives from further consideration in the environmental review.
 - e. When serving as the Lead Agency and prior to the NEPA scoping process, invite USCG to become a Cooperating Agency in the environmental review process. Prepare the appropriate NEPA document(s)—a Categorical Exclusion (CE), Environmental Assessment (EA)/ Finding of No Significant Impact (FONSI), or Environmental Impact Statement (EIS)/ Record of Decision (ROD)— in a manner that satisfies both the OAs' and USCG's NEPA implementing procedures to the maximum extent practicable.
 - f. Provide written notice to USCG and to the relevant regulatory agencies (e.g. U.S. Army Corps of Engineers or the U.S. Fish and Wildlife Service) and associated consulting parties stating that the OA will act as the lead Federal agency on behalf of USCG, as appropriate, for coordination with the U.S. Army Corps of Engineers and compliance with applicable environmental laws. The OA will furnish USCG with a written statement when it concludes all required consultations.
 - g. When new information or facts become known to the OA that may result in a reevaluation or supplemental NEPA document in accordance with the OA's NEPA implementing procedures, share with USCG the new information or facts and results from any reevaluation already developed or additional coordination performed with resource agencies. Where both the OA and USCG concur that a supplemental NEPA document is required, the roles and responsibilities of Lead and Cooperating Agencies will remain the same as for the preparation of the original NEPA document in order to prepare a single supplemental NEPA document that satisfies both the USCG's and OA's NEPA implementing procedures to the maximum extent practicable.
 - h. Work with USCG in reviewing and responding to comments and issues raised by the public during public comment and notice under NEPA and the Bridge Permit application process.

where both the OA and USCG concur that a supplemental NEPA document is required.

- g. Assist the OA and the Project Sponsor in reviewing and updating as necessary the navigational impact report at the completion of the NEPA process.
- h. Where it is necessary for USCG to hold a meeting or public review of the navigational aspects of the proposal following receipt of a complete permit application, the USCG public notice will make reference to the OA environmental documentation and navigational impact report. The USCG notice will limit public comment to the navigation impacts of the proposed bridge.
- i. Determine permit application completeness within the time agreed upon as part of the project plan. USCG will notify the OA as soon as it determines that additional information is required or new information or circumstances arise that will delay a USCG permit decision. For projects subject to 23 U.S.C. § 139, CG will coordinate with FHWA or FTA to determine if the additional information or circumstances would support a no fault certification under 23 U.S.C. § 139(h)(6). When warranted, USCG will provide any information needed for FHWA or FTA to issue the no fault certification.

VII. Issue Resolution Process

- a. Conflict resolution is intended to identify and resolve issues as early as possible and to elevate issues as soon the parties determine that they cannot resolve the issues in accordance with the most current conflict resolution guidance.¹
- b. The OAs and USCG will seek to resolve issues by discussion at the lowest possible organizational level. If an issue cannot be resolved through meetings between the parties that have day-to-day involvement in a project, then project-level staff should notify the appropriate OA, USCG, and Project Sponsor personnel having regional management responsibilities (e.g., USCG District Commander, OA Division or Regional Administrator or Program Official, Executive Director representing the Project Sponsor). Should those further discussions fail to achieve resolution in a timely fashion, the issues should be elevated incrementally to the next organizational level. Such elevation will continue until the issues reach the Secretarial level of each of the Departments with oversight of the agencies involved. Although this process does not supersede the formal issue resolution process for FHWA or FTA projects under 23 U.S.C. § 139(h)(5), it may be used as an alternative to the formal process.

VIII. Limitations

¹ See, e.g., CEQ-OMB Joint Environmental Conflict Resolution Memorandum, signed 9-7-12, DOT Order 5611.1A “U.S. Department of Transportation National Procedures for Elevating Highway and Transit Disputes,” or other applicable guidance. See also, 23 U.S.C. § 139(h)(5) for projects subject to the environmental review process under section 139.

- i. Coordinate with the Project Sponsor to review and update as necessary the navigational impact report at the completion of the NEPA process and advise USCG of any new information or facts relevant to the navigational impacts.
- j. In accordance with 23 U.S.C. § 139, FTA and FHWA will work with the Project Sponsor and USCG to provide any additional information necessary for USCG to make its permit decision in a timely manner. FHWA and/or FTA will provide “no fault certifications” when appropriate under 23 U.S.C. § 139(h)(6).

VI. Responsibility of the Coast Guard (USCG)

When a project that is administered by or federally funded under the authority of one or more of the OAs requires a Bridge Permit, it is the responsibility of USCG to take the following actions:

- a. Work closely with the OAs and Project Sponsor in all stages of the project, including planning, development of purpose and need, NEPA scoping, and navigation impact evaluations to ensure that the OA and Project Sponsor are aware of and address the navigational and environmental impacts of the bridge necessary for the USCG to expeditiously process the Bridge Permit application.
- b. Work with the OA and Project Sponsor to develop a project plan for successful completion of the NEPA and Bridge Permit processes. This project plan will serve as a framework for both the OA and USCG throughout the project development process, and should be informed by early engagement meetings between USCG and the OA. Refer to Section V.b. for the project plan content.
- c. Assist the OA and Project Sponsor in acquiring the information necessary to prepare a navigational impact report concurrent with the NEPA alternatives analysis.
- d. Review the navigational impact report and advise the OA and the Project Sponsor as to which bridge designs unreasonably obstruct navigation prior to or concurrent with the NEPA alternatives analysis.
- e. Upon receipt of invitation to become a Cooperating Agency in the environmental review process, promptly provide written acceptance of the appropriate status and work with the OA to prepare environmental documentation that satisfies both the OA’s and the USCG’s NEPA implementing procedures to the maximum extent practicable.
- f. Review any new environmental information or facts identified by the OA subsequent to the completion of the NEPA documents to determine if the USCG’s NEPA requirements necessitate a supplemental NEPA document. To the maximum extent practicable USCG will work with the OA to prepare a single supplemental NEPA document that satisfies both the USCG’s and OA’s NEPA implementing procedures

- a. Nothing in this MOU is intended to conflict with current law or regulation or the directives of USCG or OAs. If a term of this MOU is inconsistent with such authority, that term is invalid, but the remaining terms and conditions of this MOU remain in full force and effect.
- b. This MOU does not create any right or benefit, substantive or procedural, enforceable by law or equity, against the United States, any party, their officers or employees, or any other person. This MOU does not direct or apply to any person outside the parties to this MOU.
- c. As required by the Antideficiency Act, 31 U.S.C. §§ 1341 and 1342, all commitments made by the parties in this MOU are subject to the availability of appropriated funds and budget priorities. Nothing in this MOU, in and of itself, obligates the parties to expend appropriations or to enter into any contract, assistance agreement, interagency agreement, or incur other financial obligations. Any transaction involving transfers of funds between the parties to this MOU will be handled in accordance with applicable laws, regulations, and procedures under separate written agreements.
- d. This MOU does not limit the signatories from developing agreements for specific procedures and processes to improve efficiencies and effectiveness related to interactions between the agencies to focus on unique issues and concerns in order to facilitate permit decision making and improved project delivery. Any agreements made between the parties in furtherance of this MOU must be consistent with Section II and subject to all of the terms and provisions of this MOU.

IX. Commencement/ Modification/ Discontinuation

This MOU is operative upon the signature of all the parties. This MOU may be modified at any time by the mutual written consent of the parties. Any party may withdraw from this MOU at any time by providing at least 90 days written notice to the other parties.

X. Revocation

This MOU hereby replaces the 1981 *U.S. Coast Guard/Federal Highway Administration Memorandum of Understanding on Coordinating the Preparation and Processing of Environmental Documents* and subsequent amendments.

XI. Points of Contact

United States Coast Guard
 Office of Bridge Programs (CG-BRG)
 US Coast Guard Stop 7418
 2703 Martin Luther King Jr Ave, SE
 Washington, DC 20593-7418
 202-372-1511

Vermace, Charles

From: Osberg, Carl
Sent: Wednesday, August 13, 2014 10:50 AM
To: Vermace, Charles
Subject: FW: HUGH03WM - Missouri River Bridge replacement project - USCG Letter - Lead Agency Designation
Attachments: 20131114 USCG Lead Agency Request Letter.pdf; RE: South Dakota Highway Bridge, Mile 1066.4, MOR

From: Cooper, Carrie
Sent: Wednesday, November 20, 2013 5:24 PM
To: Osberg, Carl
Cc: Brown, Greg S
Subject: FW: HUGH03WM - Missouri River Bridge replacement project - USCG Letter - Lead Agency Designation

Hi Carl—

Here's correspondence from FHWA to Eric Washburn at USCG requesting to be formally identified as the federal lead agency. This may help when you contact the USCG.

Thanks,

Carrie

Carrie Cooper | URS Corporation
Environmental Planner
342 North Water Street, 7th Floor
Milwaukee, WI 53202
carrie.cooper@urs.com
414-831-4148

Please consider the environment before printing this email.

From: Lehmkuhl, Tom [<mailto:Tom.Lehmkuhl@state.sd.us>]
Sent: Friday, November 15, 2013 4:28 PM
To: Cooper, Carrie
Subject: FW: HUGH03WM - Missouri River Bridge replacement project - USCG Letter - Lead Agency Designation

Tom Lehmkuhl
Environmental Engineer
SDDOT - Office of Project Development
700 E. Broadway Ave.
Pierre, SD 57501
Ph: (605) 773-3180

From: Marion.Barber@dot.gov [<mailto:Marion.Barber@dot.gov>]
Sent: Thursday, November 14, 2013 10:59 AM
To: Lehmkuhl, Tom
Cc: Goeden, Kevin
Subject: HUGH03WM - Missouri River Bridge replacement project - USCG Letter - Lead Agency Designation

Tom,

For your records please find correspondence sent to the USCG regarding FHWA's offer to be designated as lead agency for purposes of Section 106 compliance on the Missouri River Bridge replacement project.

Marian Barber, PE

Environmental Engineer
Federal Highway Administration
South Dakota Division
(605) 776-1012

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U.S. Department
of Transportation
**Federal Highway
Administration**

November 14, 2013

South Dakota Division
116 East Dakota Avenue, Suite A
Pierre, SD 57501-3110
Phone: 605-224-8033
Fax: 605-224-8307

In Reply Refer To:
HDA-SD

Mr. Eric Washburn
Eighth Coast Guard District (dwb)
1222 Spruce Street, Suite 2.102D
St. Louis MO 63103-2832

Subject: SD Highway Bridge, Mile 1066.4, MOR – Bridge Replacement Project

Dear Mr. Washburn:

This letter concerns compliance with the National Historic Preservation Act (NHPA) of 1966, as amended 2006 (16 U.S.C. 470 *et seq.*) for replacement of the Missouri River Bridge.

The Federal Highway Administration (FHWA) and South Dakota Department of Transportation (SDDOT) are currently studying replacement of the US14-US83-SD34 Missouri River Bridge connecting Pierre and Fort Pierre in Hughes and Stanley Counties. This structure is also known as the John C. Waldron Memorial Bridge or National Bridge Inventory (NBI) Structure No. 000000033100118. The area of potential effects (APE) for the project encompasses approximately a 183 acre study area and extends between the intersection of Deadwood Street and Yellowstone Street in Fort Pierre and the intersection of Sioux Avenue and Poplar Street in Pierre (Figure 1).

FHWA is required to evaluate the project's effects on historic properties. A cultural resources review and consultation will be performed for the project in accordance with Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended 2006 (16 U.S.C. 470 *et seq.*).

When multiple Federal agencies are required to take federal actions on a project, the NHPA allows one Federal agency to be designated as the lead agency for purposes of Section 106 consultation (36 CFR 800.2 (a) (2)). As the United States Coast Guard (USCG) may be a permitting agency on the project, this letter advises that FHWA is prepared to be designated as the lead agency for Section 106 consultation.

Please let us know of your intentions with regard to this matter. If there are any questions, please contact myself at (605) 776-1012.

Sincerely,

A handwritten signature in black ink, appearing to read "Marion Barber". The signature is fluid and cursive, with the first name "Marion" written in a larger, more prominent script than the last name "Barber".

Marion Barber,
Environmental Engineer

Enclosure

cc: Marion Barber, Environmental Engineer
Tom Lehmkuhl, Project Development, SDDOT

Study Area

FIGURE 1



APPENDIX G
2013 Bridge Inspection

33-100-118

Pontis Database: Pontis DB Client

Printed: 10/18/2013 13:54:29

GENERAL BRIDGE DATA :

GENERAL BRIDGE DATA

STATUS

(8) STR NO : 33-100-118
 (7) FACILITY : US014
 (6) FEAT INTER : MISSOURI RV
 (9) LOCATION : HUGHES - STANLEY CO LINE
 INTERCHANGE :
 SECTION(S) : 31 32
 TOWNSHIP(S) : 111N
 RANGE(S) : 79W
 (2) REGION : Pierre
 (3) COUNTY : 33 HUGHES
 (21) CUSTODIAN : 1 State Highway Agency
 (22) OWNER : 1 State Highway Agency
 MAINT PROJ : 014- - -351
 (42A) SERV TYPE ON : 5 Highway-pedestrian
 (42B) SERV TYPE UND : 5 Waterway
 (103) TEMP STRUCTURE : Unknown (NBI)
 (99) BORDER BRIDGE STR NO : -1
 (98A) NEIGHBOR STATE : Not Applicable (P)
 (98B) PERCENT SHARE :

(27) YEAR BUILT : 1962 (106) RECONSTR : 0
 (49) STR LENGTH : 1,659.0 ft
 NBIS BRIDGE LENGTH : 1,646.0 ft
 (48) MAX SPAN LENGTH : 235.0 ft
 Main (43A) MATERIAL : 4 Steel Continuous
 Span (43B) DESIGN : 03 Girder-Floorbeam
 SD STR TYPE : X071
 (107) DECK STR TYPE : 1 Concrete-Cast-in-Place
 (52) DECK WIDTH : 66.5 ft
 (51) BRIDGE RDWY WIDTH : 56.2 ft
 (32) APPR RDWY WIDTH : 64.0 ft
 (50A) LT SIDEWK WIDTH : 0.0 ft
 (50B) RT SIDEWK WIDTH : 5.0 ft
 (34) SKEW : 0° SKEW DIR :
 (45) NO MAIN SPANS : 10
 (46) NO APPR SPANS : 0
 (31) DESIGN LOAD : 5 MS 18 (HS 20)
 (33) BRIDGE MEDIAN : 3 Closed Med w/Barriers
 (35) STR FLARED : 0 No flare

SUFF RATE : 54.8
 FED SUFF RATE : 54.8
 FED SR DATE : MAR 2013
 DEFICIENCY :
 CANDIDATE :

DECK DATA

(108A) WEARING SURFACE : 4 Low Slump Concrete
 DECK PROTECTION : Low slump dense concrete (LSDC)
 OVERLAY THICKNESS : 1.97 in

DECK DELAM AREA : 2,500.0 sq ft
 DECK DELAM DATE : 07/2004

DECK SURVEY : 06/1989

CHLORIDE :
 RESTEEL DEPTH :
 ELECTRO POTENT :

LOAD RATING DATA

(41) OPER STATUS : A Open, no restriction
 (66) INV HS20 : 24.0 tons HS 13.4
 (65) METHOD : 1 LF Load Factor (tons)
 (64) OP HS20 : 41.0 tons HS 22.8
 (63) METHOD : 1 LF Load Factor (Tons)
 TRUCK TYPE 3 : 32.0 tons
 TRUCK TYPE 3S2 : 55.1 tons
 TRUCK TYPE 3-2 : 61.7 tons
 BARS NO : 030005

HYDRAULICS

DRAINAGE AREA : 0.00 sq mi
 OBSERV HW ELEV : 0.0 ft
 YEAR : 0000
 DESIGN FREQ : 0
 DESIGN FLOW : 0.0 cfs
 DESIGN VELOCITY : 0.00 fps
 DESIGN AREA : 0.0 sq ft
 DESIGN YEAR : 0000
 DESIGN HW ELEV : ft
 100 YEAR FLOW : 0.0 cfts
 100 YR HW ELEV : ft
 V MAX : fps
 SCOUR SCREENING : 8 SCOUR RATING : 5
 TOPEKA SHINER :

RAIL PAINT

UNDERCOAT : LEAD-BASED PAINT
 TOPCOAT : ALUMINUM LEAFING
 YEAR : 0000 COLOR : ALUMINUM-GRAY-SILVER

HIGHWAY CARRIED (NBI 5)

(5B) ROUTE PREFIX : 2 U.S. Numbered Hwy
 (5C) LEVEL OF SERVICE : 1 Mainline
 (5D) ROUTE NUMBER : 00014
 (5E) DIRECT SUFFIX : 0 N/A (NBI)
 MRM ENGLISH : 228.35
 POSTED SPEED : 35 MPH
 SCHOOL BUS RT : MAIL RT :
 (104) NHS SYSTEM : 1 On the NHS
 FA ROUTE : 0014
 (26) FUNC CLASS : 14 Urban Other Princ
 (28A) LANES : 4
 (102) DIRECTION TRAFFIC : 2 2-way traffic
 (105) FED LANDS HWY : 0 N/A (NBI)
 (19) DETOUR : 9 mi
 (29) ADT TOTAL : 15900
 (30) YEAR OF ADT : 2011
 (109) % TRUCK : 5 %
 (53) MIN V CLR RT : 328.1 ft
 (53) MIN V CLR LT : 328.1 ft
 (10) MAX V CLR RT : 328.1 ft
 (10) MAX V CLR LT : 328.1 ft
 (47) HORIZ CLR RT : 26.5 ft
 (47) HORIZ CLR LT : 27.6 ft

BOX CULVERT DATA :

BOX CULVERT SIZE : 0 X 0 X 0
 FILL HT OVER BOX : 0.0 ft
 LENGTH OF LONGEST CELL : 0.0 ft

RAIL DATA

(36) SAFETY FEAT : 1111
 BRIDGE RAIL 1 : 12
 RAIL TRANS 1 : 41
 APPR RAIL 1 : 20
 APPR RAIL TERM 1 : 40

NBI PROP WORK

(75A) WORK TYPE : 35 Rehabilitate-gen.
 (75B) WORK BY : 1 Contract
 (76) IMPROV LENGTH : 1,659.0 ft
 (94) BRIDGE IMPROV COST : \$ 200,000
 (95) RDWY IMPROV COST : \$ 1,000
 (96) TOTAL PROJECT COST : \$ 300,000
 (97) YEAR OF IMPROV COST : 2006
 (114) ADT FUTURE : 18364
 (115) YEAR OF ADT FUTURE : 2031

STEEL PAINT

UNDERCOAT : LEAD-BASED PAINT
 TOPCOAT : ALUMINUM LEAFING
 YEAR : 0000 COLOR : ALUMINUM-GRAY-SILVER

GIS DATA

LATITUDE: 44.37208 LONGITUDE: -100.36674
 DATE: 2/6/2004
 COMMENT: FROM GIS AND DOQ ORTHO PHOTOS

PROJECT NUMBER :	PCN :	DATE DONE :	PROGRAM IMPROVEMENTS
F-030-1(02)	none	01/01/1961	YEAR: 2013
F-030-1(04)	none	01/01/1962	TYPE: 10 Bridge Projects
030-5-496	none	01/01/1969	ITEM NO :
F-0014(00)228	3351	01/01/1987	PCN : 03WM
F-0014(105)228	3289	01/01/1991	WORK: 60 Other
EM 0014(136)228	6243	01/01/2009	

GENERAL COMMENT : PLATE GIRDER 412' 418' 824' PARABOLIC
 RDWY WIDTH EBL 26.5 WBL 27.6 SEPARATED BY JERSEY BARRIER
 REGION COMMENT : PAINT BRIDGE 1993, SW corner has ET-2000 along with new w-beam appr. rail at NW and SW corners.
 FREE COMMENT : 1991-LSDC

INSPECTION TYPE	LAST INSPECTION DATE	REQUIRED	INSPECTION FREQUENCY	NEXT INSP DATE	INSPKEY :
NBI	07/16/2013		12 months	07/16/2014	CTVA
FRACTURE CRITICAL	07/16/2013	Y	12 months	07/16/2014	APPRAIS BY: SS
UNDERWATER	07/25/2012	Y	60 months	09/12/2017	APPRAIS DATE :10/15/2013
SPECIAL	NA	N	NA	NA	QA INSPECTOR :
ELEMENT INSPECTION	07/16/2013		12 months	07/16/2014	QA INSP DATE : 00/00/0000

LAST INSPECTION BY : PAULN
 CONSULTANT CODE : COLLINS ENG

Pontis Database: Pontis DB Client

CONDITION RATINGS

(58) DECK : 5 (59) SUPER : 5 (60) SUB : 5 (62) CULVERT : N
 (61) CHANNEL : 6 Minor movement of channel
 APPROACH : 8 Concrete

APPRAISAL RATINGS

(67) STR APPR : 5 Deck cracks, cracked welds, girder rust
 (68) DECK GEOM : 5 Substd width
 (69) UNDERCLR : N
 (71) WATERWAY : 9
 (72) APPR ALIN : 5 Horiz curve east end
 (70) BR POST : 5 LFA

Elements	07/16/2013	Unit	ID	Env	Tot. Qty (English)	Units	Q 1	Q 2	Q 3	Q 4	Q 5	Notes
P Conc Deck/Rigid Ov	MAIN	22	3		110,324	(SF)	0	110,324	0	0	0	PAULN inspect comments - No delam check at this inspection. Last year's check totaled 1384 sq. ft. just from the DL in the EBL from Abut 1 to Pier 7. That ends up being approx. 13 %. There are currently 4 small locations that show failing overlay within the DL of the EBLs. 7/16/13 PAULN inspect comments - Two additional areas of overlay distress in EBL. Span 1 near CL 27 ft. from Abut. 1, 2 x 3 & Span 3 in outside wheel track of EB DL 30 ft back of Pier 4 joint, 2 x 2. Delam survey completed in DL of EBLs from Abut 1 to Pier 7. 7/25/12 PAULN inspect comments - No full delam check but spot checks indicate that delam is increasing. Not difficult to find delamination along wheel paths. Two areas of distress on overlay in EBLs one near yellow line 30 ft. from Abut. 1 & the other near the white line 30 ft. back of Pier 4 jt. 9/14/11 PAULN inspect comments - No repairs required on deck surface. No formal dealm survey done. 5/28/10 PAULN inspect comments - An additional area of distress on surface in EBL near Abut 1. Partial depth patch was placed. No significant change in remainder of deck. 6/25/09 PAULN inspect comments - Area in EBL near Abut 1 showing distress above area of cracking & efflor visible on underside. Partial depth patch was placed prior to head to head traffic during rehab work. Remainder of overlay appears in good condition. 5/29/08 PAULN inspect comments - Overlay is in overall good condition. 7/9/07 PAULN inspect comments - No formal delam check done this inspection. Surface of overlay has little obvious deterioration. Some light spalling on the tops of the abutment backwalls. 7/13/06 Random areas of mainly small delam. areas throughout the deck. Outside lanes checked in both sets of lanes.
Paint Stl Opn Girder	MAIN	107	2		6,492	(LF)	122	2,210	3,910	250	0	PAULN inspect comments - No significant change in paint. 7/16/13 PAULN inspect comments - Little change in paint. More freckle rust showing through newer paint. 7/25/12 PAULN inspect comments - Some freckle rust starting to show through recently repainted areas along girders. 5/28/10 PAULN inspect comments - The bottom portions of the web and bottom flange on the inside of G2, G3 & G4 have been cleaned and painted between the bolted splices in the positive moment regions and through the pier areas with open joints eliminating most of the areas showing section loss. PAULN inspect comments - Surface rust continues to expand. Large majority of interior side of G2 & G3 have heavy freckle to mod. surface rust and some section loss through spans making inspection of bottom fillet welds difficult. 7/9/07 PAULN inspect comments - Slight increase in rust coverage. 7/13/06 PAULN inspection comments - Rust areas continue to grow slowly along with flaking areas. 7/1/04 PAULN element inspection comments - Slight increases in corrosion throughout girders. Date 2003-04-28 - PAULN element inspection comments - Much of the interior sides of G2 and G3 have sections of moderate to heavy rusting with light section loss occurring. There are also areas to a lesser extent in the same condition on the exterior girders. Estimated length of at least 1/4 of total amount of girder length. Date 2002-05-14 - > Light to moderate spot rusting throughout most of the girder lengths. Numerous areas where paint has failed and section loss is occurring. FATIGUE CRACKS THAT HAVE BEEN DRILLED & FATIGUE CRACKS

Elements	Unit	ID	Env	Tot. Qty (English)	Units	Q 1	Q 2	Q 3	Q 4	Q 5	Notes
07/16/2013											
Paint Stl Opn Girder	MAIN	107	3	144	(LF)	85	24	20	15	0	PAULN inspection comments - Several areas of light section loss adjacent to open joints. Holes in girder webs of G2 & G3 at Abut. 11. 7/16/13 PAULN inspection comments - Small areas of SR on most girders at stepped locations within stiffeners. Heavy SR along several horiz. stiffeners between stepped girder sections & bearing stiffeners. SR rust also appearing along top flanges adjacent to open jts. 9/14/11 PAULN inspection comments - Some surface rust showing through repainted areas on hangers. 5/2/0/10 PAULN inspection comments - Most of girder ends near open joints are in good condition. 7/1/04 Date 2003-04-28 - PAULN element inspection comments - Similar to previous inspection. Date 2002-05-14 - Previous comments > Girder ends at interior open joints have spot rusting in some locations. Girder ends at the abutments have areas of heavy rusting and some section loss. Remainder of girder ends are in very good condition.
Paint Stl Stringer	MAIN	113	2	6,492	(LF)	3,220	3,192	40	40	0	PAULN inspect comments - Stringers overall good. Only areas with advanced corrosion are adjacent to open joints. Small crack found at 90 degree cope on the south stringer in Span 10 west side of FB 1. 7/16/13 PAULN inspect comments - Stringers adjacent to open joints have light SL. 9/14/11 PAULN inspect comments - Crack tip in stringer drilled out. Stringers adjacent to Pier 4 on the Span 3 side have heavy SR on the top of the bottom flange. 5/28/10 PAULN inspect comments - North stringer at FB 1 Span 8 has a crack in the cope at the west end. 6/25/09 PAULN inspect comments - Stringer paint in good condition. 7/9/07 PAULN element inspection comments - Stingers not adjacent to open joints are in good condition with mainly freckle rust. 7/13/06 Date 2003-04-28 - PAULN element inspection comments - Similar to previous inspection. Only lite freckle rust on the edges of the bottom flanges for the most part. Date 2002-05-14 - Previous comments > Stringers are in good condition with light spot and freckle rusting at random locations.
Paint Stl Stringer	MAIN	113	3	144	(LF)	52	56	16	20	0	PAULN inspect comments - Stringers overall good. Only areas with advanced corrosion are adjacent to open joints. 7/16/13 PAULN inspect comments - Stringers adjacent to open joints have light SL. 9/14/11 PAULN inspect comments - Crack tip in stringer drilled out. Stringers adjacent to Pier 4 on the Span 3 side have heavy SR on the top of the bottom flange. 5/28/10 PAULN inspect comments - Stringers within 4 ft. of open joints have been cleaned and repainted. 6/25/09 PAULN inspect comments - Stringers in Bay 1 near open joint at Pier 7 have 30 ft. of light section loss. 5/29/08 PAULN element inspection comments - Moderate to heavy corrosion on several stringer ends under open joints. 7/13/06 Date 2003-04-28 - PAULN element inspection comments - Date 2002-05-14 - Previous comments > Stringers within the 2 meter limit of an open joint have spot and freckle rust fairly widespread.
Paint Stl Floor Beam	MAIN	152	2	4,078	(LF)	755	2,903	420	0	0	PAULN inspect comments - Two cracks found in the bottom fillet weld of FB 8 Span 9 Bay 1. Cracks are approx. 6 inches apart located approx. 15 inches from centerline. Floorbeams generally in good condition. Generally light freckle rust. Some heavier rust adjacent to open joints. 7/16/13 PAULN element inspection comments - Span 3 Floorbeam adjacent to Pier 4 has SR along top flange throughout. 5/28/10 PAULN element inspection comments - Floorbeams in overall good condition. Some areas of surface rust from leakage through the deck. 7/13/06 Date 2003-04-28 - PAULN element inspection comments - Mainly lite freckle rusting on floorbeams. There is some random locations of surface rusting. Date 2002-05-14 - Previous comments > Most of the floorbeams have some freckle rust with random areas of surface rusting. No significant change from previous inspection.
Paint Stl Floor Beam	MAIN	152	3	289	(LF)	188	43	45	13	0	PAULN inspect comments - Areas of light SL on FBs adjacent to open joints. 9/14/11 PAULN inspect comments - Span 3 Florbeam adjacent to Pier 4 has SR along top flange throughout. 5/28/10 PAULN inspect comments - Floorbeams within 4 ft. of open joints have been cleaned and repainted. 6/25/09 PAULN inspect comments -Areas of section loss to floorbeams at abutments. 7/9/07 PAULN element inspection comments - The last FB in Span 6 has 11 ft. of section loss. 7/13/06 Date 2003-04-28 - PAULN element inspection comments - The floorbeams near the open joints are in good condition. Date 2002-05-14 - Previous comments > Paint on floorbeams is fairly good. Light spot rusting at random locations

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Pontis Database: Pontis DB Client

Elements	Unit	ID	Env	Tot. Qty (English)	Units	Q 1	Q 2	Q 3	Q 4	Q 5	Notes
07/16/2013											
R/Conc Column	MAIN	205	2	36	(EA)	30	6	0	0	0	<p>PAULN inspect comments - Columns are in overall good condition. 7/16/13</p> <p>PAULN inspect comments - Repaired columns continue to look good. 7/25/12</p> <p>PAULN inspect comments - Columns are in good condition. No problems found on repaired columns. 9/14/11</p> <p>PAULN inspect comments - HL vert cracks occurring in new Pier 10 columns mainly in the middle of the columns. 5/28/10</p> <p>PAULN inspect comments - Rehab work summer of '09 repaired nearly all column deterioration. Pier 10 completely rebuilt while others had delam repaired and were fiber wrapped. 6/25/09</p> <p>Collins Engineering 9-6-2008; inspected 32 of columns rated 31 in CS 1 and 1 in CS2 - Did not inspect Pier 4 since under construction</p> <p>PAULN inspect comments - Columns are scheduled for repair starting 7/08.</p> <p>PAULN inspect comments - No noticeable change in column deterioration. 7/09/07</p> <p>PAULN inspect comments - CTL performed an indepth inspection of substructure units in the Fall of '04. A report submitted to the DOT showed 13 columns with various delamination and 8 with exposed resteel. Further testing revealed that many columns had high permeability, high carbonation and chloride rates and shallow cover. 7/13/06</p> <p>PAULN element inspection comments - Ten columns now found to have moderate scaling to delamination with spalling and exposed and corroding resteel. Most of the heavy corrosion appears to be on the stirrups but there are a couple of columns that have corroding vertical bars. CTL will in in depth investigation of piers this fall. 7/1/04</p> <p>COLLINSENG element inspection comments - Date 2003-09-30 - PAULN element inspection comments - Date 2003-04-28 -</p>
R/Conc Abutment	MAIN	215	3	141	(LF)	111	8	22	0	0	<p>PAULN inspect comments - Spalled areas on the top of Abut. 1 backwall in WBLs. Mod. to heavy scaling on the seat edge of Abut. 11 with stirrups & main bars exposed. Eight spalls along top of Abut 11 backwall in Bay 3. 7/16/13</p> <p>PAULN inspect comments - Minor to mod. scaling for approx. 20 ft along Abut. 11 seat with several areas of resteel exposed. Several spalls with exposed resteel near the top of Abut. 11 backwall in Bay 3. 9/14/11</p> <p>PAULN inspect comments - Some minor spalling in Bay 1 of Abut 1. 5/28/10</p> <p>PAULN inspect comments - Abut 11 has several small spalls with exposed resteel in the upper portion of the backwall. 5/29/08</p> <p>PAULN inspect comments - Moderate scaling at three locations on Abut 11 seat totaling 12 ft. 7/13/06</p> <p>PAULN element inspection comments - Random HL to narrow vertical cracking in the backwalls. 7/1/04 PAULN element inspection comments - Date 2003-04-28 - PAULN element inspection comments - Similar to previous inspection. Date 2002-05-14 - Previous comments > Abutment No. 1 seat has 3 meters of heavy scaling, up to 6 inches deep. No resteel exposed. HAIRLINE CRACKS IN CAPS AND COLUMNS</p>
R/C Sub Pile Cap/Ftg	MAIN	220	2	8	(EA)	8	0	0	0	0	<p>CollinsEng - 9-6-2008; Exposed footings and piles (2 piers) in generally good condition with no significant defects. Previous comments > Footings visible were all in good condition. HAIRLINE CRACKS IN CAPS AND COLUMNS</p>
R/Conc Cap	MAIN	234	2	448	(LF)	407	40	1	0	0	<p>PAULN inspect comments - NW corner of Pier 2 cap has heavy scaling & exposed resteel. 7/16/13</p> <p>PAULN inspect comments - Repaired cap areas look good. 7/25/12</p> <p>PAULN inspect comments - Some minor deterioration on unrepaired caps. No problems found on repaired areas. 9/14/11</p> <p>PAULN inspect comments - Repaired areas of caps look good. 5/28/10</p> <p>PAULN inspect comments - Most of the cap deterioration has been repaired. Concrete repaired with some caps getting epoxy fiber wrap, also. 6/25/09</p> <p>PAULN inspect comments - Cap repair to begin 7/08.</p> <p>PAULN inspect comments - CTL detected delamination on several of the pier caps along with some spalling and exposed resteel. 7/13/06</p> <p>PAULN element inspection comments - Several cap ends have scaling and deterioration. Several of the caps have narrow to medium transv. cracks on the interior portion of the caps. 7/1/04 PAULN element inspection comments - Date 2003-04-28 - PAULN element inspection comments - Similar to previous inspection. Date 2002-05-14 - Previous comments > Pier cap #3 has an area of scaling with exposed resteel. Hairline to narrow cracking throughout caps. A few areas have medium size cracks. HAIRLINE CRACKS IN CAPS AND COLUMNS</p>

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Pontis Database: Pontis DB Client

Elements	Unit	ID	Env	Tot. Qty (English)	Units	Q 1	Q 2	Q 3	Q 4	Q 5	Notes
07/16/2013											
R/Conc Cap	MAIN	234	3	128	(LF)	108	20	0	0	0	PAULN inspect comments - Repaired cap areas look good. 7/25/12 PAULN inspect comments - Some minor deterioration on unrepaired caps. No problems found on repaired areas. 9/14/11 PAULN inspect comments - Repaired areas of caps look good. 5/28/10 PAULN inspect comments - Most of the cap deterioration has been repaired. Concrete repaired with some caps getting epoxy fiber wrap, also. 6/25/09 PAULN inspect comments - Cap repair to begin 7/08. PAULN element inspection comments - Several cap ends have moderate deterioration with exposed resteel along with narrow to medium cracking on the interior portions. 7/1/04 PAULN element inspection comments - Date 2003-04-28 - PAULN element inspection comments - Similar to previous inspection. Date 2002-05-14 - Previous comments > Several caps with up to medium size cracking on portions of cap length. Caps at Pier No. 4 and 7 have areas of scaling 3/4 to 2 in. deep with exposed reinforcing steel.
Open Expansion Joint	MAIN	304	3	239	(LF)	36	121	82	0	0	PAULN inspect comments - Shallow spalling along Pier 4 jt. in WBLs shows little change. Overall jts. are performing. 7/16/13 PAULN inspect comments - Spalling along P4 jt. similar to previous. 7/25/12 PAULN inspect comments - Small spall adjacent to Abut. 11 in WBL & shallow spalling along Pier 4 jt. in WBLs. 9/14/2011 PAULN inspect comments - Finger joints continue to function. Tight fingers at Abut 1 and some misalignment at other joints. Corrosion continues below deck surface on assemblies. 6/25/09 PAULN inspect comments - Corrosion continues to remove section from finger joints. Areas of spalling on the underside of the deck adjacent to armor assemblies. 7/9/07 PAULN inspect comments - Abut joints are tight at 60 degrees +. Some spalling at the tops of the abutment backwalls adjacent to the joints. 7/13/06 PAULN element inspection comments - Corrosion continues on finger joints. 7/13/06 Date 2003-04-28 - PAULN element inspection comments - There is heavy section loss on many of the knee braces and the armor assembly under the fingers of these joints. Some are completely corroded away. Date 2002-05-14 - Previous comments > The fingers are in good condition for the most part. The support plates below have areas of heavy rust and section loss. There are several plates that have rusted entirely. Some of the armor assembly plates have significant section loss, also.
Moveable Bearing	MAIN	311	2	24	(EA)	23	1	0	0	0	PAULN inspect comments - Enviroment 2 moveable bearings have little corrosion. 7/16/13 PAULN inspect comments - G2 at Pier 3 is locked in expansion at 78 degrees. 9/14/11 PAULN inspect comments - No apparent movement in the rocker bearings at Pier 6 & 10. 5/28/10 PAULN inspect comments - No apparent movement in G2 or G3 rockers at Pier 10 since last painted. G2 bearing at Pier 3 has limited expansion capabilities remaining. 7/09/07 PAULN inspect comments - The G3 rocker at Pier 6 appears to have not moved since it was last painted. The paint over run between the bottom of the rocker and the bearing plate is not cracked. 7/13/06 PAULN inspection comments - Bearings are in good condition. Only light spot rusting. 7/1/04 PAULN element inspection comments - Date 2003-04-28 - PAULN element inspection comments - Date 2002-05-14 -
Moveable Bearing	MAIN	311	3	16	(EA)	10	6	0	0	0	PAULN inspect comments - Only bearings with mod. corrosion at the the abutments. 7/16/13 PAULN element inspection comments - Several abutment bearings have mod. to heavy corrosion. 7/1/04 PAULN element inspection comments - Date 2003-04-28 - PAULN element inspection comments - Date 2002-05-14 - Previous comments > Bearings at abutments have moderate to heavy corrosion.
Fixed Bearing	MAIN	313	2	12	(EA)	12	0	0	0	0	PAULN inspect comments - Fixed bearings in good overall condition. 7/13/06 PAULN element inspection comments - Fixed bearings at piers look good. Only light spot rusting. 7/1/04 PAULN element inspection comments - Similar to previous inspection. Date 2002-05-14 - Previous comments > Fixed bearings at Pier Nos. 2, 5 & 9. Good condition.

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Pontis Database: Pontis DB Client

Elements	Unit	ID	Env	Tot. Qty (English)	Units	Q 1	Q 2	Q 3	Q 4	Q 5	Notes
07/16/2013 Conc Bridge Railing	MAIN	331	3	4,977	(LF)	4,977	0	0	0	0	PAULN inspect comments - A large crack has developed 1 ft. + or - from the end of the centerline barrier adjacent to the expansion joint at Abut. 11. Crack is approx. 1/4 inch wide at the top. 7/16/13 PAULN element inspection comments - Conc barrier is in good condition. 7/13/06 Date 2003-04-28 - PAULN element inspection comments - Only HL vertical cracking along concrete bridge railing. Date 2002-05-14 - Previous comments > Barrier is in good condition. Some random hairline to narrow vertical cracks are present.
Other Bridge Railing	MAIN	333	3	1,660	(LF)	1,496	164	0	0	0	PAULN inspect comments - Overall good condition. 7/16/13 PAULN element inspection comments - Random areas of spot rust. 7/13/06 Date 2003-04-28 - PAULN element inspection comments - There is some light rusting on original rail elements. Chainlink fence has been hooked in three locations during snow removal operations. Date 2002-05-14 - Previous comments > Light rusting on the original elements. Three locations where the chainlink has been hooked during snow removal.
Steel Fatigue SmFlag	MAIN	356	2	1	(EA)	0	1	0	0	0	PAULN inspect comments - Several new cracks found this inspection. See Fracture Critical report. 7/16/13 PAULN inspect comments - A few new cracks found this inspection. See Fracture Critical report. 9/14/11 PAULN inspect comments - Some additional crack welds found at stiffeners & a welded web splice. 5/28/10 PAULN inspect comments - Fatigue retrofit completed summer of '09. Type B & C retrofits to diaphragm stiffeners along with bolted splices at cover plate terminations and welded web splices at high stress areas. 6/25/09 PAULN inspect comments - Additional cracks found mainly at the ends of stiffeners. One crack found near the weld termination at the bolted splice near FB 7 on the inside of G2 Span 2. Fillet weld ground flush with base metal. Cracks still visible in web material. Plan is to cope area out with current rehab project. 5/29/08 PAULN inspect comments - Additional cracks found this inspection. A few old cracks showed slight growth. Cracks cored at 4 locations. 7/09/07 PAULN inspect comments - Continue to see additional cracks mainly at the tops of vertical stiffeners, bearing stiffeners and diaphragm stiffeners. Several previous crack indications were declared No Crack by HDR personnel. Many of those still indicate crack with use of mag part. 7/13/06 PAULN element inspection comments - Numerous additional cracks in girders found. Several locations cored due to cracks in the flange to web fillet welds. 7/1/04 Previous comments > < none >
Deck Cracking SmFlag	MAIN	358	2	1	(EA)	0	1	0	0	0	PAULN inspect comments - Cracking is still mainly HL to narrow with isolated larger cracks of varying directions. Four potential patch areas within the outside lane of the EBLs between Abut 1 & Pier 7. 7/16/13 PAULN inspect comments - Random HL to narrow transv & long craking throughout. Delam detected along many of the cracks. Two areas of distressed overaly in EBL one near yellow line 30 ft. from Abut. 1 & the other near the white line 30 ft. back of Pier 4 jt. 9/14/11 PAULN element inspection comments - No significant change in deck cracking observed. 7/1/04 PAULN element inspection comments - Date 2003-04-28 - PAULN element inspection comments - There are random transverse and longitudinal cracks in all spans. Most of the cracks are HL in size with a small portion in the narrow to medium range. There are some cracks in the wide range in Span No. 3. Many of the cracks have been previously sealed with epoxy. Some epoxy is wearing out and disappearing. Date 2002-05-14 - Previous comments > All cracks that are fairly visible have been sealed with epoxy.

33-100-118

Pontis Database: Pontis DB Client

Elements	Unit	ID	Env	Tot. Qty (English)	Units	Q 1	Q 2	Q 3	Q 4	Q 5	Notes
07/16/2013											
Soffit Smart Flag	MAIN	359	2	1	(EA)	0	1	0	0	0	<p>PAULN inspect comments - Continued deterioration on overhangs. Areas of full depth distress in Span 1 Bay 2 & 3 between end and FB 2. Large area of distress in Span 8 Bay 2 from FB 1 to FB 3. 7/16/13</p> <p>PAULN inspect comments - Several small areas of heavy map cracking throughout underside and adjacent to deck joints. Many transv cracks allowing leakage through deck creating areas of corrosion on the top flange. Heavy spalling and corroded resteel continues on the overhangs. 9/14/11</p> <p>PAULN inspect comments - No additional areas of deterioration found on underside of deck. 5/28/10</p> <p>PAULN inspect comments - An additional deck patch placed above the distressed area in Span 1 Bay 3. Most other areas that appear distressed are adjacent to finger joints. 6/25/09</p> <p>PAULN inspect comments - Random areas of spalling concrete and exposed resteel mainly adjacent to open deck joints. 7/09/07</p> <p>PAULN inspect comments - Broken and delaminated area on the underside of the deck 6 ft east of Span 8, in Bay between G2 and stringer, 3 x 3. There is distressed concrete with some spalling adjacent to the Pier 7 finger joint on both sides. Cracking and efflor. on the underside between FB 9 & 10 Bay 3 Span 8. 7/13/06</p> <p>PAULN element inspection comments - Removed numerous loose areas of concrete along deck edges to prevent falling on boaters. Underside of deck is in fairly good condition. 7/1/04 PAULN element inspection comments - Date 2003-04-28 -</p> <p>PAULN element inspection comments - The underside of the deck near the edges continues to deteriorate and lose section. The exposed resteel along this area has heavy rusting and heavy section loss in many locations. There is an area within Span No. 1, between Abutment No. 1 and floorbeam 2, that has wide sized cracking in block pattern Date 2002-05-14 -</p>
Scour Smart Flag	MAIN	361	2	1	(EA)	0	1	0	0	0	<p>PAULN inspect comments - Underwater inspection performed last year shows areas of scour have filled in to various degrees. 7/16/13</p> <p>PAULN inspect comments - Weekly monitoring of scour summer of '11 due to flood conditions. Undermining of the full footing was indicated on Pier Nos. 2, 8 & 9. Most of the other footings had partial undermining to footing exposure. Scour to 15 ft + or - below the bottom of Pier 9 was the largest amount found. 9/14/11</p> <p>Collins Engineering - 9-6-2008; Localized scour depressions at Piers 5 thru 7</p> <p>Previous comments > Pier No. 3 and No. 9 both have undermining of the footings. The footing of Pier No. 9 has 6 ft. of exposed piling at the upstream end tapering to zero at the upstream 1/4 points. The underwater inspection done in September '98 coded this situation as a 3.</p>
Section Loss SmFlag	MAIN	363	2	1	(EA)	0	1	0	0	0	<p>PAULN inspect comments - Corrosion emerging from section loss areas that were repainted near Pier 4 & 7. 7/16/13</p> <p>PAULN inspect comments - G2 & G3 at Abut. 11 bumper locations within web reinforcements have holes completely through the web. 9/14/11</p> <p>PAULN inspect comments - Nearly all areas of section loss on the girders and elements at open joints have been cleaned and painted. Any remaining section loss is light. 6/25/09</p> <p>PAULN element inspection comments - Many areas on the interior sides of G2 and G3 have moderate rusting with little section loss. Random areas on remainder of girders have similar condition. 7/1/04 PAULN element inspection comments - Date 2003-04-28 -</p> <p>PAULN element inspection comments - Mainly lite section loss is still present mostly on the lower flange of the interior girders and under open joints. Date 2002-05-14 -</p> <p>Previous comments > Girder ends near abutments and random locations throughout the girders have rusting with section loss. The knee braces under the fingers of the expansion joints have heavy section loss throughout the expansion joints.</p>
# Elements											

APPENDIX H
2012 Underwater Bridge Inspection Report

UNDERWATER BRIDGE INSPECTION REPORT



NBI Item 60 Rating: 6
NBI Item 61 Rating: 8
NBI Item 113 Rating: 5

Bridge Number: 33-100-118
Inspection Date: 9/12/2012
Division: Statewide
River: Missouri River

Engineer of Record: David Reser, 6209
Team Leader: David Reser, 6209
Substructures Inspected: Piers 2 thru 10
Team Members:
ARY, DRR, KRR, MPC, MDD

Signature/Seal
12/28/12

Summary of Scour and Channel Conditions:

There has been up to 18-feet of general channel degradation between Bents 6 and 9 since bridge construction. Additionally, there has been significant local scour at Bents 6 thru 9 since 2008, including up to 11-feet of local scour at Bent 8 since the 2008 underwater inspection.

Summary of Structural Conditions:

The inspected substructure units are in satisfactory condition. There are no significant structural defects present below the high waterline. Scour has exposed the steel H-piles under the footings at Piers 3 and 6 thru 9. Refer to Photos 1 and 2 for overall views of the bridge and substructure configuration.

Summary Evaluation of Previous Corrective Actions:

The pier wall and cap at Pier 10 was reconstructed in 2009. Additional concrete repairs were performed above the waterline on the remaining piers. The repairs at Pier 10 are performing well.

Summary of Repair Recommendations:

No repairs are required at this time.



Route: US 14
Inventory Direction: West to East
County: Hughes
Location: Pierre
Bridge Length: 1659 FT
Superstructure Type: Steel Girder
Substructure Type: CIP Concrete Columns on Footings
Foundation Type: Footing w/ Steel H-Piles
Total Substructure Units: 11
Substructure Units in Water: 9
Deepest Water Depth: 30 FT
Water Velocity: 2 FPS
Underwater Visibility: 6 FT
Water Temperature: 69 °F

Attachments Included:

- A - Drawings (Pages A-1 through A-13)
- B - PONTIS Table (Page B-1)
- C - Location Map (Page C-1)



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St. Cloud, FL 34772
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UNDERWATER BRIDGE INSPECTION REPORT



NBI Item 60 Rating: 6
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Bridge Number: 33-100-118
Inspection Date: 9/12/2012
Division: Statewide
River: Missouri River

Channel Evaluation:

The channel is well aligned with the substructure units and there is no debris or other restrictions to flow. Both channel banks are protected with riprap which is in good condition. The east embankment riprap under the bridge is covered with sand and is smaller than the channel riprap. The bridge embankment on the west side is well protected with riprap. Refer to Photos 3 and 4 for images of the bridge embankments.

Scour Conditions:

Both local and general scour is present at the bridge. When current conditions are compared to the construction plans, there appears to have been 18' of channel degradation between Bents 6 and 9 since bridge construction. Additionally, there has been significant local scour at Bents 6 through 9 since 2008. Refer to Pages A-1 and A-2 for a comparison of the channel profiles. Channel contours representing the existing conditions at the bridge are provided on Page A-3.

Local scour conditions are relatively unchanged since 2008 at Piers 2 through 5, and Pier 10. Refer to Pages A-4 through A-13 for illustrations showing scour conditions around the piers.

Local scour has significantly increased at Piers 6 through 9 since 2008. Details for each of these piers is provided below:

Pier 6 - There is 7-feet of additional local scour at the upstream nose than was reported in 2008. The footing is undermined at the northwest corner 1.5-feet high extending along the west face approximately 16-feet. Steel H-piles are exposed. Refer to Page A-9 for an illustration of this condition.

Pier 7 - There is 6-feet of additional local scour at the upstream nose than was reported in 2008. The footing is undermined at the upstream nose 4-feet high extending along the east face 30-feet and the west face 12-feet. Steel H-piles are exposed. Refer to Page A-10 for an illustration of this condition.

Pier 8 - There is 11-feet of additional local scour at the upstream nose than was reported in 2008. The footing is undermined at the upstream nose 6-feet high extending around the entire pier decreasing in vertical height until the downstream nose is not undermined. Steel H-piles are exposed. Refer to Page A-11 for an illustration of this condition.

Pier 9 - There is 3-feet of additional local scour at the upstream nose than was reported in 2008. The footing is undermined for the entire perimeter, with the maximum undermining at the upstream nose of 10-feet high. Steel H-piles are exposed. Refer to Page A-12 for an illustration of this condition.

Substructure Condition:

The substructure columns are encased from above the high waterline to the footing pedestal in a galvanized corrugated steel form filled with grout. The encasements are in fair condition with minor surface corrosion and isolated areas of possible voiding. The substructure units are in satisfactory condition. There are no significant structural defects, but significant scour is present at most of the piers exposing foundation piles. Detailed descriptions of the structural conditions at each substructure unit are presented on the following page.



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UNDERWATER BRIDGE INSPECTION REPORT



NBI Item 60 Rating: 6
NBI Item 61 Rating: 8
NBI Item 113 Rating: 5

Bridge Number: 33-100-118
Inspection Date: 9/12/2012
Division: Statewide
River: Missouri River

Pier 2 - No structural defects. No undermining.

Pier 3 - The footing is undermined at the upstream nose 2-feet high. Exposed steel H-piles which are in good condition with no section loss.

Pier 4 - Northeast corner of footing exposed 1-foot high. The corrugated steel pipe encasement has random perforations and voiding. Refer to Photo 5.

Pier 5 - The footing is exposed 1.5-feet high at upstream nose only. There are unpatched 2" diameter core holes above the normal high waterline from previous chloride test. Refer to Photo 6.

Pier 6 - The footing is undermined 1.5-feet high at the northwest corner. The exposed steel H-piles are in good condition with no section loss noted. Refer to Photo 7. There is an area of voiding and spalling on the bottom edge of the undermined footing starting 3-feet from the northwest corner extending back approximately 6-feet. This condition is most likely construction related. Refer to Photos 8 through 10.

Pier 7 - The footing is undermined 4-feet high at the upstream face. The exposed steel H-piles are in good condition with no section loss. Refer to Photos 11 and 12.

Pier 8 - The entire footing with the exception of the downstream nose is undermined. The maximum undermining is 6-feet high at the upstream nose. The exposed steel H-piles are in good condition with no section loss. There are several areas of voiding on the bottom edge of the footing. The largest is on the north face where there is a construction void, 12" H x 36" W x 16" D with exposed primary reinforcing steel including two longitudinal bars which are exposed for 2-feet. There is no significant section loss on the reinforcing steel. Refer to Photos 13 and 14. There are two smaller voids, one 8-feet from the south nose on the west face, 3"H x 28"L x 5" D, with no exposed reinforcing steel. The other smaller void is midway on the east face, 13" H x 12" W x 24" D with two pieces of exposed primary reinforcing steel with no significant section loss.

Pier 9 - The footing is undermined around the entire perimeter. The maximum undermining is 10-feet high at the upstream nose, with the minimum at 3-feet high at the downstream nose. All the exposed steel H-piles are in good condition with no section loss.

Repair Recommendations:

No repairs are required at this time.



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UNDERWATER BRIDGE INSPECTION REPORT



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Bridge Number: 33-100-118
Inspection Date: 9/12/2012
Division: Statewide
River: Missouri River

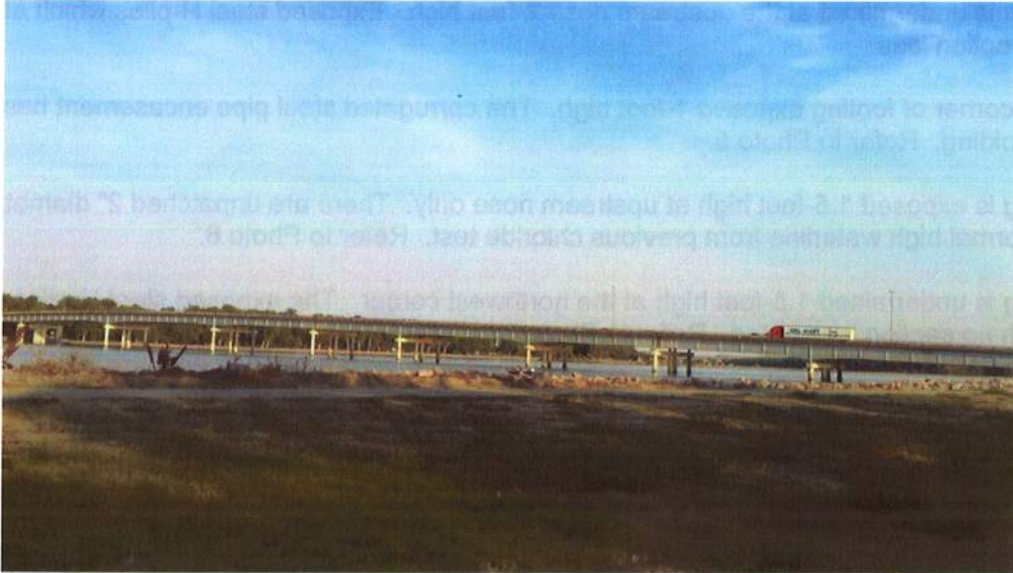


Photo 1 - Upstream Elevation



Photo 2 - Pier 3, West Face, Typical Substructure Configuration



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UNDERWATER BRIDGE INSPECTION REPORT



NBI Item 60 Rating: 6
NBI Item 61 Rating: 8
NBI Item 113 Rating: 5

Bridge Number: 33-100-118
Inspection Date: 9/12/2012
Division: Statewide
River: Missouri River



Photo 3 - West Embankment

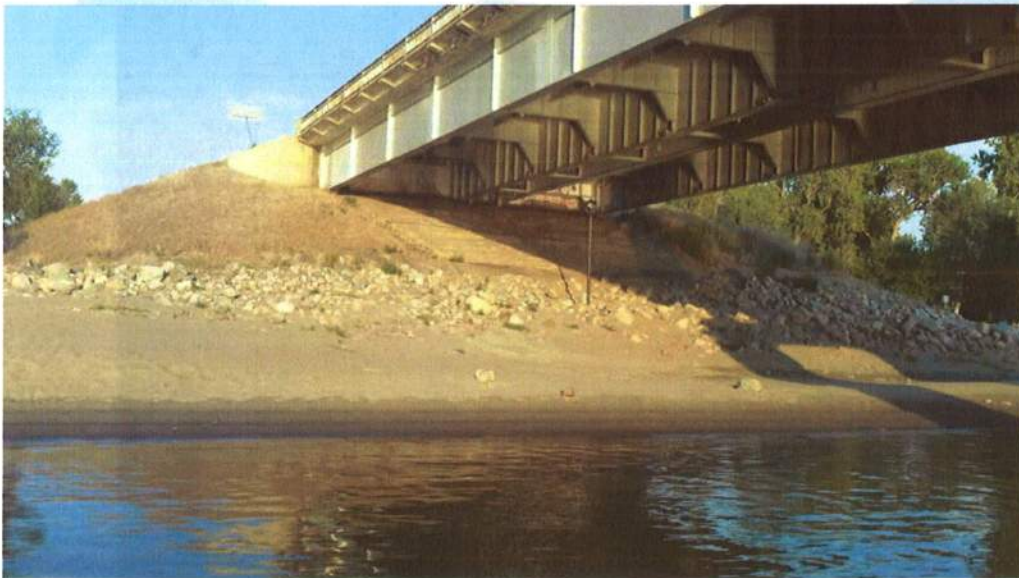


Photo 4 - East Embankment



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NBI Item 60 Rating: 6
NBI Item 61 Rating: 8
NBI Item 113 Rating: 5

Bridge Number: 33-100-118
Inspection Date: 9/12/2012
Division: Statewide
River: Missouri River



Photo 5 - Bent 4, Pile 4, Perforations and Voids in Encasement



Photo 6 - Bent 5, Unpatched Chloride Test Hole



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Inspection Date: 9/12/2012
Division: Statewide
River: Missouri River

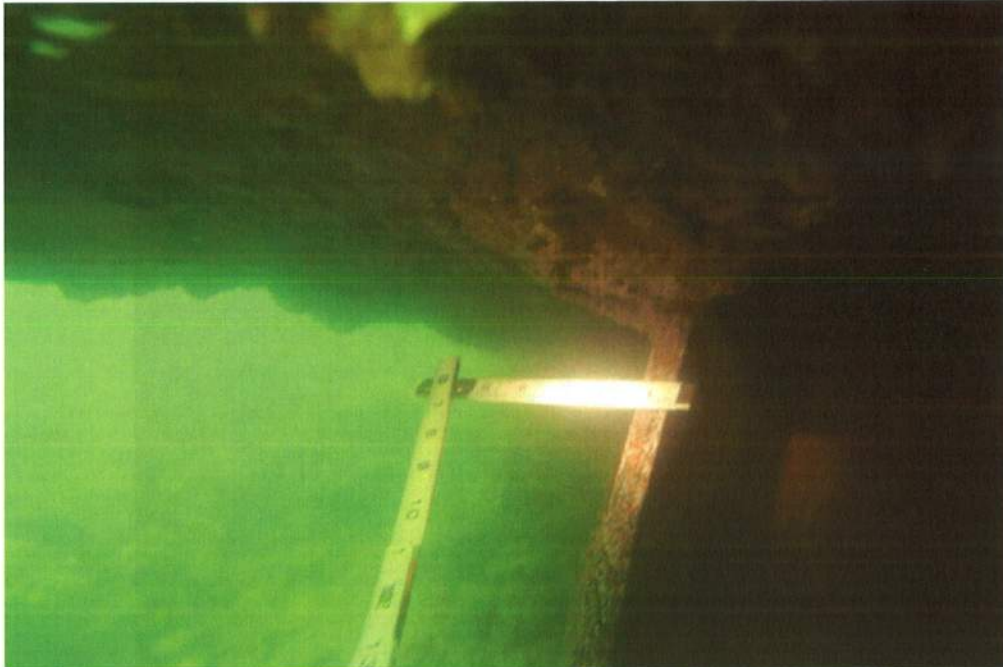


Photo 7 - Pier 6, Steel H-Pile Condition Below Undermined Footing



Photo 8 - Pier 6, Bottom of Footing, West Face



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Bridge Number: 33-100-118
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Division: Statewide
River: Missouri River

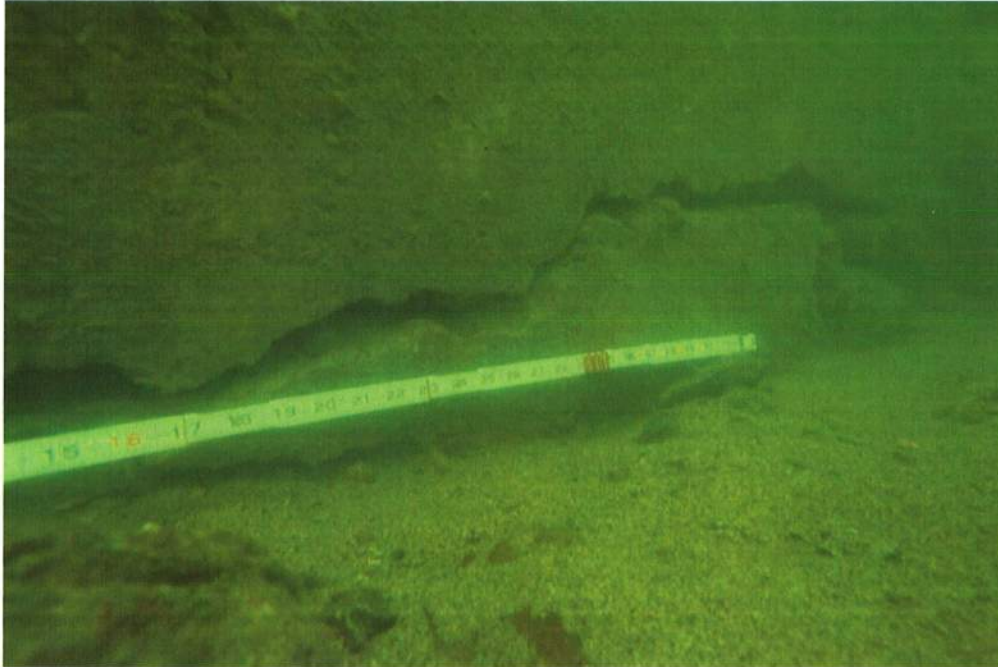


Photo 9 - Pier 6, Bottom of Footing, West Face, Spall

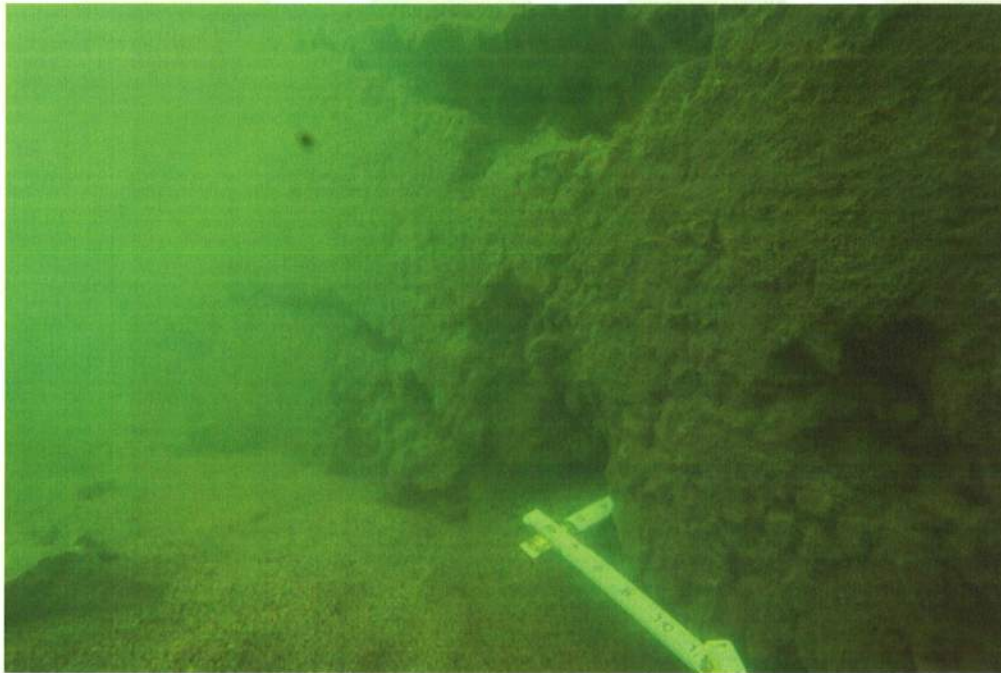


Photo 10 - Pier 6, Bottom of Footing, West Face, Voids



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Inspection Date: 9/12/2012
Division: Statewide
River: Missouri River

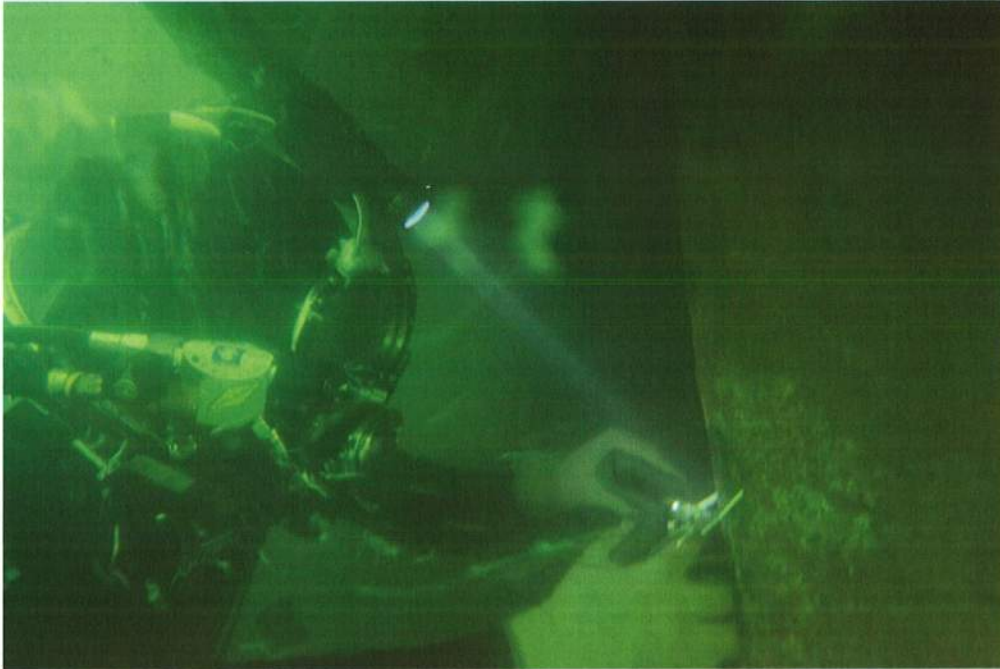


Photo 11 - Pier 7, Steel H-Pile Condition



Photo 12 - Pier 7, Steel H-Pile Condition Close Up



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Division: Statewide
River: Missouri River

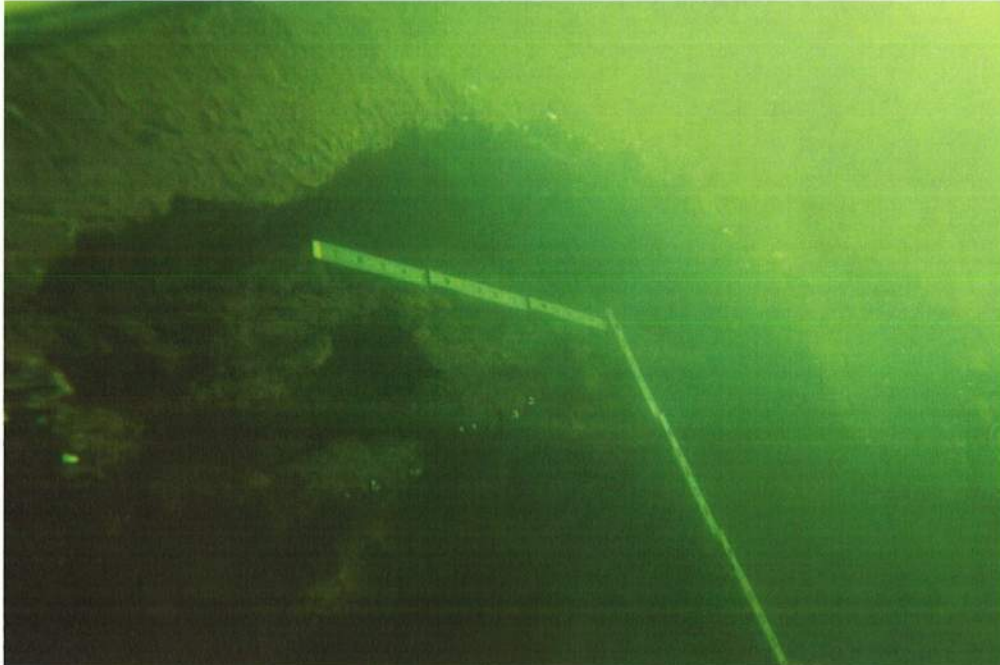


Photo 13 - Pier 8, North Bottom Edge of Footing, Eposed Reinforcing Steel



Photo 14 - Pier 8, North Face of Footing, Eposed Reinforcing Steel



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NBI Item 113 Rating: 5

Bridge Number: 33-100-118
Inspection Date: 9/12/2012
Division: Statewide
River: Missouri River

INSPECTION SOUNDING DATA

All sounding data is presented in elevations referenced to the construction plans.

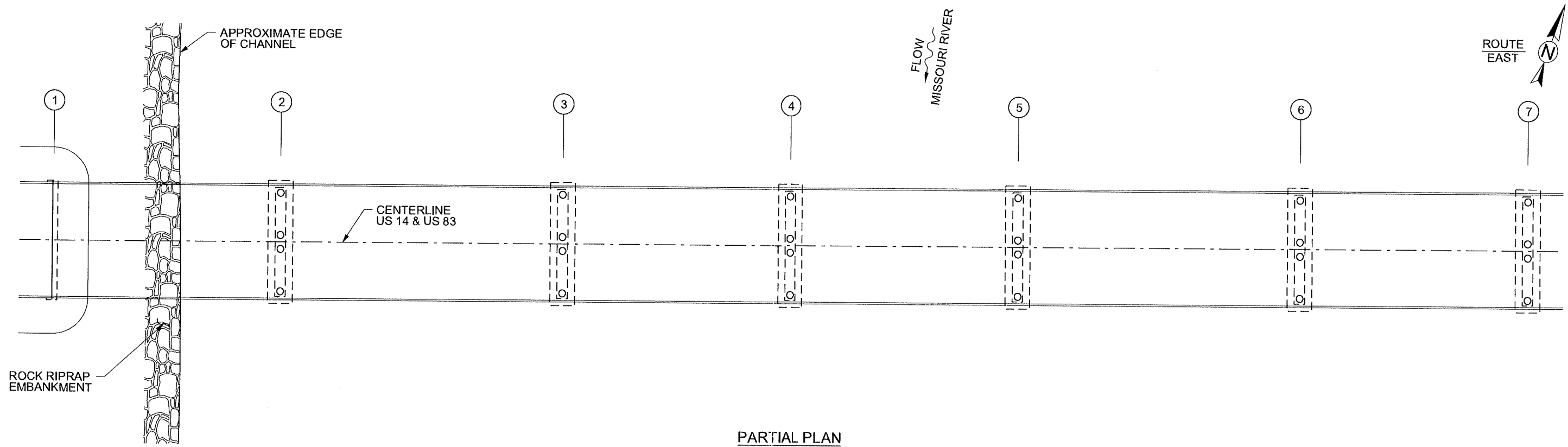
All sounding data is provided in the contour map on Page A-3.



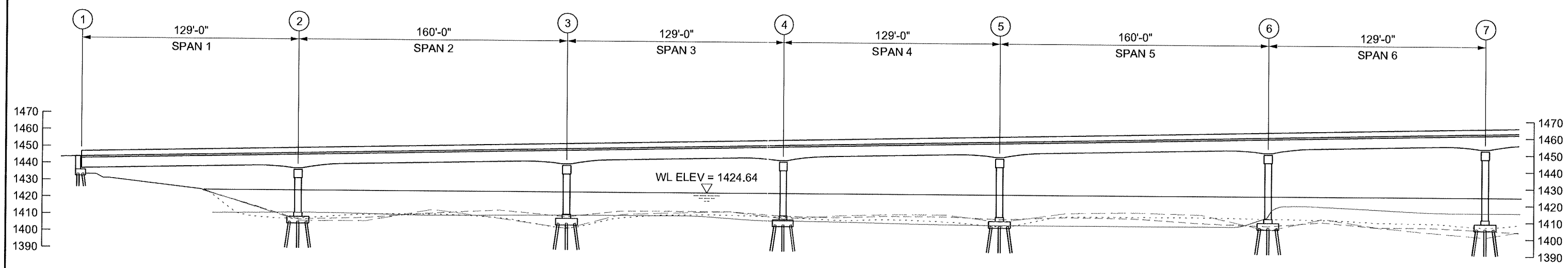
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PARTIAL PLAN

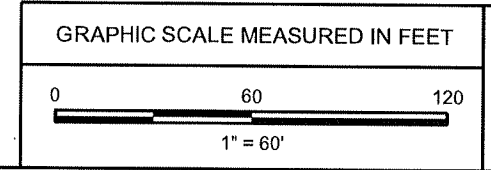


PARTIAL ELEVATION

GENERAL NOTES:

1. AT THE TIME OF INSPECTION ON SEPTEMBER 12, 2012, THE WATERLINE WAS LOCATED 19.5-FT ABOVE THE BOTTOM OF PIER 3 FOOTING. THIS CORRESPONDS TO A WATERLINE ELEVATION OF 1424.64 BASED ON THE AVAILABLE PLANS.

CHANNEL PROFILE LEGEND	
ORIGINAL	—————
2008 - UPSTREAM FASCIA
2012 - UPSTREAM FASCIA	-----
2012 - DOWNSTREAM FASCIA	-----



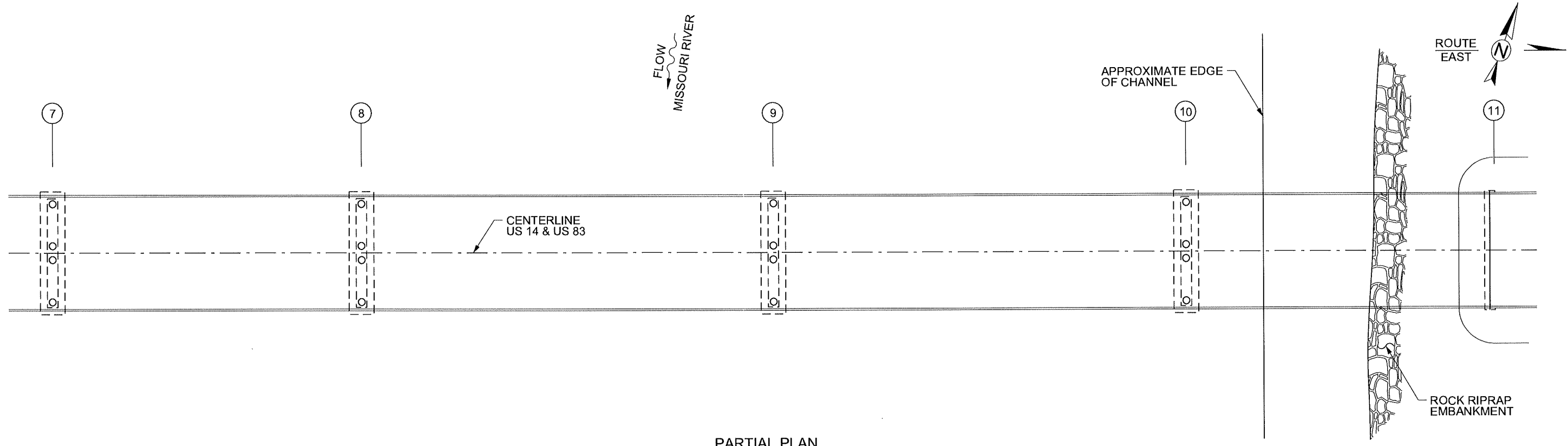
DATE
SEP, 2012



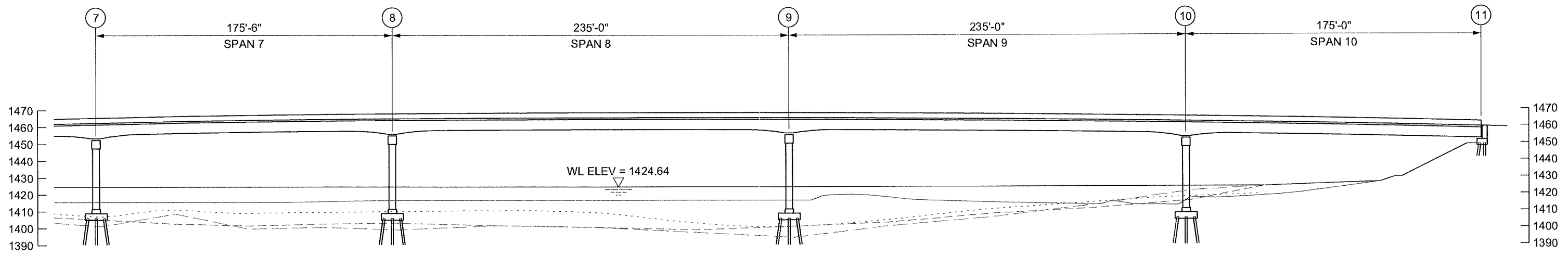
US 14/83 OVER THE MISSOURI RIVER
BRIDGE NO. 33-100-118

PLAN AND ELEVATION (PAGE 1 OF 2)

PAGE
A-1



PARTIAL PLAN



PARTIAL ELEVATION

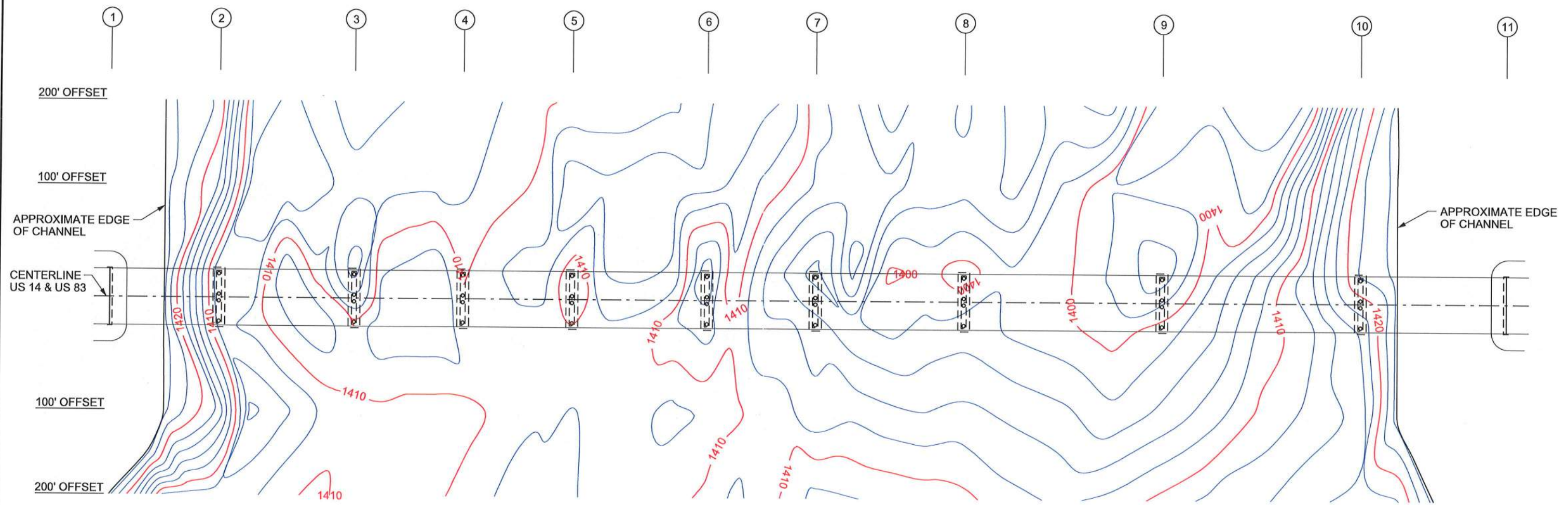
GENERAL NOTES:

1. AT THE TIME OF INSPECTION ON SEPTEMBER 12, 2012, THE WATERLINE WAS LOCATED 19.5-FT ABOVE THE BOTTOM OF PIER 3 FOOTING. THIS CORRESPONDS TO A WATERLINE ELEVATION OF 1424.64 BASED ON THE AVAILABLE PLANS.

CHANNEL PROFILE LEGEND	
ORIGINAL	—————
2008 - UPSTREAM FASCIA	- - - - -
2012 - UPSTREAM FASCIA	- - - - -
2012 - DOWNSTREAM FASCIA	- - - - -

GRAPHIC SCALE MEASURED IN FEET 1" = 60'	DATE SEP, 2012	 2121 Old Hickory Tree Road St. Cloud, Florida 34772 PH.: 407.957.1660 FAX: 407.957.8744 INFRASTRUCTURE ENGINEERS, INC.	US 14/83 OVER THE MISSOURI RIVER BRIDGE NO. 33-100-118	PAGE A-2
	PLAN AND ELEVATION (PAGE 2 OF 2)			

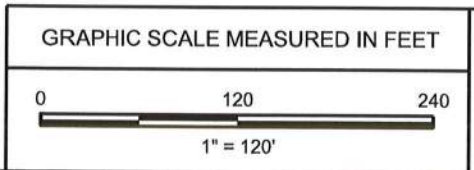
FLOW
MISSOURI RIVER



CHANNEL CONTOUR PLAN

CONTOUR NOTES

1. THIS DRAWING WAS PREPARED WITH SELECTED PLAN SHEETS PROVIDED BY THE SOUTH DAKOTA DEPARTMENT OF TRANSPORTATION.
2. ALL CHANNEL PROFILE DATA COLLECTED IN THE FIELD IS ACCURATE $\pm 1/2$ FT.
3. AT THE TIME OF INSPECTION ON 09/12/2012, THE WATERLINE WAS LOCATED 19.5 FEET ABOVE THE BOTTOM OF PIER 3 FOOTING. THIS CORRESPONDS TO A WATERLINE ELEVATION OF 1424.64 BASED ON THE AVAILABLE PLANS.



DATE
SEP, 2012

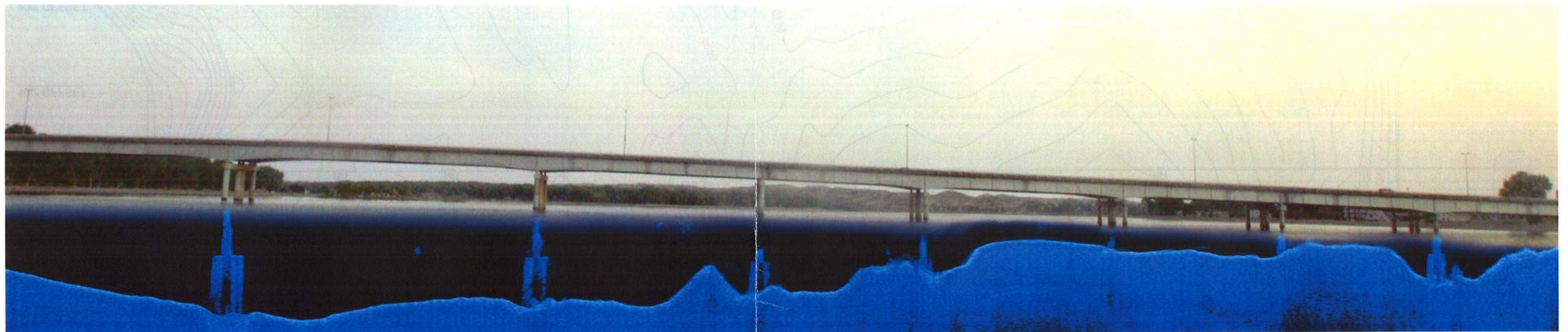
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US 14/83 OVER THE MISSOURI RIVER
BRIDGE NO. 33-100-118

CHANNEL CONTOUR PLAN


PAGE
A-3

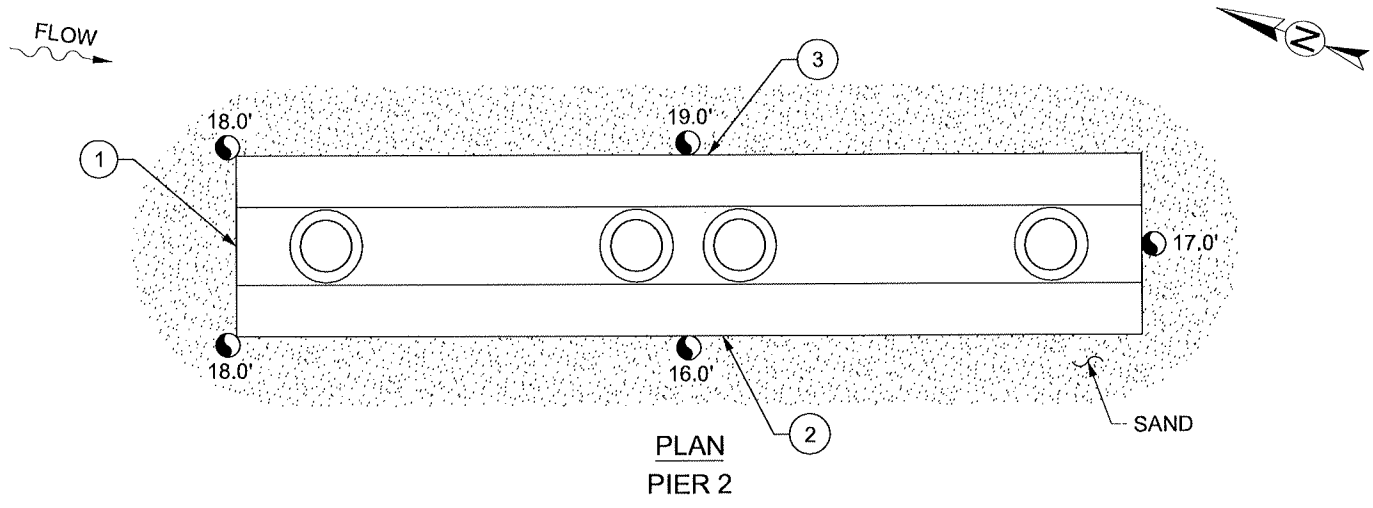
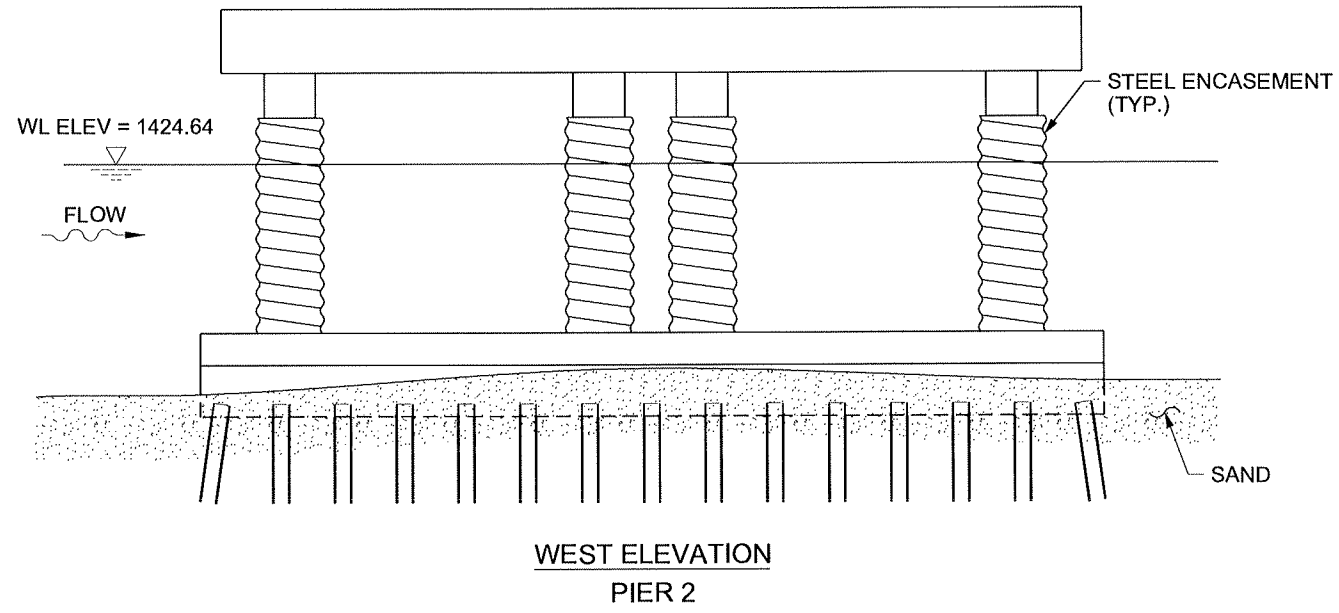


NORTH ELEVATION ACOUSTIC SCAN

GENERAL NOTES:

1. AT THE TIME OF INSPECTION ON SEPTEMBER 12, 2012, THE WATERLINE WAS LOCATED 19.5-FT ABOVE THE BOTTOM OF PIER 3 FOOTING. THIS CORRESPONDS TO A WATERLINE ELEVATION OF 1424.64 BASED ON THE AVAILABLE PLANS.

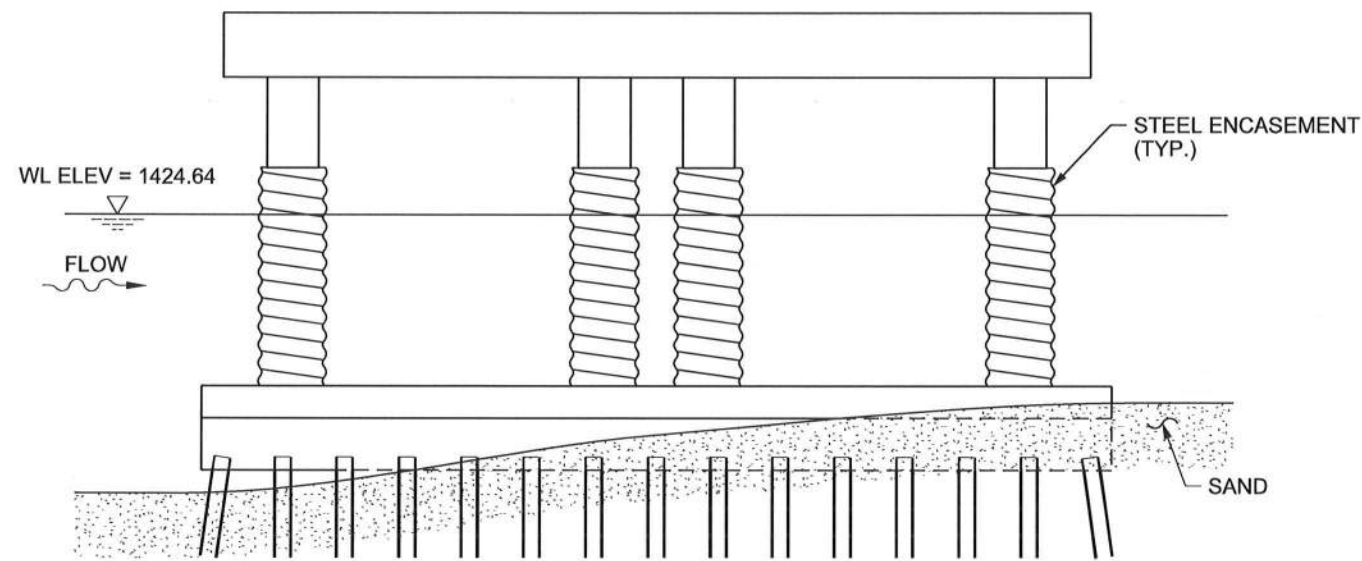
DATE SEP, 2012	 2121 Old Hickory Tree Road St. Cloud, Florida 34772 PH: 407.957.1660 FAX: 407.957.8744	US 14/83 OVER THE MISSOURI RIVER BRIDGE NO. 33-100-118	PAGE A-4
INFRASTRUCTURE ENGINEERS, INC.			ELEVATION ACOUSTIC SCAN



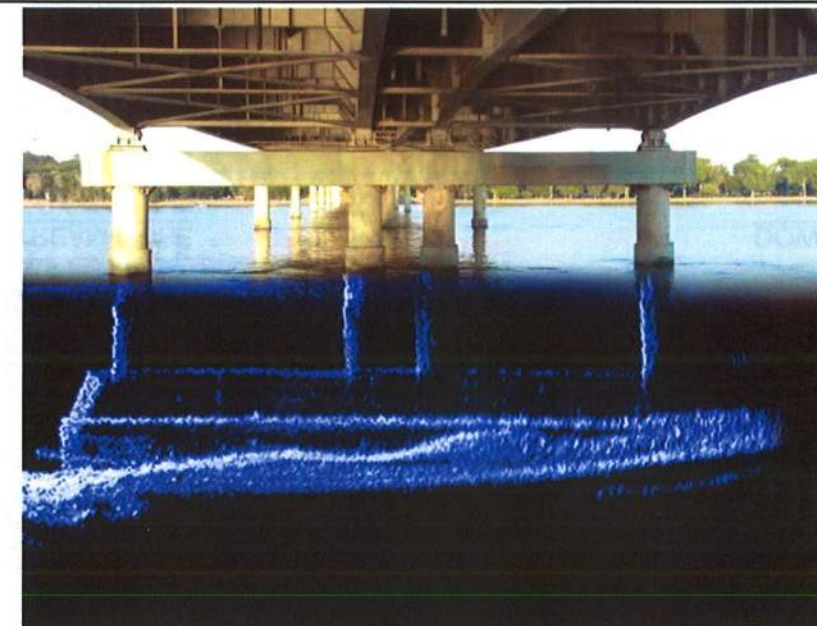
- NOTES:**
- ① FOOTING EXPOSED UP TO 3' HIGH, UPSTREAM NOSE (NORTH)
 - ② FOOTING EXPOSED UP TO 2' HIGH, WEST FACE
 - ③ FOOTING EXPOSED UP TO 4.5' HIGH, EAST FACE

LEGEND:
 ● 21.5' DENOTES WATER DEPTH

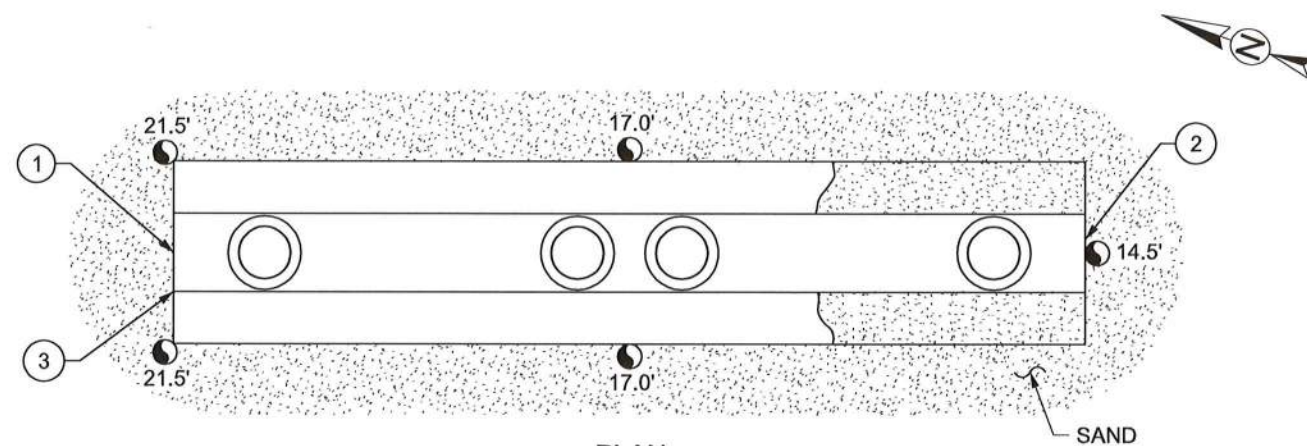
GRAPHIC SCALE MEASURED IN FEET 	DATE SEP, 2012	2121 Old Hickory Tree Road St. Cloud, Florida 34772 PH.: 407.957.1660 FAX: 407.957.8744 INFRASTRUCTURE ENGINEERS, INC.	US 14/83 OVER THE MISSOURI RIVER BRIDGE NO. 33-100-118	
			PIER 2	PAGE A-5



WEST ELEVATION
PIER 3



WEST ELEVATION ACOUSTIC IMAGE



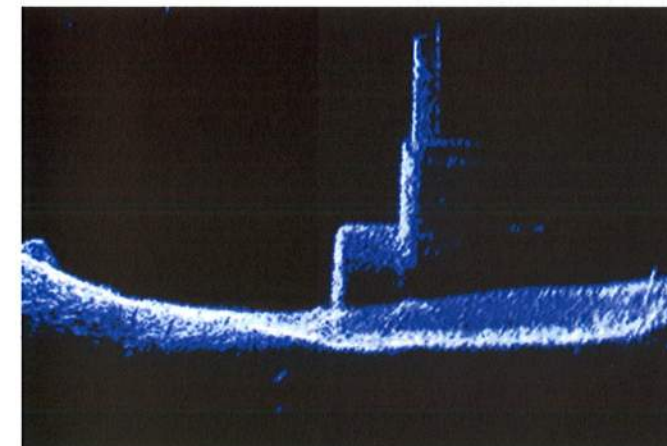
PLAN
PIER 3

NOTES:

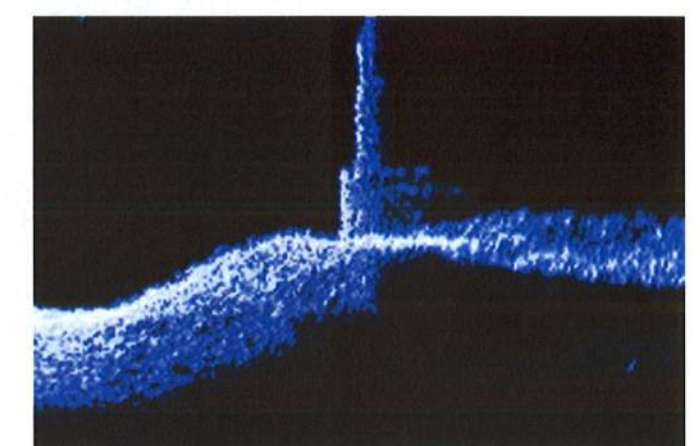
- ① FOOTING IS UNDERMINED UP TO 2' HIGH AT UPSTREAM NOSE (NORTH) AND EXTENDS 6' ALONG WEST FACE AND 7' ALONG EAST FACE
- ② CHANNEL BOTTOM FLUSH WITH TOP OF FOOTING AT DOWNSTREAM NOSE (SOUTH)
- ③ THREE ROWS OF STEEL PILES EXPOSED, PILE COATING IS STILL INTACT.



EAST ELEVATION ACOUSTIC IMAGE



UPSTREAM NOSE

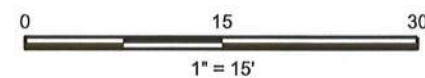


DOWNSTREAM NOSE

LEGEND:

● 21.5' DENOTES WATER DEPTH

GRAPHIC SCALE MEASURED IN FEET



DATE

SEP, 2012

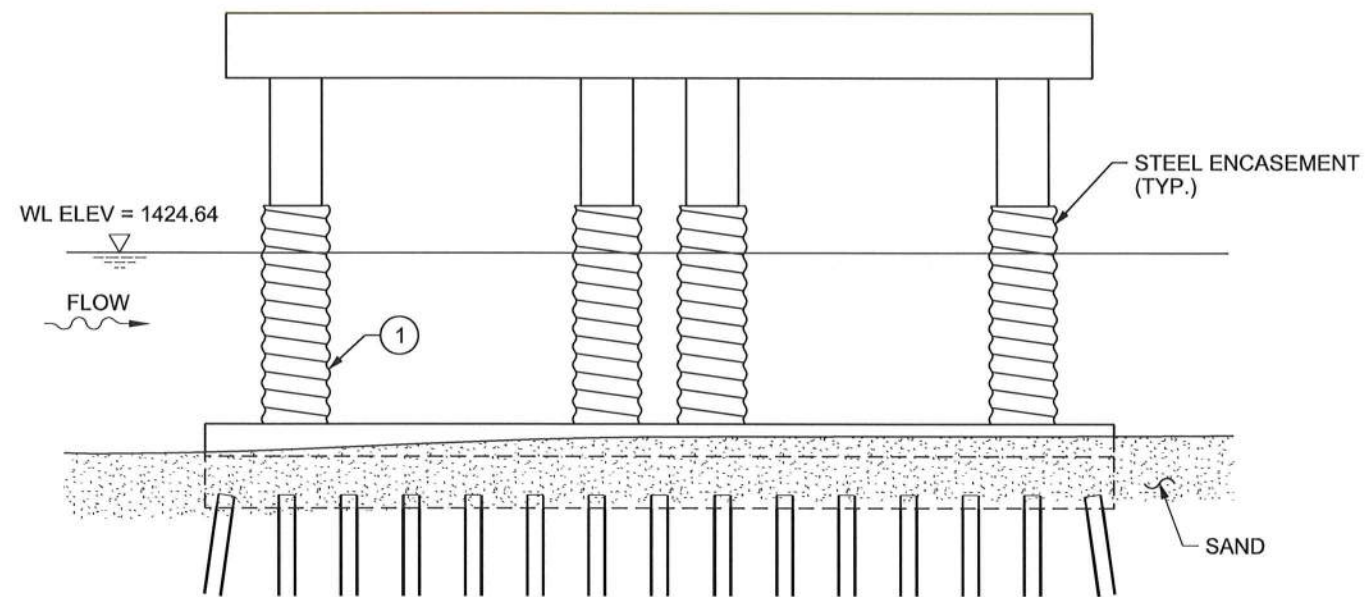
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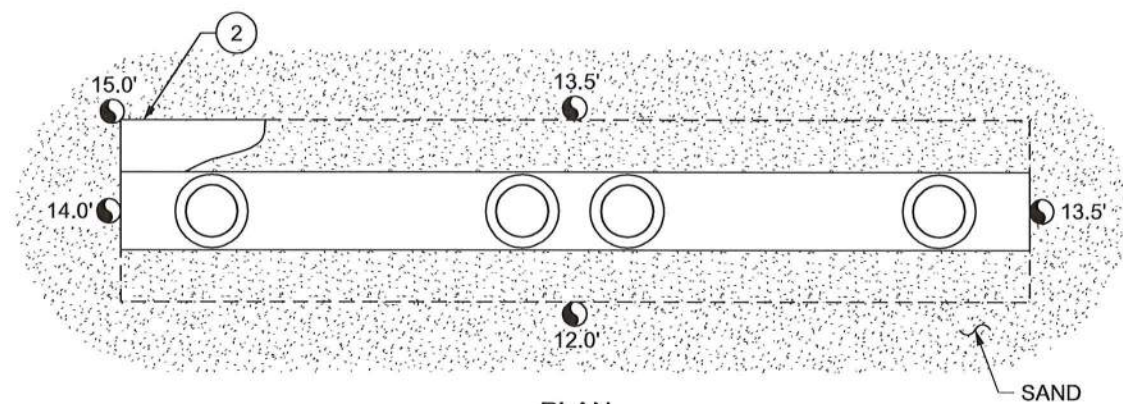
US 14/83 OVER THE MISSOURI RIVER
BRIDGE NO. 33-100-118

PIER 3

PAGE
A-6



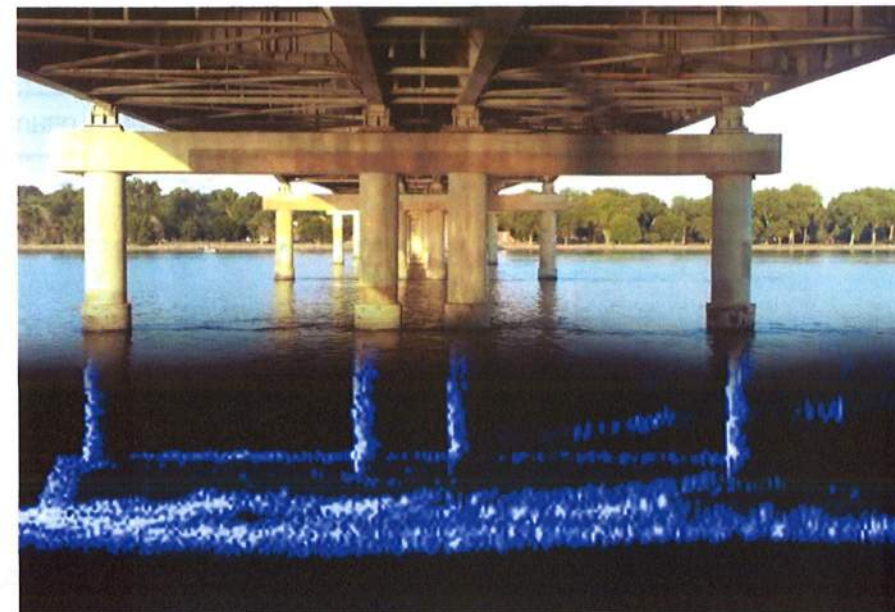
WEST ELEVATION
PIER 4



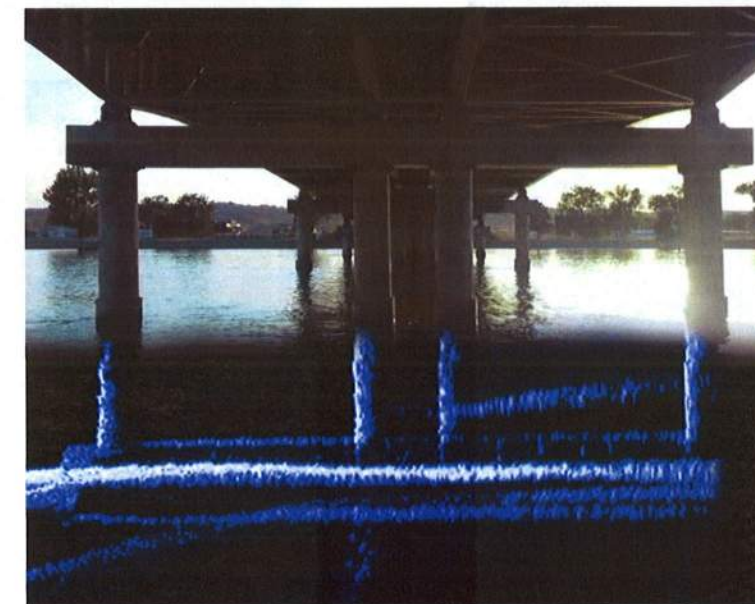
PLAN
PIER 4

NOTES:

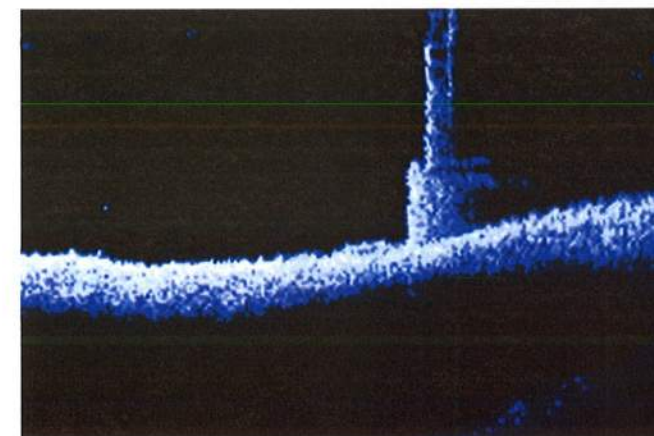
- ① COLUMN 1 STEEL ENCASUREMENT HAS VOIDS AND PERFORATIONS EXPOSING THE ORIGINAL COLUMN, COLUMN HAS SCALING UP TO 1/16" DEEP.
- ② NORTH EAST CORNER OF FOOTING EXPOSED, EXTENDS 6' ALONG EAST FACE.



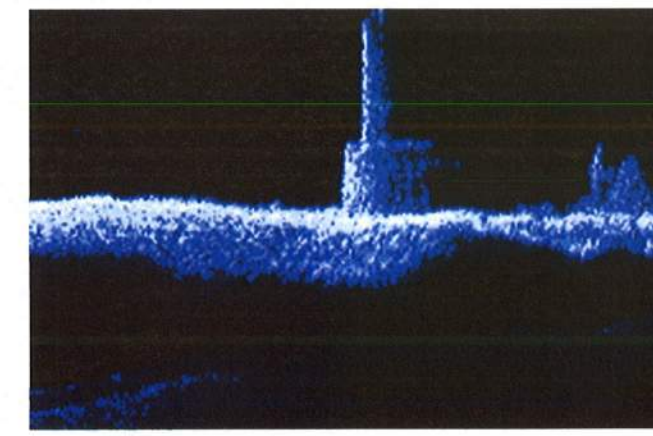
WEST ELEVATION ACOUSTIC IMAGE



EAST ELEVATION ACOUSTIC IMAGE



UPSTREAM NOSE

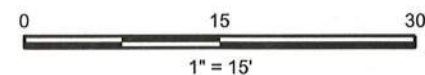


DOWNSTREAM NOSE

LEGEND:

● 21.5' DENOTES WATER DEPTH

GRAPHIC SCALE MEASURED IN FEET



DATE

SEP, 2012

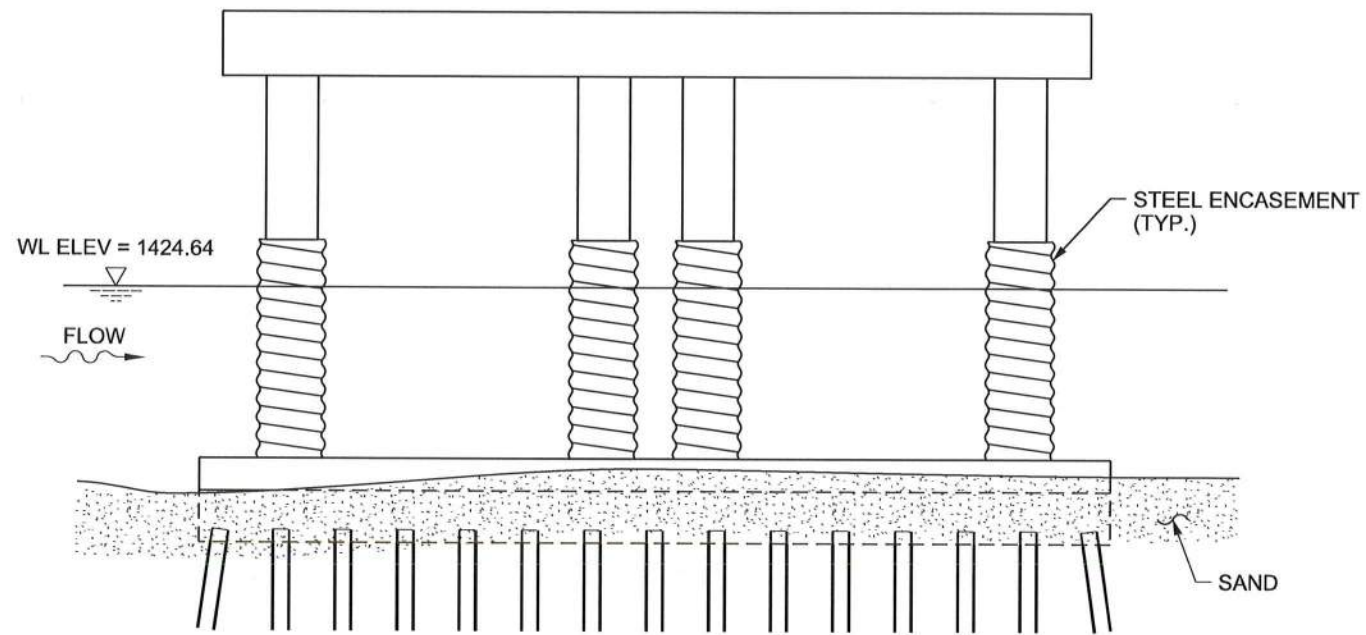
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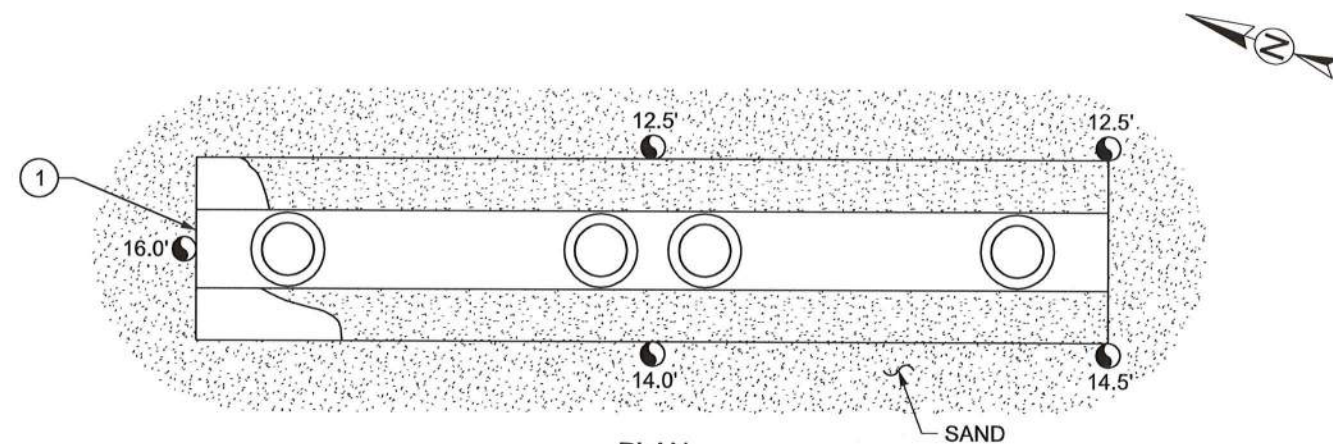
US 14/83 OVER THE MISSOURI RIVER
BRIDGE NO. 33-100-118

PIER 4

PAGE
A-7



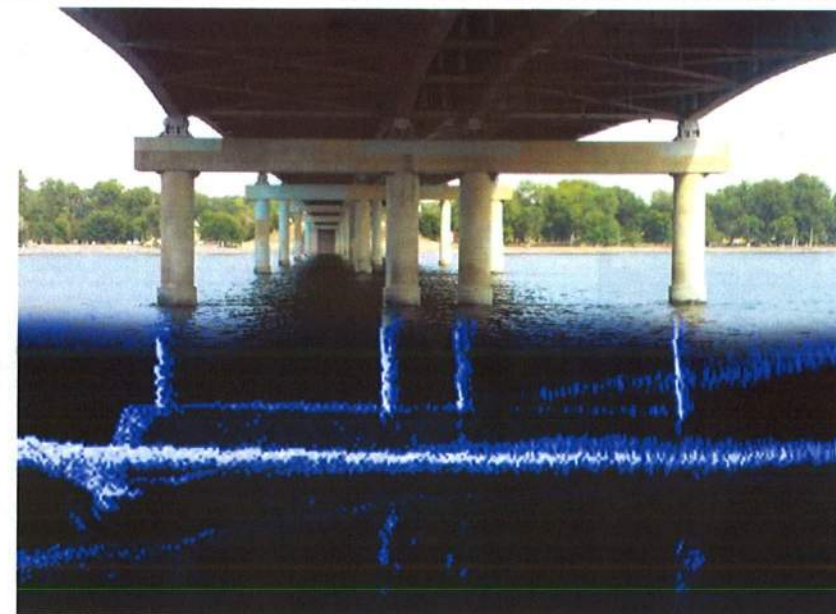
WEST ELEVATION
PIER 5



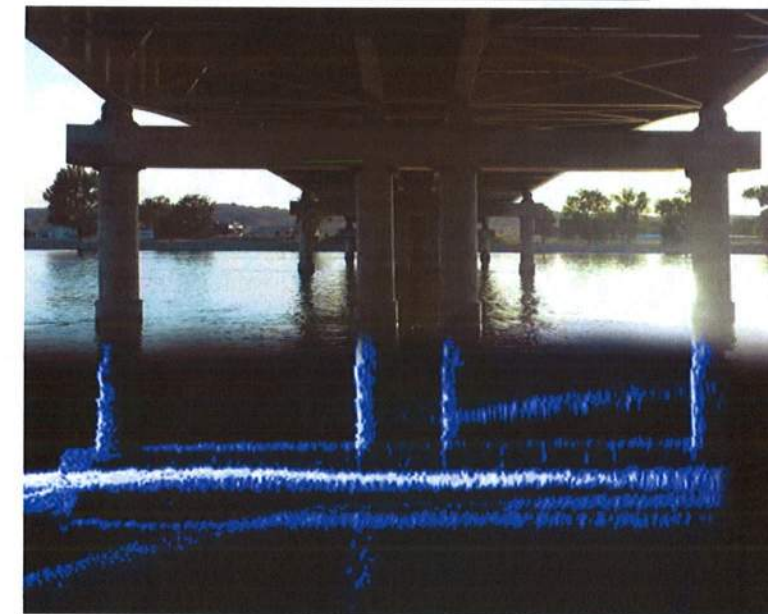
PLAN
PIER 5

NOTES:

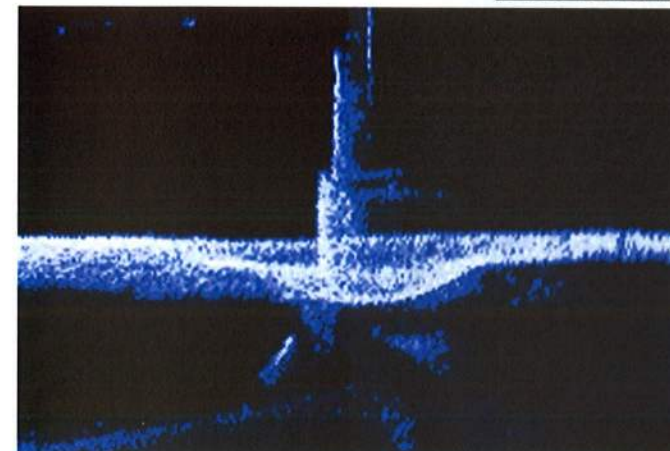
- ① SMALL SCOUR CONE WITH A 7' RADIUS x 3' DEEP, FOOTING EXPOSED UP TO 1.5' HIGH



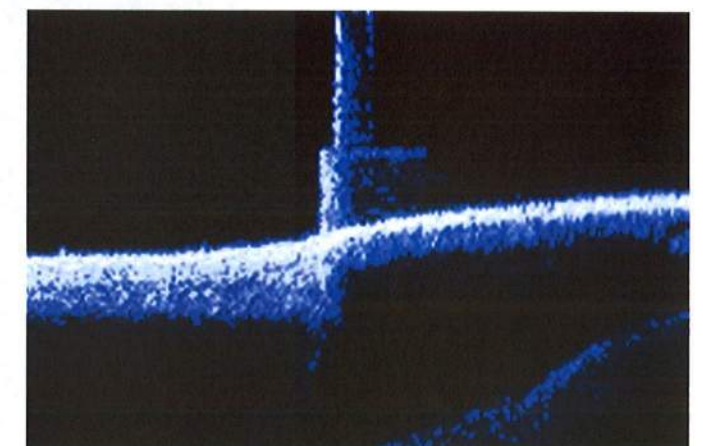
WEST ELEVATION ACOUSTIC IMAGE



EAST ELEVATION ACOUSTIC IMAGE



UPSTREAM NOSE

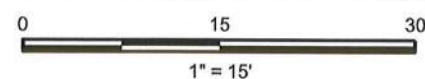


DOWNSTREAM NOSE

LEGEND:

- 21.5' DENOTES WATER DEPTH

GRAPHIC SCALE MEASURED IN FEET



DATE

SEP, 2012

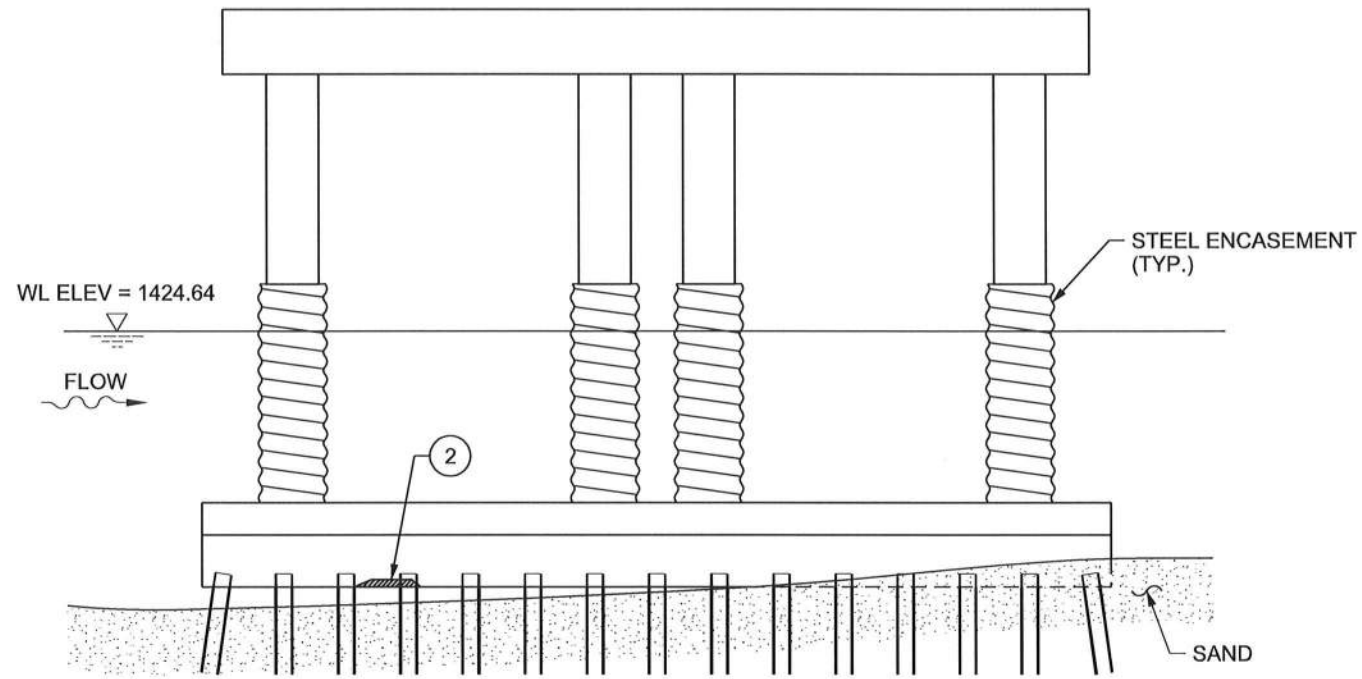
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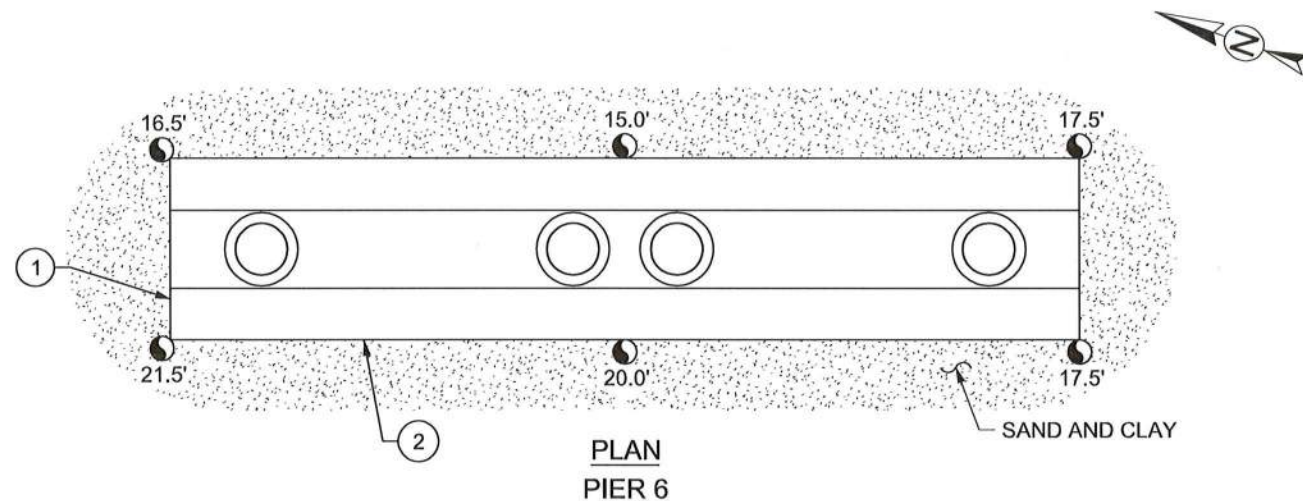
US 14/83 OVER THE MISSOURI RIVER
BRIDGE NO. 33-100-118

PIER 5

PAGE
A-8



WEST ELEVATION
PIER 6

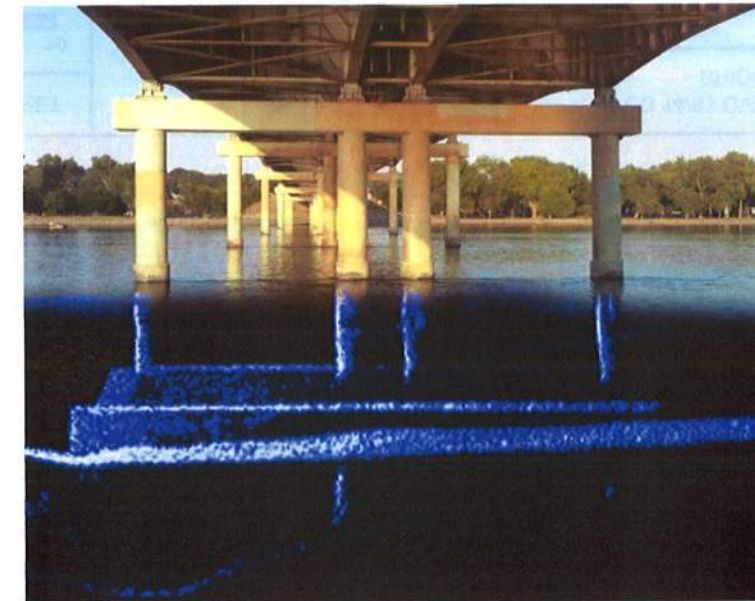


NOTES:

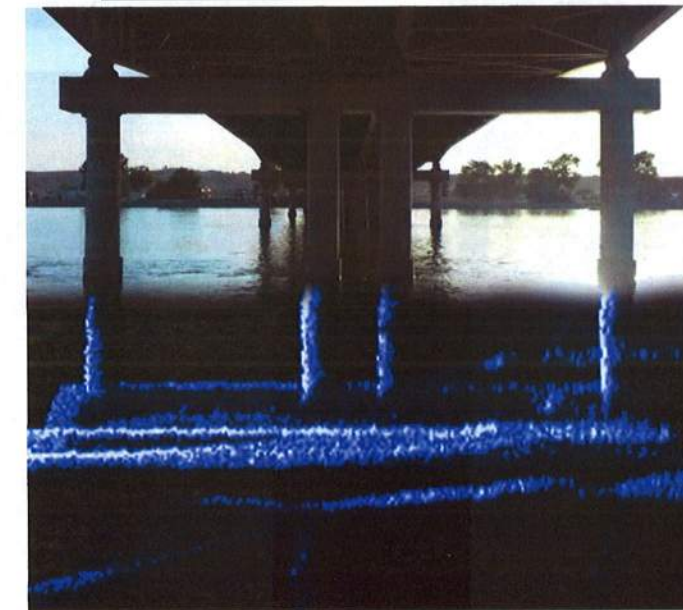
- ① FOOTING UNDERMINED UP TO 1.5' HIGH FROM CENTER OF UPSTREAM NOSE TO EXTEND 16' ALONG WEST FACE. EXPOSED STEEL PILES ARE IN GOOD CONDITION.
- ② CONSTRUCTION VOIDING AND CRACK 3' FROM UPSTREAM NOSE, EXTENDS 6' ON WEST FACE, ONE AREA HAS FRACTURED OFF. SEE REPORT PHOTO

LEGEND:

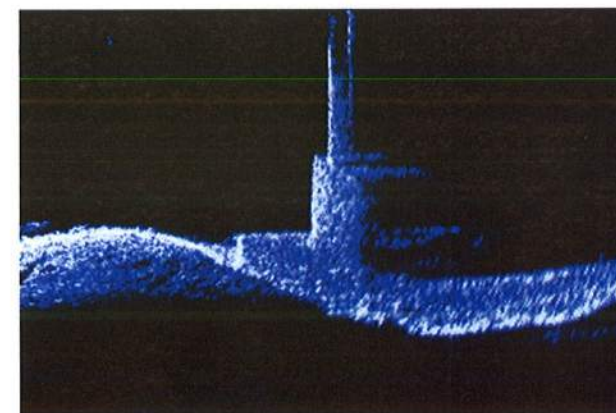
● 21.5' DENOTES WATER DEPTH



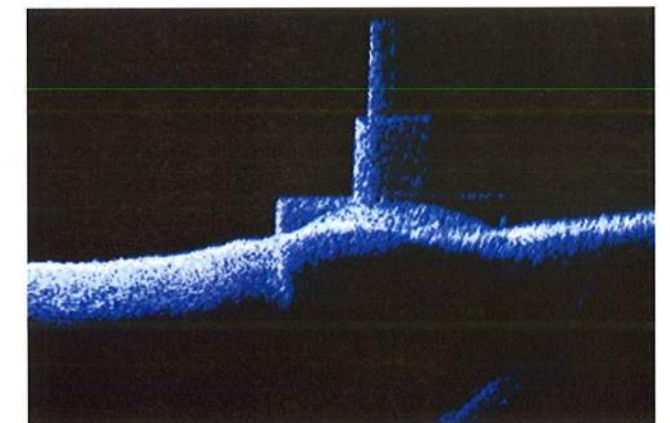
WEST ELEVATION ACOUSTIC IMAGE



EAST ELEVATION ACOUSTIC IMAGE

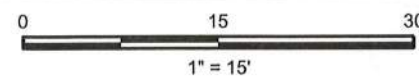


UPSTREAM NOSE



DOWNSTREAM NOSE

GRAPHIC SCALE MEASURED IN FEET



DATE

SEP, 2012

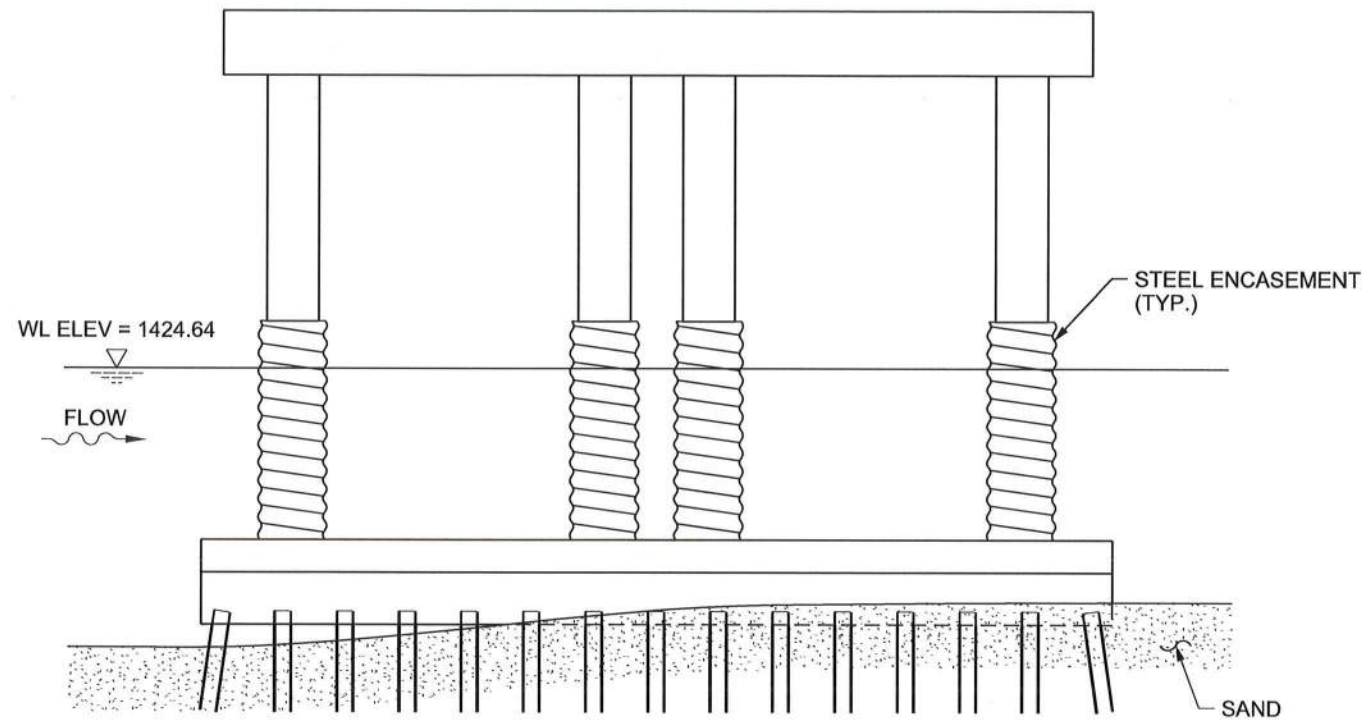
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INFRASTRUCTURE
ENGINEERS, INC.

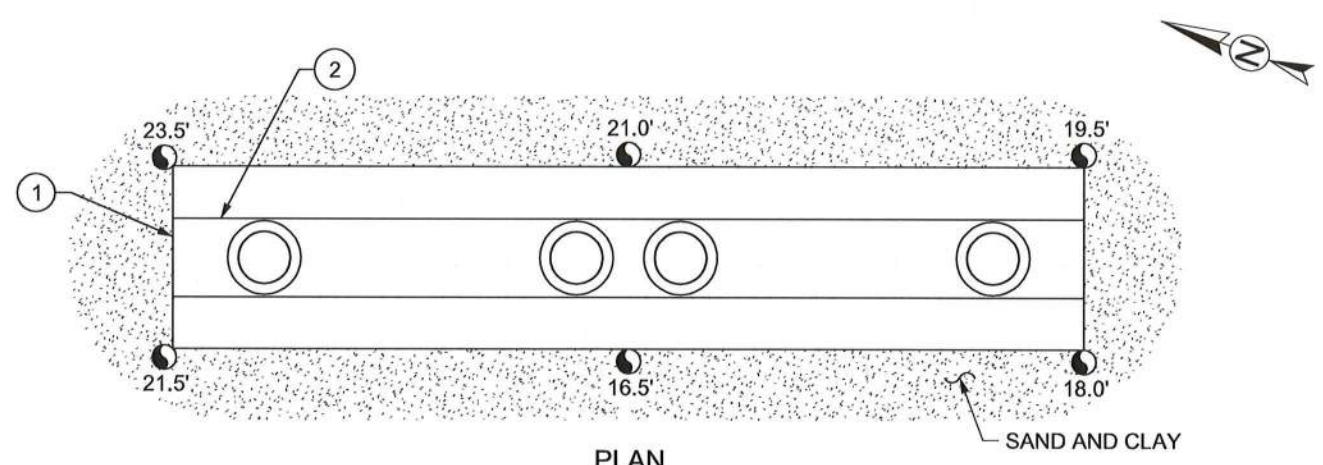
US 14/83 OVER THE MISSOURI RIVER
BRIDGE NO. 33-100-118

PIER 6

PAGE
A-9



WEST ELEVATION
PIER 7



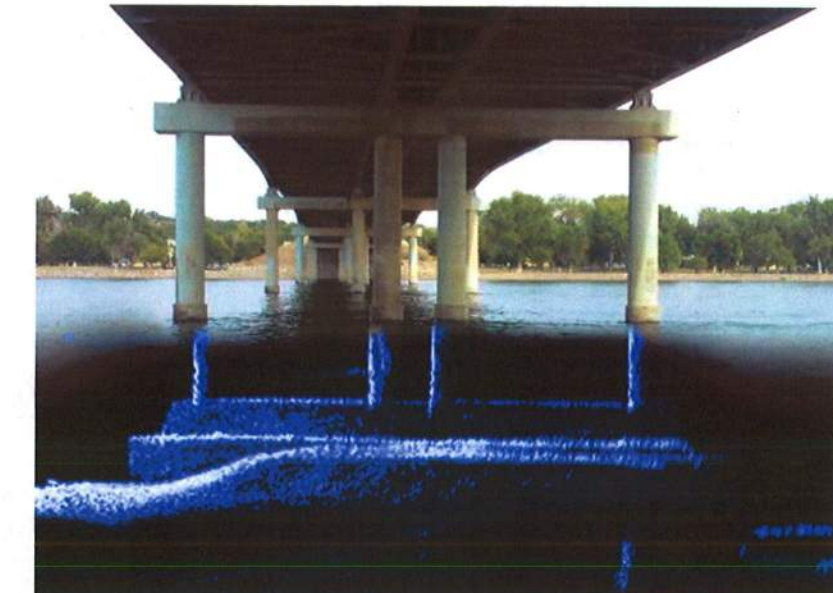
PLAN
PIER 7

NOTES:

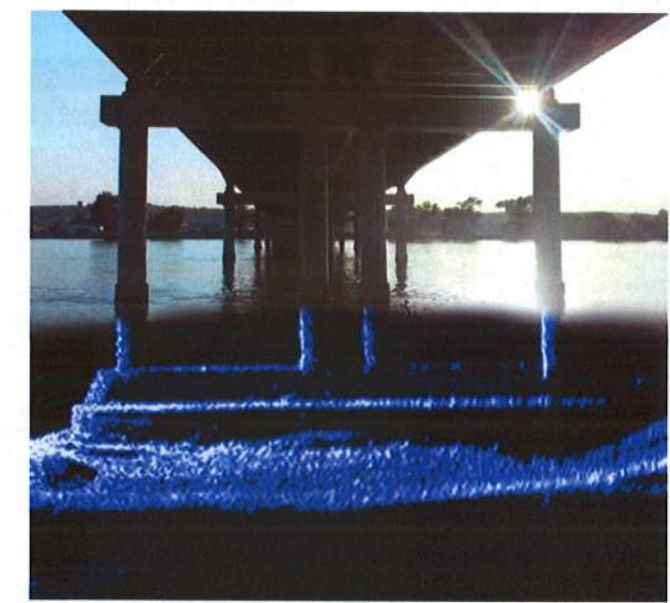
- ① 4 FEET OF VERTICAL UNDERMINING AT UPSTREAM NOSE, EXTENDING FROM 30' ON EAST FACE AND 12 FEET ON WEST FACE. STEEL PILES ARE EXPOSED AND IN GOOD CONDITION.
- ② RANDOM SPALLING ON TOP CORNER OF PEDESTAL, NO EXPOSED STEEL

LEGEND:

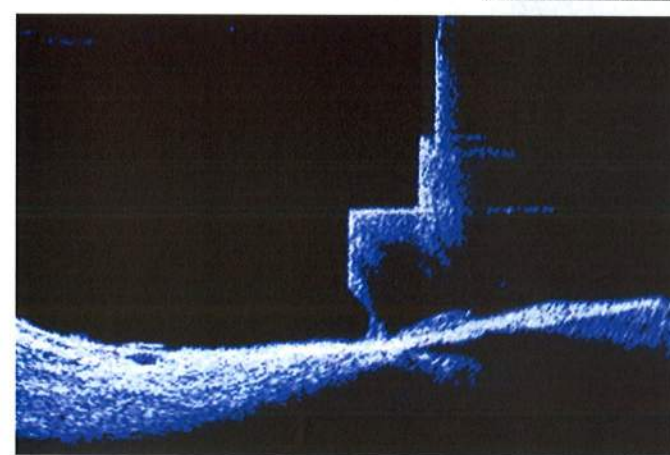
● 21.5' DENOTES WATER DEPTH



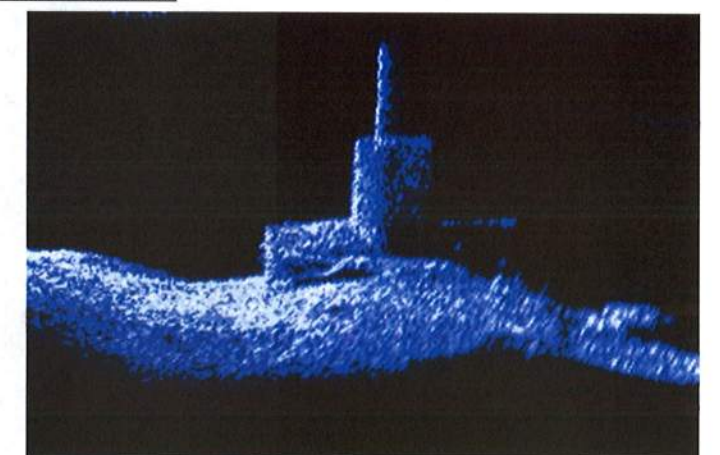
WEST ELEVATION ACOUSTIC IMAGE



EAST ELEVATION ACOUSTIC IMAGE

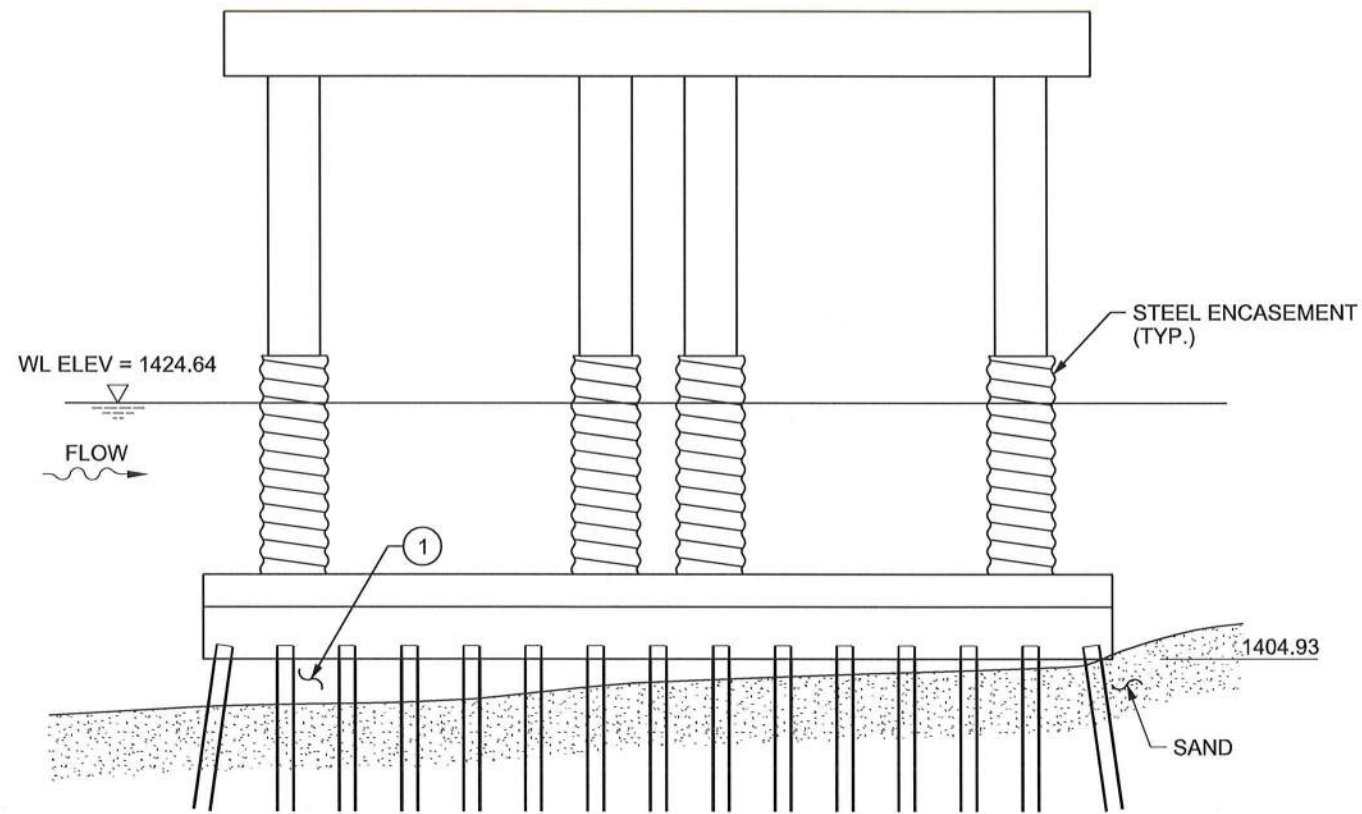


UPSTREAM NOSE

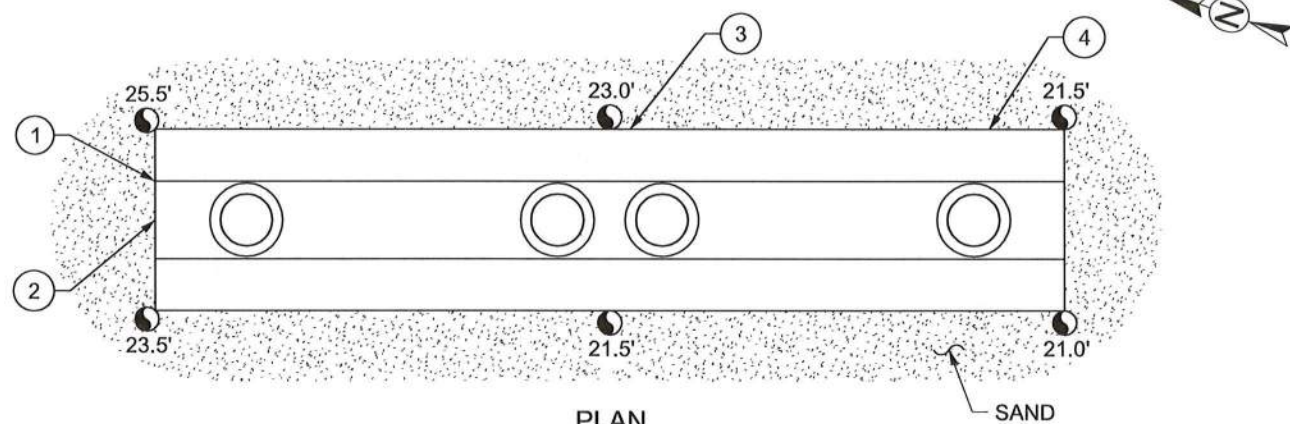


DOWNSTREAM NOSE

GRAPHIC SCALE MEASURED IN FEET 	DATE SEP, 2012	2121 Old Hickory Tree Road St. Cloud, Florida 34772 PH.: 407.957.1660 FAX: 407.957.8744	US 14/83 OVER THE MISSOURI RIVER BRIDGE NO. 33-100-118	
	INFRASTRUCTURE ENGINEERS, INC.		PIER 7	PAGE A-10



WEST ELEVATION
PIER 8



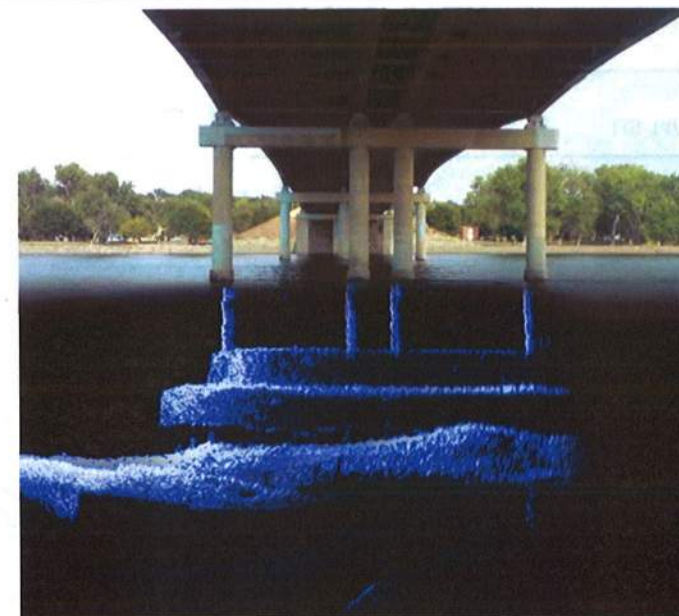
PLAN
PIER 8

NOTES:

- ① UNDERMINING IS UP TO 6' HIGH AT UPSTREAM NOSE (NORTH) WITH PILES EXPOSED. ALL PILES ARE IN GOOD CONDITION WITH NO SECTION LOSS. FOOTING IS UNDERMINED ON ALL SIDES EXCEPT FOR DOWNSTREAM NOSE WHERE A MOUND OF SAND IS PRESENT.
- ② VOID - BOTTOM EDGE, 36"Wx12"Hx16"D W/ 1 HORZ. BAR & 2 VERT. BARS EXPOSED
- ③ VOID - BOTTOM EDGE AT MIDPOINT OF FOOTING, 12"Wx12"Hx24"D W/ 2 BARS EXPOSED
- ④ VOID - 8' FROM SOUTH END OF FOOTING, 3"Wx28"Hx5"D W/ NO EXPOSED STEEL

LEGEND:

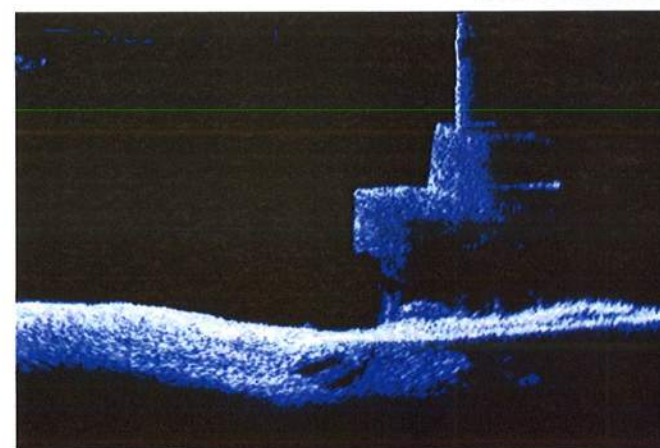
- 21.5' DENOTES WATER DEPTH
- W=Width D=Depth H=Height



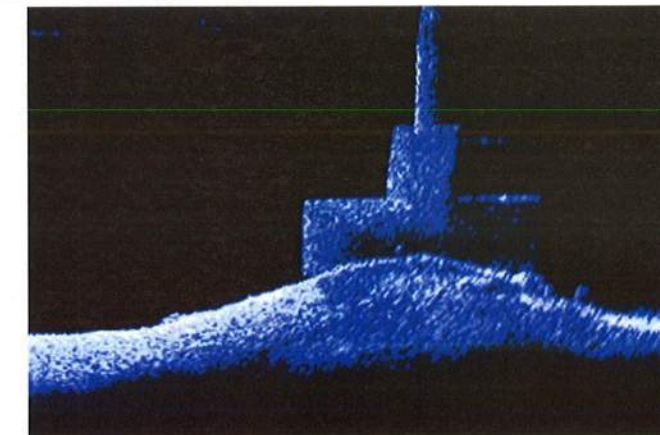
WEST ELEVATION ACOUSTIC IMAGE



EAST ELEVATION ACOUSTIC IMAGE

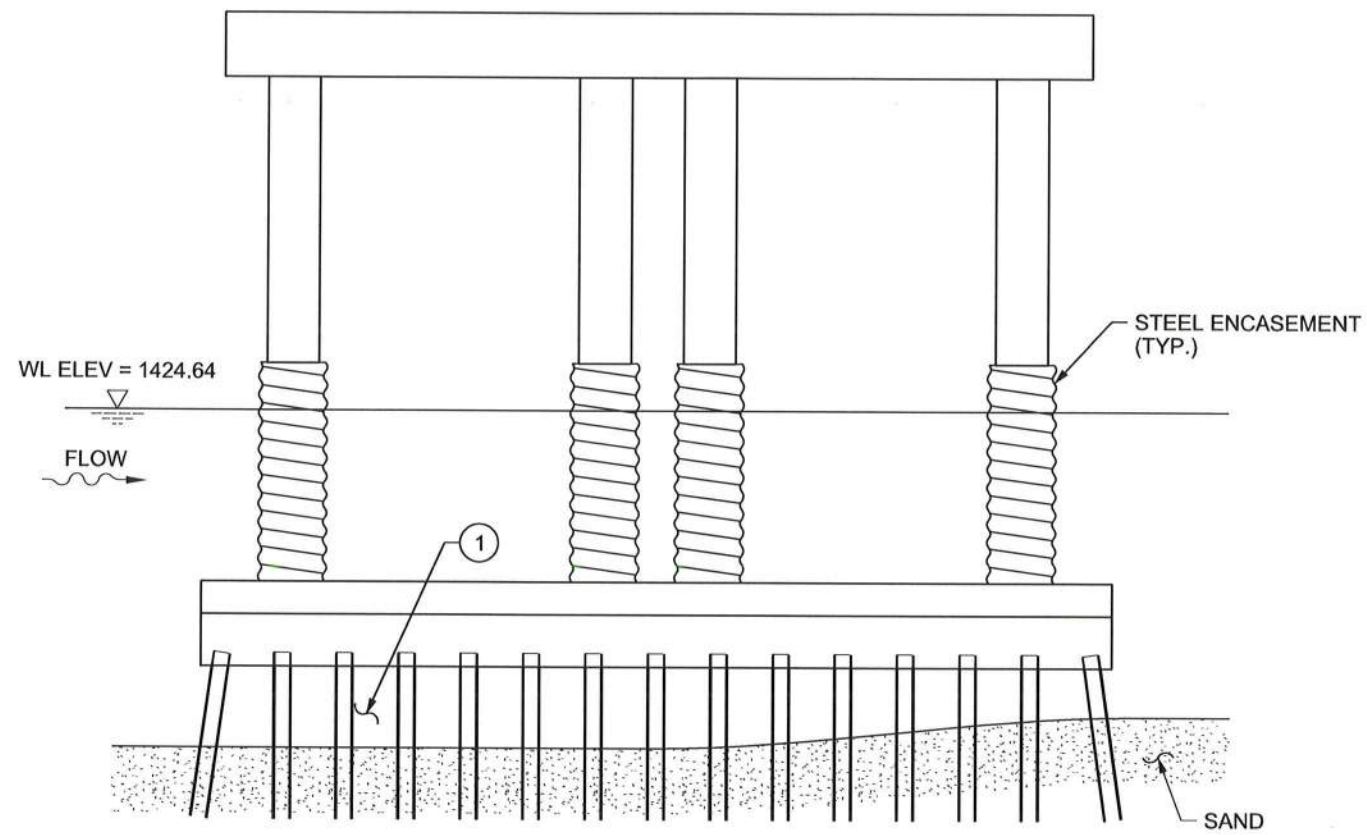


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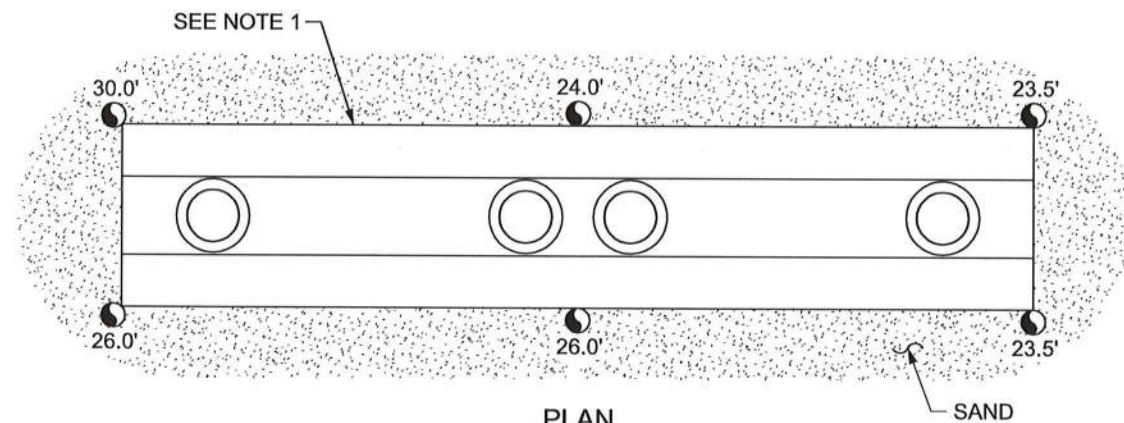


DOWNSTREAM NOSE

GRAPHIC SCALE MEASURED IN FEET 	DATE	2121 Old Hickory Tree Road St. Cloud, Florida 34772 PH.: 407.957.1660 FAX: 407.957.8744	US 14/83 OVER THE MISSOURI RIVER BRIDGE NO. 33-100-118	
	SEP, 2012		INFRASTRUCTURE ENGINEERS, INC.	PIER 8



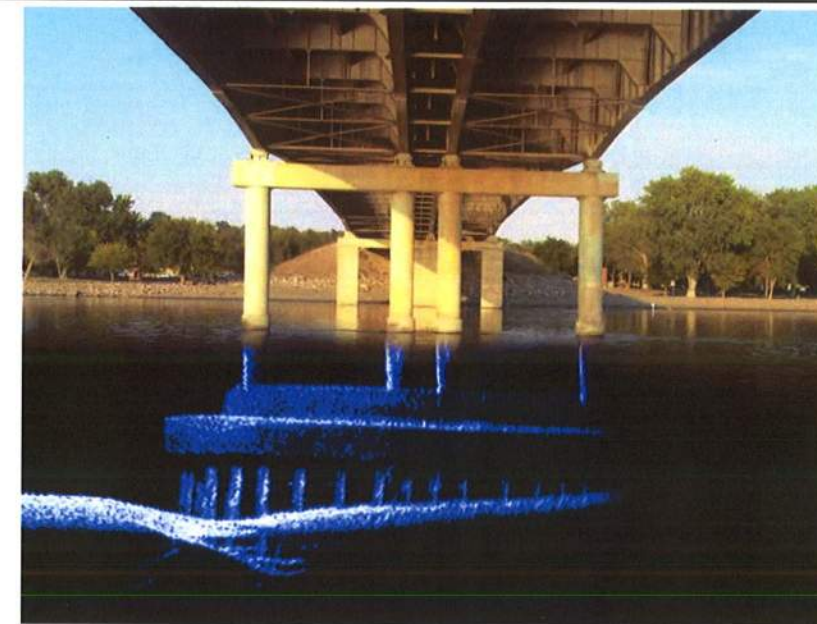
WEST ELEVATION
PIER 9



PLAN
PIER 9

NOTES:

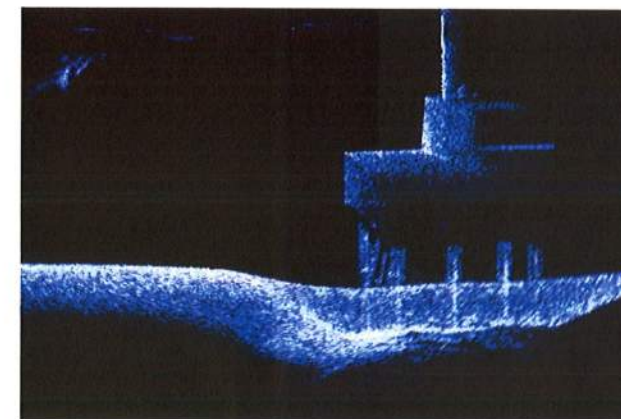
- ① PIER FOOTING IS UNDERMINED THE ENTIRE CIRCUMFERENCE, UP TO 10' HIGH AT UPSTREAM NOSE (NORTH) TO A MINIMUM OF 3' HIGH AT THE DOWNSTREAM NOSE (SOUTH). ALL PILES ARE EXPOSED. STEEL H-PILES ARE IN GOOD CONDITION.



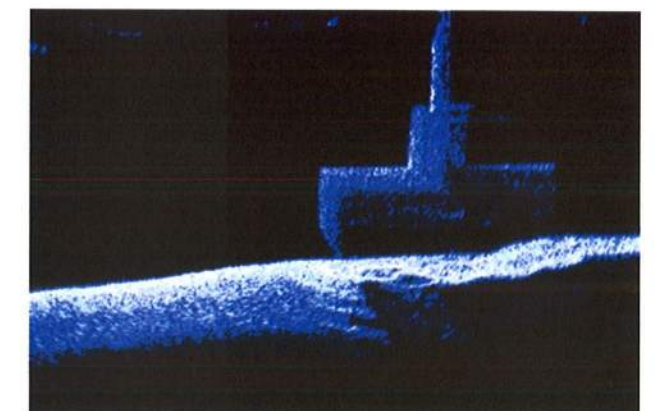
WEST ELEVATION ACOUSTIC IMAGE



EAST ELEVATION ACOUSTIC IMAGE



UPSTREAM NOSE

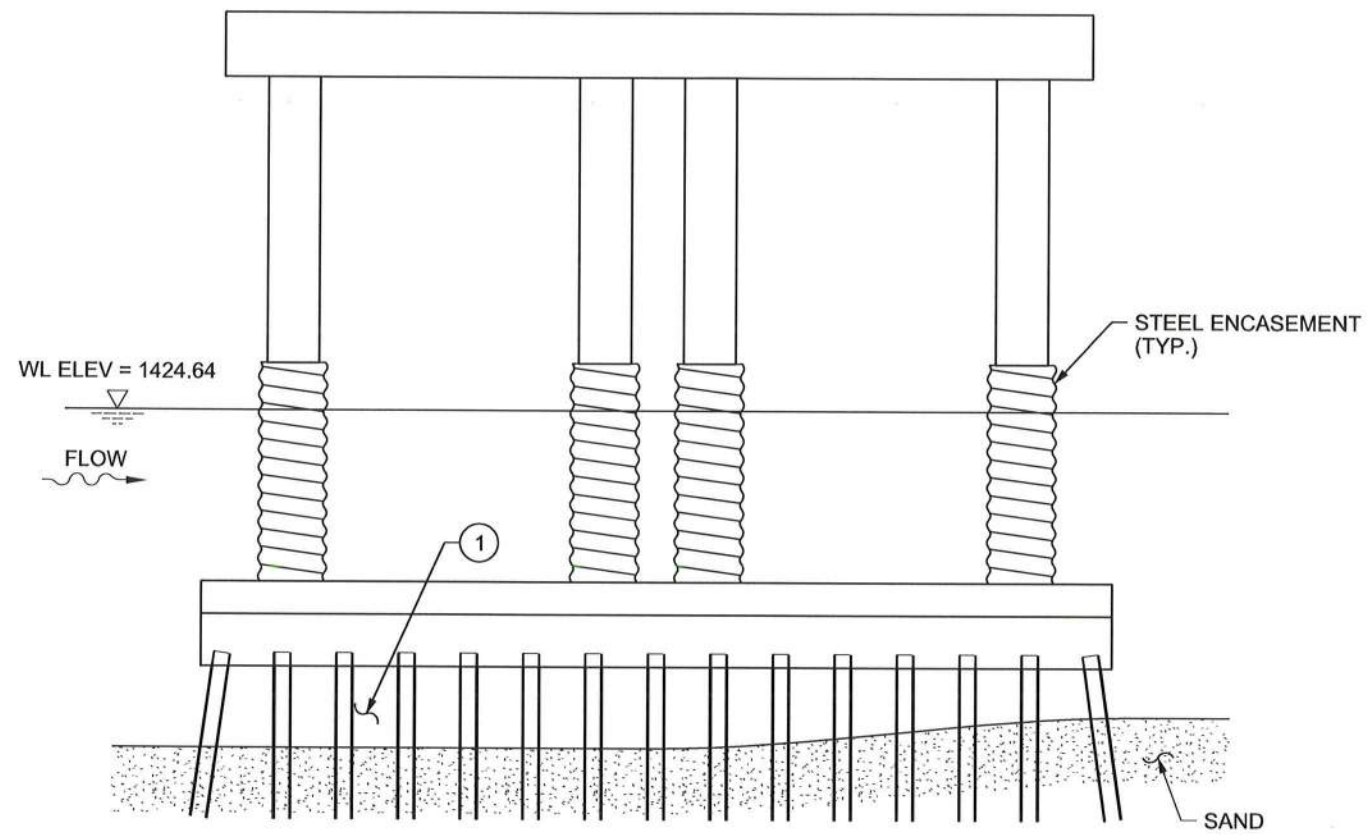


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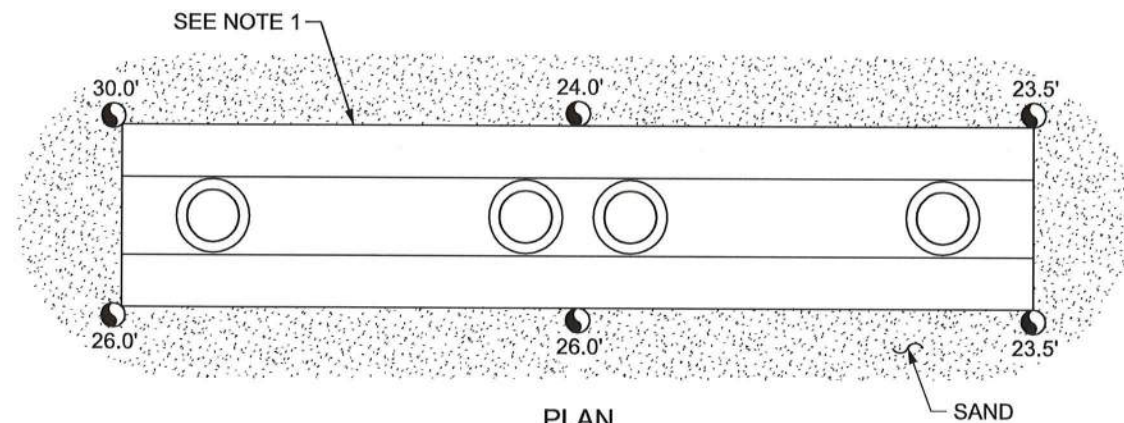
LEGEND:

- 21.5' DENOTES WATER DEPTH

GRAPHIC SCALE MEASURED IN FEET 1" = 15'	DATE SEP, 2012	 2121 Old Hickory Tree Road St. Cloud, Florida 34772 PH.: 407.957.1680 FAX: 407.957.8744 INFRASTRUCTURE ENGINEERS, INC.	US 14/83 OVER THE MISSOURI RIVER BRIDGE NO. 33-100-118	
	PIER 9		PAGE A-12	



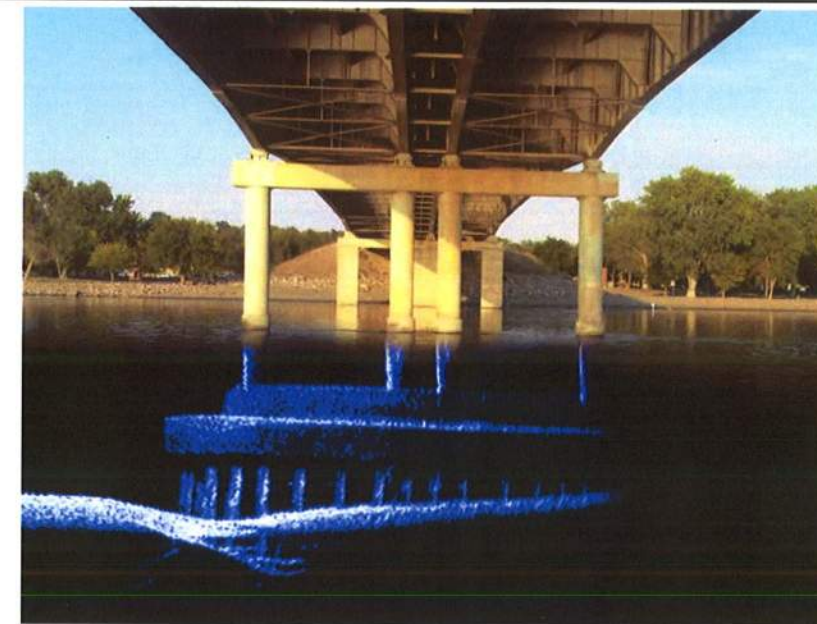
WEST ELEVATION
PIER 9



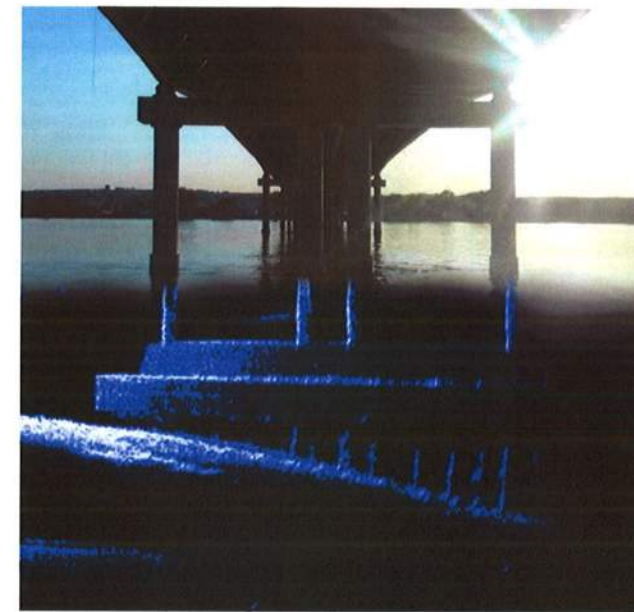
PLAN
PIER 9

NOTES:

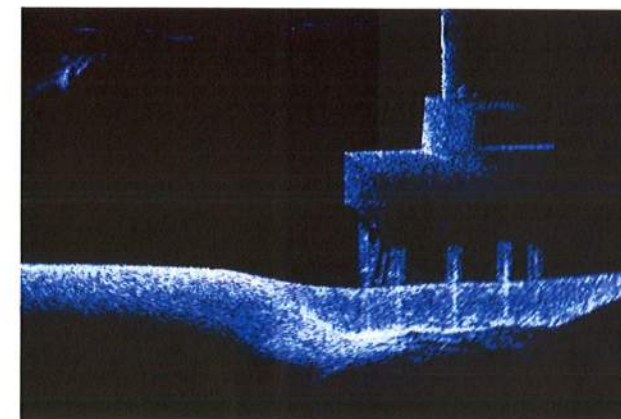
- ① PIER FOOTING IS UNDERMINED THE ENTIRE CIRCUMFERENCE, UP TO 10' HIGH AT UPSTREAM NOSE (NORTH) TO A MINIMUM OF 3' HIGH AT THE DOWNSTREAM NOSE (SOUTH). ALL PILES ARE EXPOSED. STEEL H-PILES ARE IN GOOD CONDITION.



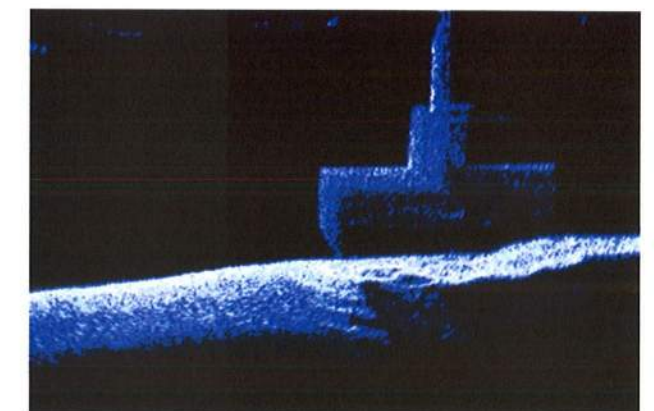
WEST ELEVATION ACOUSTIC IMAGE



EAST ELEVATION ACOUSTIC IMAGE



UPSTREAM NOSE

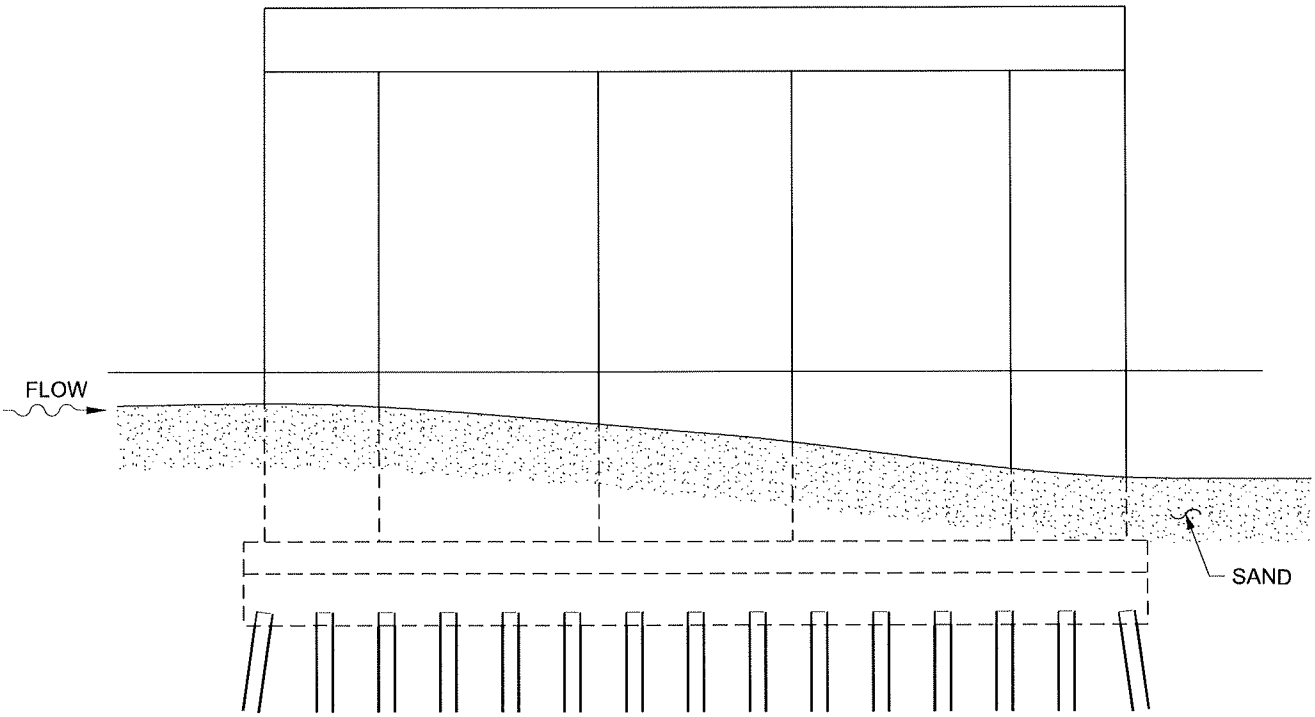


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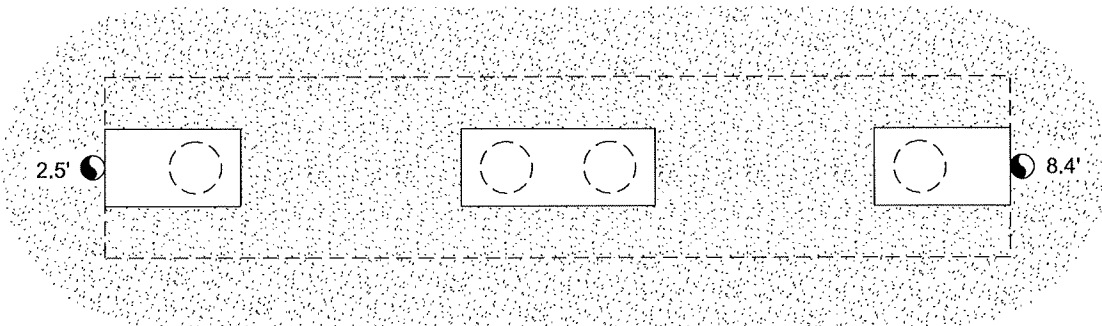
LEGEND:

- 21.5' DENOTES WATER DEPTH

GRAPHIC SCALE MEASURED IN FEET 1" = 15'	DATE SEP, 2012	2121 Old Hickory Tree Road St. Cloud, Florida 34772 PH.: 407.957.1680 FAX: 407.957.8744 INFRASTRUCTURE ENGINEERS, INC.	US 14/83 OVER THE MISSOURI RIVER BRIDGE NO. 33-100-118	PAGE A-12
	PIER 9		Appendix H - Page H25	



**WEST ELEVATION
PIER 10**

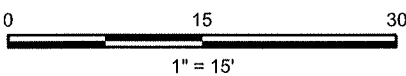


**PLAN
PIER 10**

LEGEND:

● 21.5' DENOTES WATER DEPTH

GRAPHIC SCALE MEASURED IN FEET



DATE

SEP, 2012



2121 Old Hickory Tree Road
St. Cloud, Florida 34772
PH: 407.957.1660
FAX: 407.957.8744

INFRASTRUCTURE
ENGINEERS, INC.

US 14/83 OVER THE MISSOURI RIVER
BRIDGE NO. 33-100-118

PIER 10

PAGE
A-13

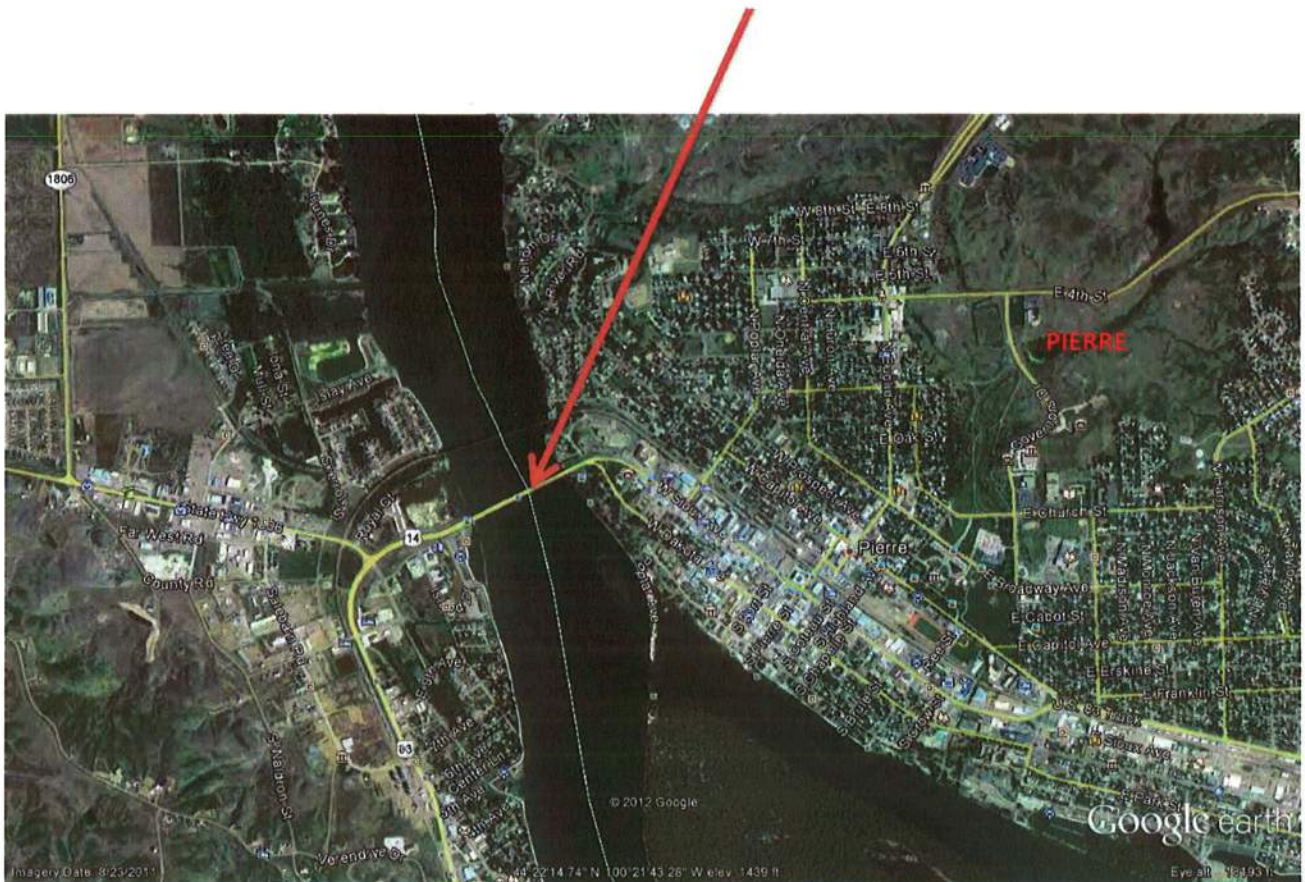
PONTIS Bridge Ratings

ELEMENT NO.	ELEMENT DESCRIPTION	ENV. STATE	UNIT	TOTAL QUANTITY	QUANTITY IN CONDITION STATE				
					1	2	3	4	5
205	Reinforced Concrete Column	2	EA	36	32	4			
220	Reinforced Concrete Submerged Pile Cap/Footing	2	EA	8	8				
225	Steel Submerged Pile	2	EA	Unknown	ALL				
Smart Flags									
361	Scour Smart Flag	2	EA	1		1			

NOTE: We require individual plans for each pier to develop the PONTIS quantity for the exposed steel H-piles.

LOCATION MAP

Bridge 33-100-118



APPENDIX I

Design Criteria



REVISIONS:

Project: SDDOT - US14/US83/SD34 Missouri River Bridge Replacement Study

Document: APPENDIX H – Design Specifications

Revision	Date of Issue	Description
D0	October 24, 2013	Draft Issue – For Client and FHWA Comment
D1	August 08, 2014	Reissue – For Client and FHWA Comment

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APPENDIX H: DESIGN SPECIFICATIONS

H.1 INTRODUCTION

This appendix contains the bridge design specifications and criteria used for the preliminary engineering and development of the preferred bridge concept(s) for the replacement of the US14/US83/SD34 Missouri River Bridge Replacement Study, as determined through the activities of the US14/US83/SD34 Missouri River Bridge Replacement Study and the accompanying Environmental Assessment (EA)

All information contained herein shall be considered preliminary, as its use is to allow for: 1) confirmation of the structural feasibility of the preferred type(s); and 2) preparation of preliminary cost estimates. All design elements will need to be reevaluated and further refined during the project's subsequent design phases after the study has concluded.

H.2 DESIGN OVERVIEW

H.2.1 Design Documents

The following documents and references were used in the development of these design specifications and in evaluating the US14/US83/SD34 Missouri River Bridge replacement concepts.

- 2012 AASHTO LRFD Bridge Design Specifications, Sixth Edition
- 2010 AASHTO Highway Capacity Manual
- AASHTO Highway Safety Manual
- 2013 SDDOT Structures Construction Manual
- 2012 SDDOT Average Unit Bid Prices
- 2012 SDDOT Annual S.D. Construction Cost Index (CCI)
- 2004 SDDOT Standard Specifications for Roads & Bridges, with Updates
- SDDOT Road Design Manual
- SDDOT Drainage Manual
- SDDOT Water Quality Program Design Manual
- SDDOT Road Design's CADD Procedures Manual
- SDDOT Standard Plates Index
- SDDOT Highway Surveying Manuals

H.2.2 Design Goals and Guidelines

The following project goals were expressed in the project RFP:

- The design life (Durability Criteria) was stated as 100 years for replacement. The deck design goal is also 100 years, however, lesser design service life's will be evaluated. Additionally, periodic maintenance items necessary to achieve a 100-year design life will be identified and included in life cycle analyses.
- Typical cross sections are dictated by traffic volumes and requirements. Span lengths for the river bridge are driven by structure type & height, superstructure depth and economics as well as US Coast Guard (USCG) requirements. Maximum and minimum lengths are not specifically limited.
- River bridge replacement options will not reuse existing foundations. Standard design and construction practices dictate proximity of adjacent new foundations. The channel has not been identified for any substantial realignment.
- Aesthetic considerations will be a result of stakeholder input as evaluated by the SDDOT / URS Team. All aesthetic concepts or proposals shall be provided for SDDOT review/acceptance prior to their publishing or public access.
- Aviation and Railroad restrictions or requirements may be specific to the location and will be the investigative responsibility of the URS Team with assistance from SDDOT as

necessary.

- If two superstructures are implemented for the river bridge, a minimum distance of 8 feet shall be provided between adjacent copings. If a single superstructure is implemented, means of superstructure maintenance and inspection shall be provided and included in feasibility studies.

H.3 DESIGN LOADS, FORCES AND DESIGN EFFECTS

Design loads, forces and design effects will follow AASHTO LRFD unless noted otherwise. Major load effects considered during the conceptual engineering phase are highlighted below and include:

H.3.1 Dead Loads: (See Table H.3.1)

Table H.3.1 - Dead Loads

Material	Density
Reinforced Concrete	150 lb/ft ³
Prestressed Concrete	150 lb/ft ³
Post-Tensioned Concrete	155 lb/ft ³
Structural Steel	490 lb/ft ³
Soil	120 lb/ft ³

H.3.2 Superimposed Dead Loads: (See Table H.3.2)

Table H.3.2 - Superimposed Dead Loads

Superimposed Dead Loads	Weight
Future Wearing Surface	22 lb/ft ²
Sidewalk Wearing Surface	TBD lb/ft ²
Traffic / Pedestrian Barriers:	
Adjacent to Traffic	TBD lb/ft
Adjacent to Pedestrians	TBD lb/ft
Center Median	TBD lb/ft
Total all Barriers and Parapets	TBD lb/ft
Utilities:	5 lb/ft ²

H.3.3 Live Loads:

Traffic:

- TBD = LRFD HL-93 plus dynamic load allowance
- Multiple Presence Factor (m) = 1.0.

Pedestrian:

- 100 lbs/ft² without dynamic load allowance loaded in the worst configuration.
- Pedestrian loads on sidewalks and vehicular loads in traffic lanes shall occur concurrently.

The study of bridge vibration due to dynamic influences of pedestrians and traffic shall be undertaken during final design. The live load deflection due to traffic will be reported for the preliminary designs.

H.3.4 Temperature:

Temperature ranges considered are based upon AASHTO Bridge Design Specifications Section 3.12 – Procedure B as follows:

Uniform Temperature:

Concrete Structure:

Maximum Temperature	= +110° F
Minimum Temperature	= -10° F
Median Temperature	= +70° F
Design Temperature Range	= 130° F

Steel Structure:

Maximum Temperature	= +120° F
Minimum Temperature	= -30° F
Median Temperature	= +70° F
Design Temperature Range	= +150° F

Temperature Gradient:

Solar Radiation Zone = 2

Uniform temperature differential between the stay cables (if used) and the superstructure and towers = ± 15°F for light colored stays.

Uniform temperature differential between the arch rib hangers (if used) and the superstructure and arch rib = ± 15°F for galvanized hangers.

Combine extreme values of uniform temperature and temperature gradient at 50% intensities.

H.3.5 Creep and Shrinkage:

Strains are calculated in accordance with CEB/FIP Model Code for Concrete Structures, 1978.

Relative Humidity = 65%

H.3.6 Wind:

Quasi-static design per Section 3.8 of AASHTO LRFD. The basic wind speeds and corresponding wind pressures shall be adjusted for the height above low ground in accordance with Eq. 3.8.1.1-1.

The basic wind speed is assumed to be 100 mph.

The study of vibration (if cables are used) due to the interaction of wind and rain shall be undertaken during final design.

The geometry proportions (span length, width and depth) of the bridge should not warrant the investigation of dynamic responses such as vortex excitation, galloping, flutter and divergence. Wind tunnel testing will not be undertaken.

H.3.7 Ice Loading:

For the bridge replacement study, the below ice loading criteria for the permanent works were derived from Reference [H-R1]. A lesser value of ice thickness, based on engineering judgment, was assumed for the design of the temporary works. For both permanent and temporary works, the ice loading is considered an Extreme Event limit state as defined by AASHTO.

Design Thickness:

Permanent Works: 225 psi @ 1.5 feet thickness of AASHTO Ice Load = 32 ksf
 Temporary Works: 225 psi @ 1.0 feet thickness of AASHTO Ice Load = 32 ksf

Point of Application:

Temporary and Permanent Works: Max. EL 1434.26 (100-year Flood Elevation)
 Min. EL 1419.26 (Min. Pool Elevation)

Shielding:

Shielding by adjacent foundation elements will be considered; thus, the ice load shall be applied only to each substructure element (in any direction) and not all elements concurrently. For example, if a multi-column/drilled shaft system is intended, the ice loading shall be applied to the outside column/drilled shaft (the upstream nose of the foundation system) and the interior columns shall be designed similarly.

H.3.8 Vessel Collision:

Vessel Collision forces will be neglected due to river navigation restrictions in this area.

H.3.9 Bridge Hydraulics and Scour:

Preliminary hydraulics/scour assumptions and foundation alternatives are discussed briefly in this type study report. A comprehensive final hydraulics report was not included as a part of URS' scope; however, they are anticipated to be a requirement for final design.

H.3.9.1 Bridge Hydraulics: URS reviewed USGS data from the Pierre, SD Missouri River gaging station from 2007 to 2014 [H-R2] to estimate the river hydraulics. Based on this research, the hydraulics data used in the assessment of pier stability and application of ice loads is as follows:

Estimated 100-year Flood Elevation: Gage datum (1414.26 ft.) + 20 ft. = 1434.26 ft.
 Estimated 500-year Flood Elevation: Gage datum (1414.26 ft.) + 25 ft. = 1439.26 ft.
 Minimum Pool Elevation: Gage datum (1414.26 ft.) + 5 ft. = 1419.26 ft.

Stream flow, i.e., the maximum velocity for design will be determined during final design. Debris rafts shall be considered as appropriate.

Elevations for temporary works including cofferdams and shoring towers will be specified during final design for a seasonal operation max water level from the USACE in consultation with SD DOT.

H.3.9.2 Bridge Scour: URS reviewed the existing bridge scour information [H-R3] and rock profiles [H-R4] and developed the following engineering assumptions regarding replacement bridge scour.

H.4.2 Bridge Vertical Geometry

Main Navigational: (TBD)

DM&E Railroad Minimum Clearance Span	= 15.0 feet
Original Bridge Minimum Clearance Span	= 30.0 feet (NW)
Existing Bridge Minimum Opening	= 28.7 feet (1425.8')
US Coast Guard Requirement (Minimum)	= 30.0 ft. (Low Chord EL>=1421.3 ft.)

H.4.3 Demolition Geometry

Pile cutoff elevation = 1403.7 ft.

Demolition may include dropping the structure into the water. USCG requires a 150-foot wide channel to be cleared within 24 hours. Since there is only recreational traffic and no commercial navigation at this location, this criteria is flexible.

H.4.4 Bridge and Road Geometrics

Geometrics for roads and bridges included in this project shall follow the SDDOT Road Design Manual [H-R7] summarized in Table H.4.1.

Table H.4.1 – Road Geometric Criteria

Design Element	Expressway		Crossroads / Collectors
	Main Lines	Ramps	
Design Speed, MPH	40 mph (TBD)	30 mph (TBD)	30 mph Local (TBD)
Horizontal Alignment			
a. Max Curve, Deg	3.5 deg	24.75 deg (loop) 8.25 deg (diamond) 8.25 deg (direct connection)	20 deg
b. Max Superelevation (ft/ft)	0.10	0.10	0.05 Urban 0.10 Rural
c. Lane Drop Tapers	70:1	50:1	
d. Transitions	Use Spirals for curves > 1.5 deg.	Use Spirals for curves > 1.5 deg.	Use Spirals for curves > 1.5 deg.
Vertical Alignment			
a. Max Grade	5%	5% (30 mph) 7% (35 mph)	5% (30 mph) 7% (35 mph)
b. Vertical Curvature (K) (K=Length/%grade change)			
Crest	506 290 to 540 AASHTO	31 (30 mph) 136 (50 mph) 110 to 160 Other (AASHTO)	31 to 136
Sag	206 150 to 200 AASHTO	31 (30 mph) 136 (50 mph) 90 to 110 Other (AASHTO)	37 to 96
c. Decision Sight Dist. (ft)	Refer to AASHTO	N/A	N/A

Design Element	Expressway		Crossroads / Collectors
	Main Lines	Ramps	
Cross Sections			
a. Lane widths (ft)	12	12 dual lanes 15 min. single lane	12 inner lanes 12-16 outer-lanes
b. Shoulder width (ft)	4-Lane	Single Lane	8 (4* paved)
Right	12 (10 paved)	6 (4 paved)	8 (2 paved)
Left	8 (4 paved)	6 (2 paved)	*Min. 5' paved
Right	6-Lane	Dual lanes	12 inner lanes
Left	12 (10 paved)	10 (8 paved)	12-16 outer-lanes
	12 (10 paved)	8 (4 paved)	8 (4* paved)
			8 (2 paved)
			*Min. 5' paved
1. Bridge(s) (ft)	4-Lane	Single Lane	
Right	5	6	
Left	2	6	
c. Cross Slopes			
1. Traffic Lanes	2% (4-lane) 3% or TBD (6-lane)	2% 5%	2%
2. Left Shoulder	5%	6%	5%
3. Right Shoulder	6%		6%
d. Median Width, ft (4-lane) (EOP/EOP)	64 (typical) 26 w/ concrete barrier (min.)	N/A	22,40
Horizontal Clearance	TBD	TBD	TBD
Vertical Clearance, ft.			
a. Over Roadway	16.5	16.5	16.5
b. Overhead Signs	17.5	17.5	17.5
c. Over Trails	10.0	10.0	10.0

H.4.5 Traffic Lane Geometry (Summarized from Table H.4.1 above)

Traffic Widths:

- Traffic Lane Minimum = 11 feet (12 feet Pending)
- Traffic Shoulder Maximum = 14 feet
- Traffic Shoulder Minimum (Inside) = 2 feet (SD DOT Preferred)
- Traffic Shoulder Minimum (Outside) = 5 feet (SD DOT Preferred)

H.4.6 Trail/Sidewalk Geometry

On-Bridge Trail/Sidewalk Width:

- Trail(s) Width = 12 feet
- Maintenance Vehicle Minimum = 12 feet
- Maintenance Vehicle Max from Shoulder = 8 feet

Under-Bridge Trail Width:

= TBD

H.4.7 Center Median Geometry

Minimum length of median access control beyond the structure = TBD

H.5 ANALYSIS AND DESIGN DETAILS

The structural analyses and trial designs performed for US14/US83/SD34 Missouri River Bridge Replacement Study will be developed to a level that allows: 1) confirmation of the structural feasibility of the preferred type; and 2) preparation of preliminary cost estimates.

The preliminary structural arrangements will employ some optimization, and will be further refined during the final design phase.

H.5.1 Reinforcing Cover Requirements

Superstructure:

100-year Deck Design Option:

Top Cover	= 2.0 inches
Bottom Cover	= 1.0 inches
Additional cover may be used to accommodate 100 year service life	

*The top of the deck slab shall be designed with ½ inch sacrificial thickness.

Substructure:

Abutments and Columns	= 2.5 inches
Footings	= 3.0 inches

Additional cover may be used to accommodate 100 year service life

Drilled Shafts:

Casing	= 6 inches
Rock Socket	= 3 inches

H.5.2 Distribution of Reinforcing

Use Class 2 exposure conditions for crack control per AASHTO Article 5.7.3.4.

H.5.3 Stay-In-Place Forms

Stay-in-place forms and associated weight will not be considered for the construction of deck slabs. The deck slabs shall be assumed to be cast-in-place with conventional formwork that is removed after the concrete gains sufficient strength.

H.6 MATERIALS

The materials selected for the US14/US83/SD34 Missouri River Bridge Replacement will be selected to be durable and consistent with providing a design that meets a 100-year overall design life for the bridge concepts. As material technology evolves, these materials will need to be reevaluated during the subsequent design phases after the study has concluded.

H.6.1 Concrete:

Concrete mixes and strengths typically utilized by SDDOT, and shown in Table H.6.1, are valid for the project; however, proposed revisions for the sake of increased durability or corrosion protection will be considered. Recommendations for concrete will be refined as the study

progresses and will be discussed in the final report.

The Type II cement and Class F fly ash required for all concrete.

Table H.6.1 – Concrete Classes (Review Concrete Classes)

Location	Class	f'ci (psi)	f'c (psi) 28 Days
Drilled Shafts	A45	-	4,500
Traffic Rails	A45	-	4,500
Seal Concrete	TBD	-	3,000
Foundation Caps	A45	-	4,500
Substructure Concrete	A45	-	4,500
Reinforced Concrete Slab	A45	-	4,500
Center Median (TBD)	A45	-	4,500
Prestressed Concrete (TBD)	TBD	5,500	8,000

A life cycle study shall investigate the use of life prolonging admixtures to promote shrinkage reduction, corrosion mitigation, and permeability reduction.

H.6.2 Reinforcing Steel:

- Black, Epoxy or Galvanized - ASTM A615 Grade 60 ($F_y = 60$ ksi); or,
- Stainless - ASTM 955A Grade 75 ($F_y = 75$ ksi); or,
- Zinc and Epoxy Dual Coated - ASTM A 1055 ($F_y = 60$ ksi).
- Superstructure – TBD as part of the replacement type study. A life cycle study shall investigate the use of life prolonging reinforcing steels for the superstructure including epoxy coated, stainless, galvanized, and dual coated.
- Substructure and Foundations: Black

H.6.2 Prestressing Steel:

- ASTM A416 Grade 270 ($F_{pu} = 270$ ksi) Low Relaxation
- 0.60 in. dia. – Area = 0.217 in.²
- Effective prestress or post-tensioning will be estimated to be 0.6 F_{pu} after all losses.

SD DOT has communicated that there are currently no post-tensioned bridges in the SD DOT bridge inventory.

H.6.3 Structural Steel:

- No specific restrictions have been identified with HPS Grades 50 or 70.
- ASTM A709 Grade 50 Painted; or,
- ASTM A709W Grade HPS 50W Weathering (Unpainted); or,
- ASTM A709W Grade HPS 70W Weathering (Unpainted).
- Field connections shall be bolted using 7/8 in. dia. ASTM A325 bolts.
- All materials of domestic manufacture.

HPS Grade 100 may be restricted to bolted connections only. Under-matched welds to lower grade HPS components will be considered where appropriate. (No design proposal will be restricted to the mandatory use of HPS Grade 100).

A life cycle study will investigate the use of painted versus weathering steel.

H.6.4 Bearings and Expansion Joints:

- The following expansion joints will be investigated and will be kept to a minimum:
 - Finger joint (preferred);
 - Silicone (where viable); and,
 - Strip seal
- Steel reinforced neoprene bearings are anticipated; however, loads may require the use pot or disk bearings.
- Concrete surfaces adjacent to bearings shall be sloped to permit free drainage and to prevent debris build-up.
- Bearings shall be designed to be removed and replaced.

H.6.5 Arch Hangers:

- Galvanized, braided wire.
- ASTM A586 - Class A 245 Ton Maximum Breaking Strength
- 4 to 1 Minimum Factor of Safety

H.6.6 Stay Cables:

- ASTM A416 Grade 270 ($F_{pu} = 270$ ksi) Low Relaxation
- 0.60 in. dia. – Area = 0.217 in.²
- Designed in Conformance with PTI Spec – “*Recommendations for Stay Cable Design, Testing and Installation*” (PTI DC45.1-12).

H.6.7 Lighting and Power:

- Roadway lighting – TBD
- Aesthetic lighting – TBD
- Power and outlets for inspection – TBD
- Future ducts – TBD

H.6.8 Finishes and Coatings:

- All colors and architectural finishes to be determined.
- Concrete Abutments
 - Wrap around walls integrated with the structural form and cladding TBD.
- Structural Steel
 - Painted to SDDOT standard
- Traffic and Pedestrian Rails
 - Galvanized with stainless steel anchor bolts.
- Concrete Decks, Rails, and Medians
 - Concrete Surface Treatment – TBD

These and other materials used will be consistent with industry and SDDOT practices.

H.6.9 Bridge Railings, Parapets and Bridge Amenities:

- TBD – Various types of parapets, railings, and other bridge amenities will be presented for stakeholder and design team input. The preferred type(s) will be finalized as part of the type study process.
- Crash Test Criteria = TBD (TL-4, or TL-5)
- Vehicle Barrier Minimum Heights:
 - 32” for TL-4
 - 42” for TL-5
- Pedestrian Railing Minimum Heights:
 - 54” for pedestrian/bicycle w/ 6” diameter max opening (8” diameter above 27”)

H7. References

- H-R1 Minnesota Department of Transportation – LRFD Bridge Design Manual (<http://www.dot.state.mn.us/bridge/lrfd.html>) accessed Jul., 2014.
- H-R2 USGS 0644000 Missouri River at Pierre, SD - Gage Height Data (http://waterdata.usgs.gov/sd/nwis/uv?site_no=06440000) accessed Jul., 2014.
- H-R3 South Dakota Department of Transportation “Underwater Bridge Inspection Report for U.S. 14/83 Over the Missouri River”, Sep., 2012.
- H-R4 South Dakota Department of Transportation – Bridge Plans “U.S. Trunk Highway No. 14 & 83 Hughes County”, Nov. 05, 2013.
- H-R5 E-Mail Correspondence – Vern Bump (American Engineering Testing) to Carl Osberg, “Geotech recommendations for HP14x73 piles and Drilled Shafts in LRFD”, Nov. 05, 2013.
- H-R6 Correspondence 16591.1/1066.4 MOR??? – Rob McCaskey (U.S Dept of Homeland Security / United States Coast Guard) to Dan Strand (SD DOT), “South Dakota Highway Bridge, Mile 1066.4, MOR”, Mar. 13, 2014.
- H-R7 South Dakota Department of Transportation – Road Design Manual (<http://www.sddot.com/business/design/forms/roaddesign>) accessed Jul., 2014.

APPENDIX J

Pertinent Correspondence

This appendix is a partial collection of correspondence gathered for this project. It does not represent a complete compilation of all correspondence.

US14/US83/SD 34 Missouri River Bridge Replacement Study CAC Workshop/Meeting

Record of Meeting

Monday, March 3, 2014 2:00-3:30PM

SDDOT Pierre Central Office (Becker Hansen)

ATTENDEES:

Steve Gramm, SDDOT
Tom Lehmkuhl, SDDOT
Tom Gilsrud, SDDOT
Mark Leiferman, SDDOT
Sonia Downs, SDDOT
Dean VanDeWiele, SDDOT
Steve Johnson, SDDOT
Mark Hoines, FHWA

Laurie Gill, Pierre Mayor
Gloria Hanson, City of Fort Pierre
Tom Lee, Bicycle Club
Anne Lewis, Peds & Discovery Center
Laura Schoen Carbonneau, Chamber
Paul Lepisto, Izaak Walton & SDWU
Greg Brown, URS
Carl Osberg, URS

- A. Introductions were given. Community Advisory Committee members Dave Bonde, Karen Kern, Rick Murray, Cptn Dave Panzer, Scott Rounds, and the Waldron Family were not present.
- B. Attendees were given short summaries on the EA document progress and results.

1) Traffic Report

- a. Summary of report indicates that current approach roadways will reach a congested state (LOS D) somewhere between 2028 and 2060. This may require some changes to approach roadways (Sioux Ave in particular).
 - i. Future options range from:
 - 1. A new bridge may be needed elsewhere to reroute traffic (especially truck traffic) off Sioux Ave from Harrison Ave to the east,
 - 2. A system of one way pairs may be used for Sioux Ave (and possible Dakota Ave),
 - 3. Sioux Ave will need to be widened to accommodate 6 lanes, or
 - 4. Divided roadway with access management may be required,

2) Safety Report

- a. Summary of report indicates that:
 - i. Poplar Ave to Bridge is worst segment, primarily due to driveway access points and geometry (site lines).
 - ii. Some crashes are occurring on the bridge against the median or barriers.

iii. Access management may be an issue in the future

3) HazMat Report

- a. Summary of report indicates that:
 - i. There don't appear to be any large issues with the study area in terms of hazardous materials of underground tanks.

4) Wetlands Report

- a. Summary of report indicates that:
 - i. There don't appear to be any large issues with the wetlands in the study area.

5) Historical Report

- a. Summary of report indicates that:
 - i. There don't appear to be any historically eligible structures in the study area – except the now added RR Bridge.

6) Public Meeting #1 Comments

- a. Summary of report indicates that:
 - i. Public sentiment matches the SAT and CAC. Most people want a bridge close to the existing location, with a larger trail and of a modest bridge type.

C. Attendees went through the summary of the Bridge Matrices and Analysis. The purpose of this discussion was to get feedback on the promoted alternatives and input on desired features.

1) Bridge Types:

- a. The team reviewed the universe of bridge types. The alternatives ranged from girder type bridges to cable-stayed types.
- b. After reviewing the alternatives, the consensus was that the best bridge type for this location and span length should be a girder type with flexibility to expand in the future. Keeping both steel and concrete alternatives are desirable from an industry and bidability viewpoint.
- c. Types to be considered for Phase 2 Refinement:
 - i. Alternative 1 – No-build
 - ii. Alternative 2 – Steel Girder (parallel flange)
 - iii. Alternative 2A - Steel Girder (haunched)
 - iv. Alternative 3 – Spliced Prestressed Concrete Girder (haunched)
- d. CAC agreed that bridge types were okay

2) Bridge/Approach Cross-Sections::

- a. The team reviewed the universe of bridge cross-sections. The alternatives ranged from very narrow 2-lane options to large 6 lane options.
- b. After reviewing the alternatives, the consensus was that the best cross-section should have 4-lanes and a large trail.
- c. Sections to be considered for Phase 2 Refinement:
 - i. Alternative 1 – No-build
 - ii. Alternative 4A – 4 Lanes, 1 large trail, min shoulders (no median)
 - iii. Alternative 4B - 4 Lanes, 1 large trail, max shoulders (no median)

- iv. Alternative 5A – 4 Lanes, 2 small trails, max shoulders (no median)
- v. Alternative 5B – 4 Lanes, 1 large trail, 1 small trail, medium shoulders (no median)
- vi. CAC discussions altered these SAT alternatives as follows:
 - 1. A single large trail (12' wide min) on the south side of the bridge was most desirable – reasoning being that people like to be together rather than be all alone on a small sidewalk on the north side of the bridge. The southern side is preferred due to wind effects, warmth and views.
 - 2. Shoulders with curb/gutter could be 5' min
 - 3. Median and median curb should be in some options (it is preferable to prevent head on collisions)– using 2' min shy distance
 - 4. 11' min lanes can be used

3) Bridge/Approach Locations/Alignments:

- a. The team reviewed the universe of bridge locations. The alternatives ranged from reasonable and expected to more wild attempts to examine all the possibilities in the study area.
- b. After reviewing the alternatives, the consensus was that the least impactful location of the new bridge would be near the existing location or just to the north.
 - i. The aquatic center in Pierre has been put on hold, so planning around this is likely not going to be a high priority.
- c. Locations/alignments to be considered for Phase 2 Refinement:
 - i. Alternative 1 – No-build
 - ii. Alternative N1 – Adjacent and just north of the existing bridge
 - Alternative N1 west end will be rotated closer to the existing bridge.
 - iii. Alternative N2 – 100 feet north of existing bridge
 - iv. Alternative N4 – Adjacent and overlapping existing bridge to the north
 - v. Alternative N7 – Overlapping half the existing bridge and to the north (bypassing the gas line)
 - Alternative N7 will be greatly modified to correct western alignment and show one superstructure
- d. CAC discussions led to bridge locations preferences that:
 - i. Do not use a south alignment
 - ii. Place the new bridge north of the existing, but not too far north
 - iii. Rotate new bridge so closer to parallel with existing

4) Bridge Amenities:

- a. Canoe Launch of west side
- b. Fishing pier on east side – especially if bridge pier lands on shoreline
- c. Park areas under bridge
- d. Cantilevered walkways

D. Next Steps:

- 1) Future work includes refinement of the alternatives with high resolution graphics.
- 2) A follow-up CAC will be held in May or June to discuss the draft form of the promoted alternatives.
- 3) Public Meeting #2 Meeting will occur in June. It is envisioned the presentation at the PIM will include:
 - a. 3 bridge type alternatives
 - b. 2 or more cross-sections (perhaps one with a median and one without)
 - c. Multiple bridge location/alignments
 - d. Universe of Pier and Abutment Types
 - e. Architectural features in more detail

The meeting adjourned.

If there are additions or corrections to these minutes, please contact Carl Osberg of URS at 612-373-6394 or carl.osberg@urs.com.

cbo/

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U.S. Department of
Homeland Security

United States
Coast Guard



Commander
Eighth Coast Guard District

1222 Spruce Street
St. Louis, MO 63103-2832
Staff Symbol: dwb
Phone: (314)269-2381
Fax: (314)269-2737
Email: rob.e.mccaskey@uscg.mil
www.uscg.mil/d8/westerriversbridges

16591.1/1066.4 MOR
March 13, 2014

Mr. Dan Strand
South Dakota Department of Transportation
104 South Garfield
Pierre, South Dakota 57501

Subj: PIERRE, SOUTH DAKOTA HIGHWAY BRIDGE, MILE 1066.4, MISSOURI RIVER

Dear Mr. Strand:

We have completed our navigation channel placement review and clearance requirements for the subject bridge project. After careful consideration we have determined it to be acceptable for the replacement bridge to meet or exceed the vertical clearance of 30 feet above the bridge reference plane of 1425.7 feet, m.s.l. (1929 datum), which is the established minimum clearance on the Missouri River above Gavin's Point.

This office is aware that the current bridge does not meet this standard nor does the railroad bridge immediately upstream, as it is no longer required to open for vessel traffic. However, if future events would dictate, the railroad bridge would be required to function as a drawbridge again. Therefore, due to current waterway use, the minimum vertical clearance for a proposed bridge will be 30 feet above normal pool elevation of 1421.3 feet, m.s.l. (1929 Datum). Additionally, a minimum horizontal clearance of 210 feet would meet the needs of navigation.

We have determined it to be acceptable for the channel to be shifted more to the center of the river. However, while this office has no objection to such a move, primary jurisdiction for matters of that kind lies with the Army Corps of Engineers and any final approval of such a move would require their review and approval.

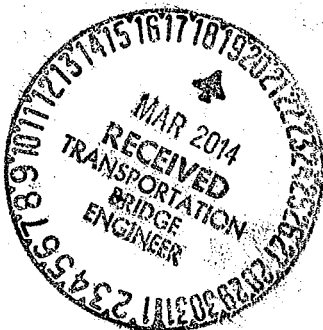
Finally, be aware that this is a preliminary finding and it may be subject to adjustment, pending public notification and comment in the future.

We appreciate the opportunity to comment on this project at this early stage. You may contact Mr. Rob McCaskey at the above number of you have any questions.

Sincerely,

A handwritten signature in black ink, appearing to read "Eric A. Washburn".

ERIC A. WASHBURN
Bridge Administrator, Western Rivers
By direction of the District Commander





MEMORANDUM

Fifth Street Towers
Suite 1500
100 South Fifth Street
Minneapolis, MN 55402
Phone: (612) 370-0700
Fax: (612) 370-1378

To: Steve Gramm, SDDOT

From: Carl Osberg, URS

Date: August 8, 2014

Subject: Pierre/Fort Pierre US 14 Bridge Replacement Study: Boat, Bicycle, and Pedestrian Analysis

Introduction

This memorandum is in response to a pedestrian, bicycle, and boat usage analysis requested for the US 14 Missouri River Bridge Replacement Study. The purpose of this analysis is to observe and document pedestrian, bicycle and boat traffic under and around the Missouri River Bridge crossing. Counts for Boats, Pedestrians and Bicycles were conducted between July 26th and July 27th, 2014, which encompasses an in-season weekend.

Data Collection

Data collection for this study was done primarily at the southeastern end of the US 14 Missouri River Bridge overlooking Steamboat Park. The majority of the data was collected in the evening and morning hours, with some midday and late night observation as well.

For the boat counts, a single observation (count) consisted of a craft passing completely under the bridge between two piers. There was not a limit to the number of observations (counts) per craft; this was important since boat use on the Missouri River is a popular recreational activity. Recreational traffic is circuitous in nature, and this was particularly true for the observed boat traffic.

For the bicycle and pedestrian counts, a single observation (count) consisted of a cyclist or pedestrian travelling along the path under the western Fort Pierre abutment, over the bridge, or on the path under the eastern Pierre abutment. A single rider or walker could be counted multiple times if they passed under/along the bridge at each location.

A typical traffic study contains a minimum of one hour during each peak period (weekday AM, Midday, and PM) for this type of study. However, pedestrian, bicycle and boat traffic use

slightly different timeframes and are more recreational in usage than standard roadway vehicles. For instance the peak recreational traffic occurs on the weekend and is more dependent on weather. For pedestrian and bike traffic along the US 14 corridor during the weekday peaks hours, refer to the separate Traffic Study Report.

Table 1 provides the summary results; see the attached study forms for a complete review of each observational period.

Table 1: Summary Observations

Date	Start Time	End Time	Boat Count	Bicycle Count	Pedestrian Count	Weather
7/26/2014	8:00 AM	9:00 AM	5	2	3	Rain
7/26/2014	5:45 PM	6:45 PM	75	10	13	Fair
7/26/2014	6:45 PM*	7:15 PM*	23	5	34	Fair
7/26/2014	11:00 PM	12:00 AM	20	0	4	Fair
7/27/2014	8:00 AM	9:00 AM	26	11	32	Fair

* Note ½ Hour Count

Except for the morning of Saturday, July 26th, the weather was warm with varying humidity and did not appear to affect the traffic counts, although it is reasonable to assume that summer is the peak recreational season for the Missouri River Bridge and surrounding area.

Data Validation

The number of boats counted over the observational periods makes sense given the high percentage of boat ownership in the greater Pierre/Fort Pierre area. According to the South Dakota Department of Motor Vehicles, there are 4,445 boats registered in Hughes County. As of 2012, the county population was 17,450, putting boat ownership at 25.5%. Similarly, there are 477 boats registered in Stanley County, with a population of 2,699. Thus, 17.7% of these residents are boat owners. While there is not hard data available regarding park use, the Pierre Parks director, Tom Farnsworth, estimates that Steamboat Park sees 250 visitors a day in season. The observed number of pedestrians and bicycles in the area is an accurate reflection of this statistic. It shall also be noted that, a large percentage of out of town visitors also use the river and adjacent parks.

Bridge Area Use Observations

Data from the five observational periods showed that the local area surrounding the Missouri River Bridge is a popular recreational spot. Boat traffic on the river consisted of a variety of crafts including fishing boats, ski boats, kayaks, jet-skis, pontoon boat and a raft. Figure 1 shows the span layout of the bridge; the western-central spans (W3, C1) and eastern-central span (C4, E1) saw the greatest traffic.

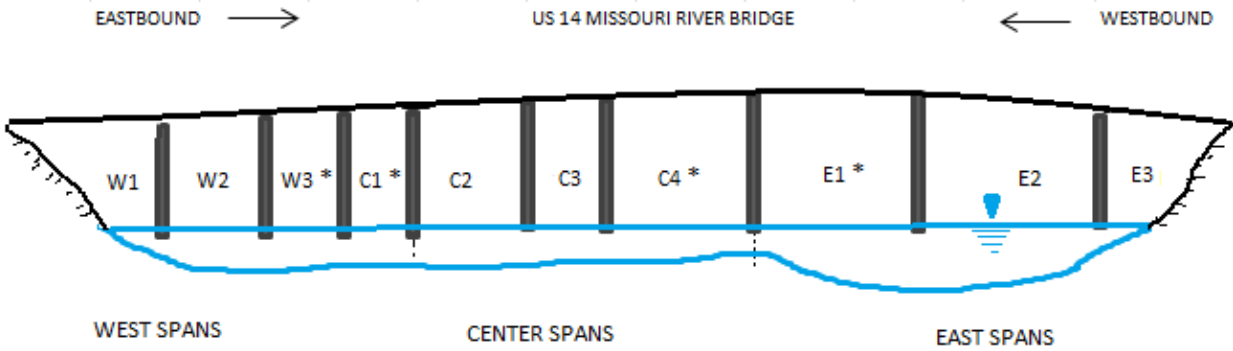


Figure 1: Missouri River Bridge Span Layout (* Spans accommodated the greatest amount of boat traffic)

Presently, the proposed span arrangements for a new bridge feature fewer spans with increased span lengths which will help the popular boating lanes to safely accommodate more traffic and reduce the risk of accidental collision with a pier.

For the early evening count on 7/26/2014, twelve boats were observed on the adjacent Discovery Island. The number of boat on this island can approach 100+ during the 4th of July holiday. It could be expected that the boat counts of a 4th of July weekend approach 250 boats per hour under the bridge during the late afternoon hour.

Figure 2 and Figure 3 show some of the typical recreational boat use surrounding the Missouri River Bridge.

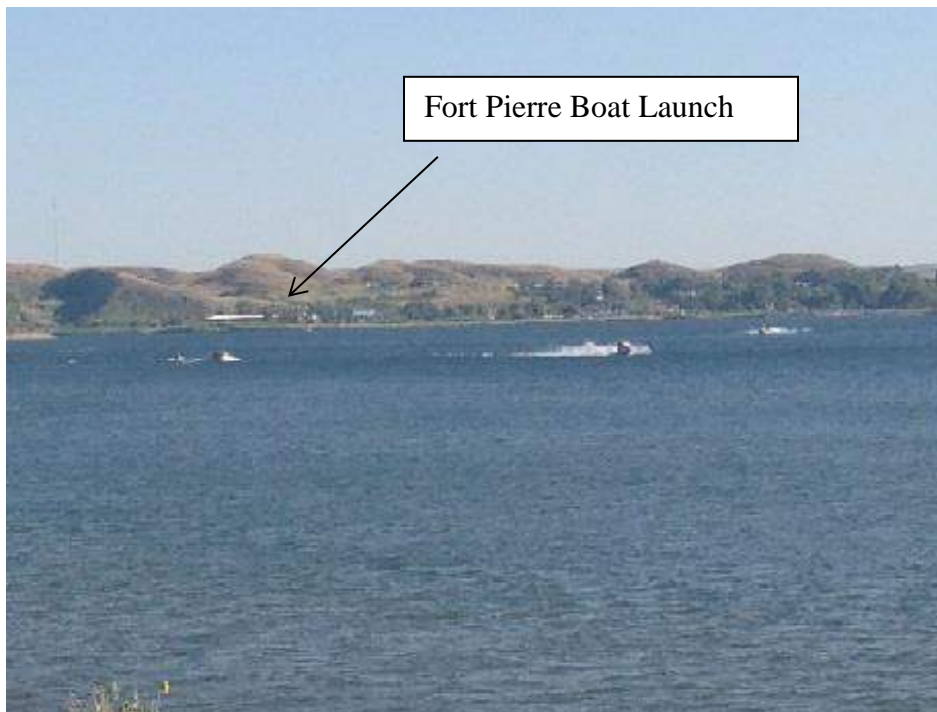


Figure 2: Photograph of Typical Boat Usage (Looking South of Bridge)



Figure 3: Photograph of Boat Usage and Discovery Island (Looking South of the Bridge)

Although pedestrian and bicycle presence on the bridge was low, the surrounding area is quite popular. Steamboat Park usage was high during the observational periods – including walking, running, biking, picnicking, and Frisbee Golf. Walkers and bikers were observed on both paths near the eastern and western abutments of the bridge as well as on the trail leading to La Framboise Island.

At times Steamboat Park accommodates fairs and the nearby Ramkota Convention Center hosts functions that can supply the Riverfront with multitudes of pedestrians. Likewise, during the 4th of July the area sees a spike in pedestrian and bicycle traffic due to the parade, rodeo and firework displays.

A majority of the pedestrian and bicycle traffic on the bridge for the morning of Sunday 7/27/2014 was observed crossing the bridge from Pierre to eat breakfast at Perkins in Fort Pierre. During other parts of the day, the pedestrian and bike traffic appeared to be geared more towards exercise and without a defined destination.



Figure 4: Panoramic Photograph of trails surrounding Missouri River Bridge (From East Bank)

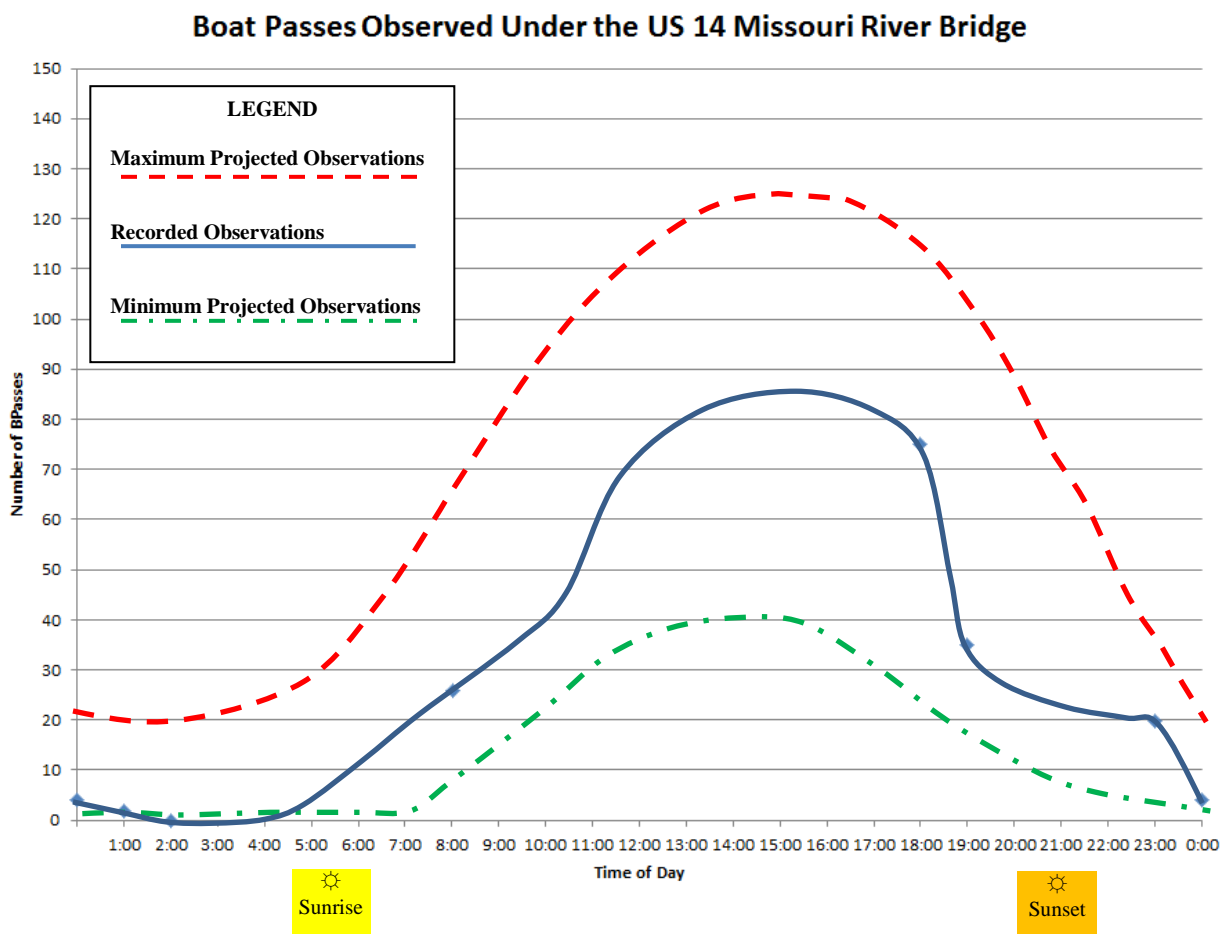


Figure 5: Boat Passes Observed Under the US 14 Missouri River Bridge

Pedestrian and Bicycle Passes Observed Under or Over US 14 Missouri River Bridge on Trails

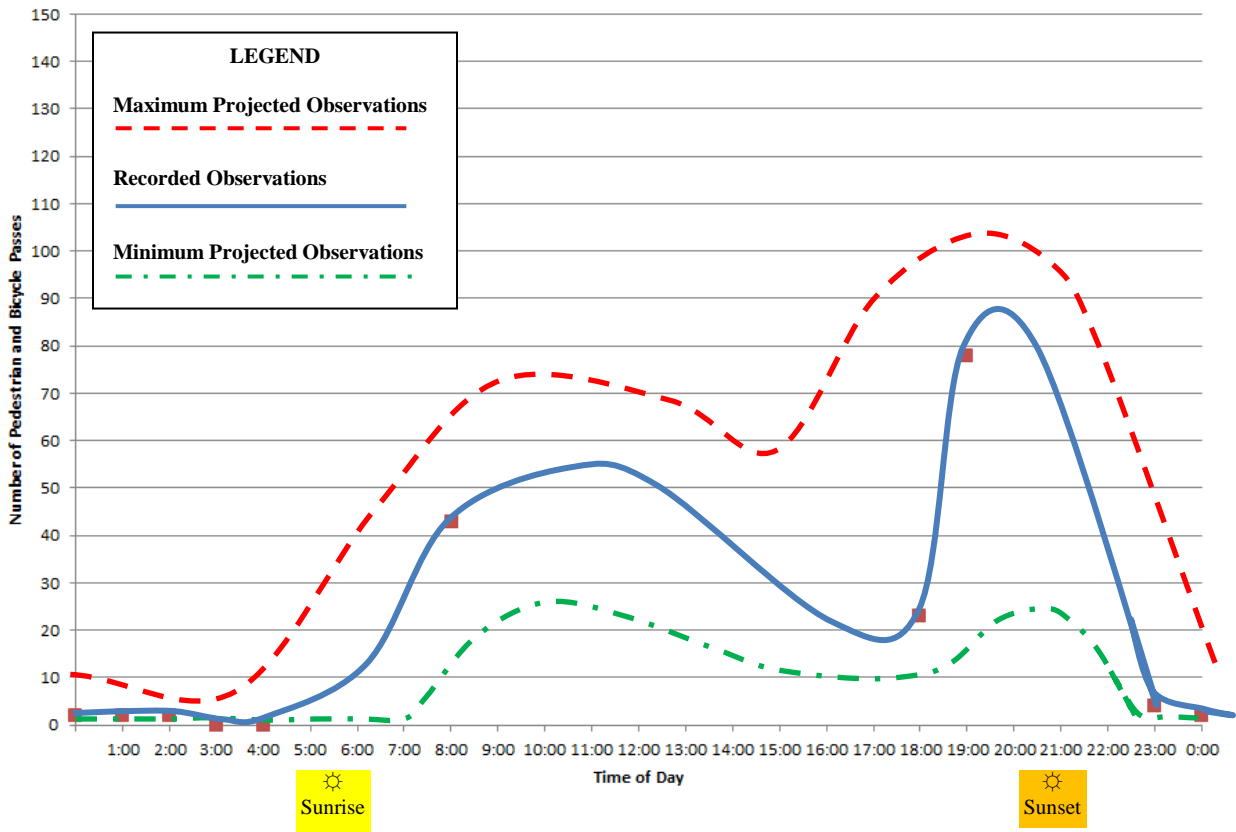


Figure 6: Pedestrian and Bicycle Passes Observed Under/Over Missouri River Bridge

Conclusions and Recommendations

Along with serving as a critical piece of infrastructure for Pierre and Fort Pierre, the Missouri River Bridge is an important spot for varied recreational use in the region; this observational study documented some of its many uses including fishing, biking, kayaking, running, walking, and boating. As the Missouri River Bridge study proceeds, it is recommended that any bridge designs and construction plans take specific note of the value of this resource to the region.

As mentioned earlier, the proposed bridge layouts increase span lengths and reduce the number of piers which will increase boating access and safety. Existing biking and walking paths are used heavily, but they weren't designed to accommodate the high levels of use observed in this study. Any new proposal should address this shortcoming so that the biking and walking paths in the area meet present day use as well as a growing demand in the years to come. ADA compliance must be implemented in the design. It is further recommended that any future structures strive to strengthen and enhance the value of the surrounding recreational area for years to come.

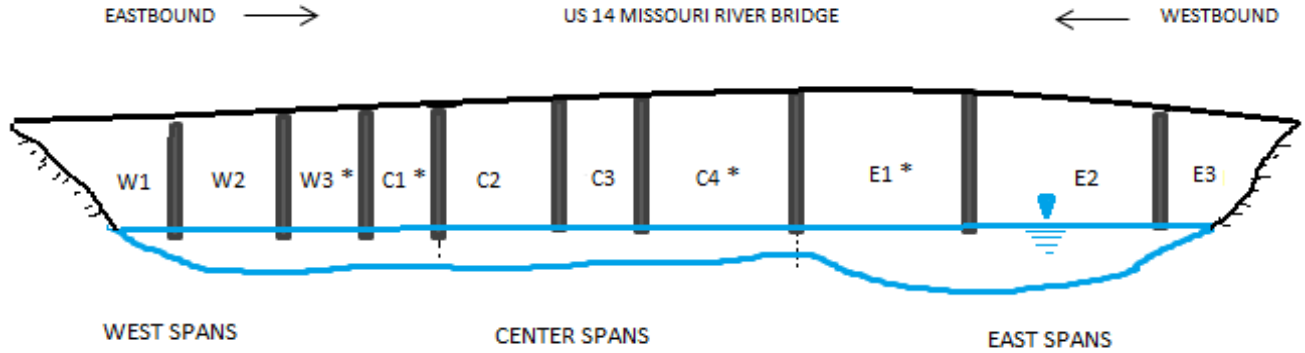
JOB: US14 Missouri River Bridge Boat Counts

BY: Carl Osberg

DATE: Saturday, July 26, 2014

WEATHER 65 °F; Rain

TIME: 8:00 TO 9:00



BOAT COUNT	BOAT COUNT	BOAT COUNT
2	0	3

* These spans accommodated the greatest amount of boat traffic. TOTAL BOATS:

REMARKS:

- 1.) Raining -- 2 fishing boats meandering around bridge.
- 2.) _____
- 3.) _____
- 4.) _____
- 5.) _____
- 6.) _____
- 7.) _____
- 8.) _____
- 9.) _____
- 10.) _____

- Instructions:
1. Please count boat activity for one hour during each peak period (AM, MID, PM).
 2. Record the date and hour for each observation period.
 3. Tally the number of boats observed using each span grouping (West, Center, East) as shown above.
 4. Bridge Diagram above assumes observations made from Western end of bridge on south side.
 5. A boat may be tallied multiple times as long as it goes completely under span.

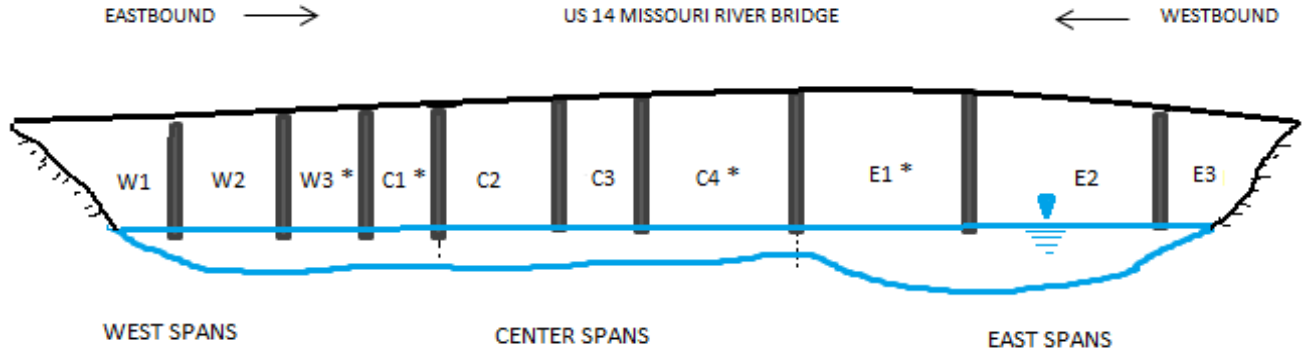
JOB: US14 Missouri River Bridge Boat Counts

BY: Carl Osberg

DATE: Saturday, July 26, 2014

WEATHER 84 °F; 26% Humidity; 10 mph

TIME: 17:45 TO 18:45



BOAT COUNT	BOAT COUNT	BOAT COUNT
17	34	24

* These spans accomodated the greatest amount of boat traffic.

TOTAL BOATS: 75

REMARKS:

- 1.) 12 Boats on the island
- 2.) Pleasure Boating
- 3.) Good mix: Fishing boats, ski boats, jet-skis, pontoon raft, water skiff raft
- 4.) Low wind
- 5.) _____
- 6.) _____
- 7.) _____
- 8.) _____
- 9.) _____
- 10.) _____

Instructions:

1. Please count boat activity for one hour during each peak period (AM, MID, PM).
2. Record the date and hour for each observation period.
3. Tally the number of boats observed using each span grouping (West, Center, East) as shown above.
4. Bridge Diagram above assumes observations made from Western end of bridge on south side.
5. A boat may be tallied multiple times as long as it goes completely under span.

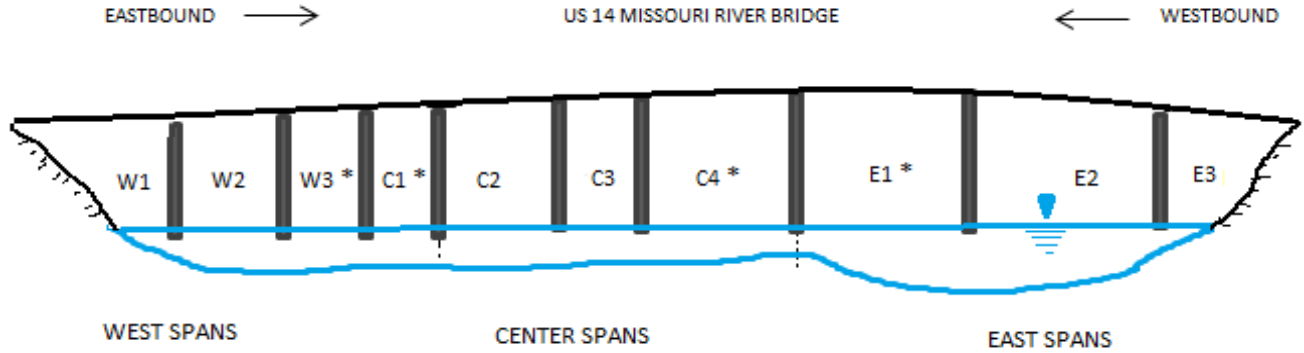
JOB: US14 Missouri River Bridge Boat Counts

BY: Carl Osberg

DATE: Saturday, July 26, 2014

WEATHER 88 °F; 26% Humidity; 10 mph

TIME: 18:45 TO 19:15



* These spans accomodated the greatest amount of boat traffic.

TOTAL BOATS: 23

REMARKS:

- 1.) West spans boat traffic included kayaks.
- 2.) In 2013 there were 4,445 boats registered in the county according to the Pierre DMV.
- 3.) Low wind
- 4.) _____
- 5.) _____
- 6.) _____
- 7.) _____
- 8.) _____
- 9.) _____
- 10.) _____

Instructions:

1. Please count boat activity for one hour during each peak period (AM, MID, PM).
2. Record the date and hour for each observation period.
3. Tally the number of boats observed using each span grouping (West, Center, East) as shown above.
4. Bridge Diagram above assumes observations made from Western end of bridge on south side.
5. A boat may be tallied multiple times as long as it goes completely under span.

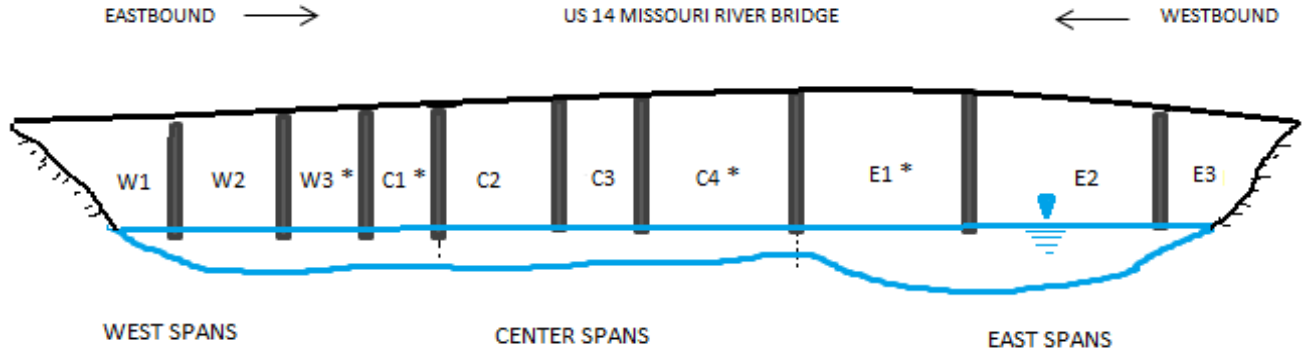
JOB: US14 Missouri River Bridge Boat Counts

BY: Carl Osberg

DATE: Saturday, July 26, 2014

WEATHER 65 °F; 83% Humidity

TIME: 23:00 TO 0:00



BOAT COUNT	BOAT COUNT	BOAT COUNT
10	0	10

* These spans accommodated the greatest amount of boat traffic. TOTAL BOATS: 20

REMARKS:

- 1.) Very active boaters -- few craft with multiple passes.
- 2.) Total count is made of up five boats making multiple passes under the bridge.
- 3.) _____
- 4.) _____
- 5.) _____
- 6.) _____
- 7.) _____
- 8.) _____
- 9.) _____
- 10.) _____

- Instructions:
1. Please count boat activity for one hour during each peak period (AM, MID, PM).
 2. Record the date and hour for each observation period.
 3. Tally the number of boats observed using each span grouping (West, Center, East) as shown above.
 4. Bridge Diagram above assumes observations made from Western end of bridge on south side.
 5. A boat may be tallied multiple times as long as it goes completely under span.

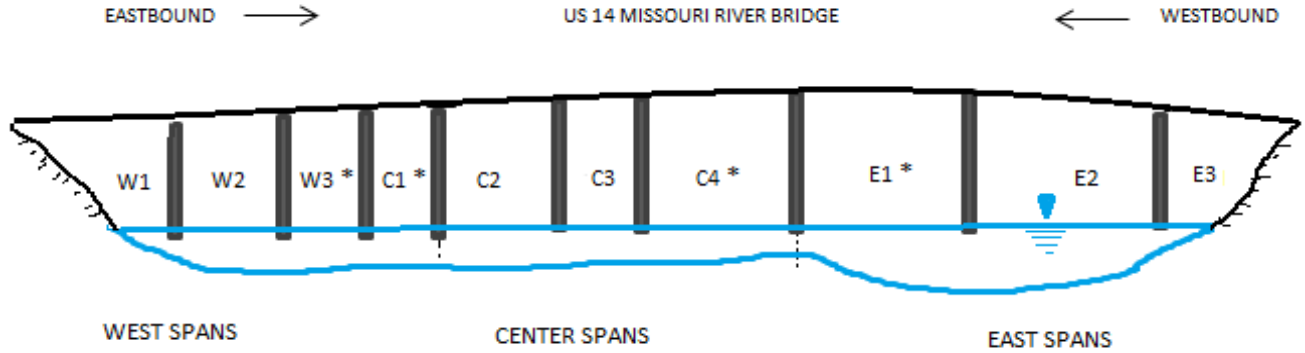
JOB: US14 Missouri River Bridge Boat Counts

BY: Carl Osberg

DATE: Sunday, July 27, 2014

WEATHER 65 °F; 83% Humidity; 5 mph

TIME: 8:00 TO 9:00



BOAT COUNT	BOAT COUNT	BOAT COUNT
9	14	3

* These spans accommodated the greatest amount of boat traffic. TOTAL BOATS: 26

REMARKS:

- 1.) Lingering Boat traffic -- fishing around the bridge
- 2.) Low wind
- 3.) _____
- 4.) _____
- 5.) _____
- 6.) _____
- 7.) _____
- 8.) _____
- 9.) _____
- 10.) _____

- Instructions:
1. Please count boat activity for one hour during each peak period (AM, MID, PM).
 2. Record the date and hour for each observation period.
 3. Tally the number of boats observed using each span grouping (West, Center, East) as shown above.
 4. Bridge Diagram above assumes observations made from Western end of bridge on south side.
 5. A boat may be tallied multiple times as long as it goes completely under span.

JOB: US14 Missouri River Bridge Pedestrian Counts

DATE: Saturday, July 26, 2014

TIME: 8:00 TO: 9:00

BY: Carl Osberg

WEATHER: 65 °F; Rain

LOCATION: East End of Bridge

SITE SKETCH



NUMBER OF PEDESTRIANS GOING UNDERNEATH FORT PIERRE ABUTMENT

NUMBER OF PEDSTRIANS GOING ACROSS BRIDGE

NUMBER OF PEDESTRIANS GOING UNDERNEATH PIERRE ABUTMENT

NUMBER OF BICYCLES GOING UNDERNEATH FORT PIERRE ABUTMENT

NUMBER OF BICYCLES GOING ACROSS BRIDGE

NUMBER OF BICYCLES GOING UNDERNEATH PIERRE ABUTMENT

TOTALS

PEDESTRIANS

BICYCLES

TOTAL

REMARKS

- 1.) Rain
- 2.) Exercise focused joggers and hikers
- 3.) _____
- 4.) _____
- 5.) _____
- 6.) _____
- 7.) _____

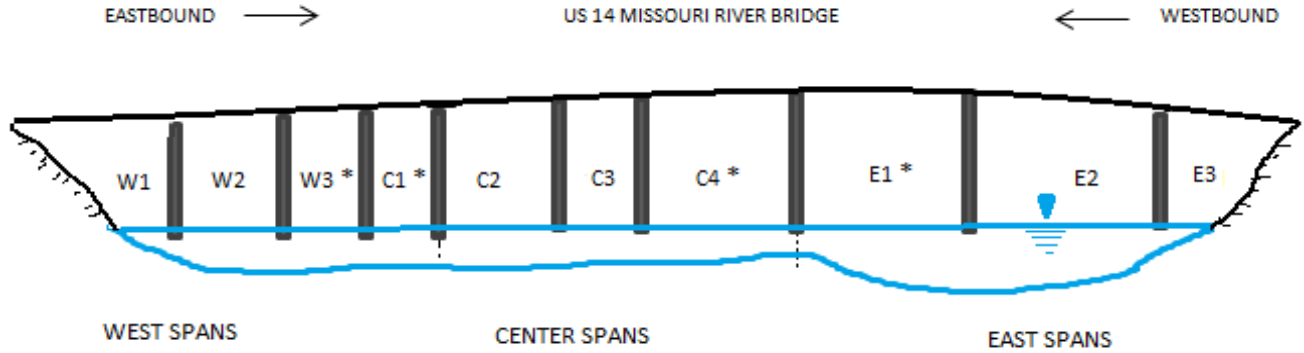
JOB: US14 Missouri River Bridge Boat Counts

BY: Carl Osberg

DATE: Saturday, July 26, 2014

WEATHER 84 °F; 26% Humidity; 10 mph

TIME: 17:45 TO 18:45



BOAT COUNT	BOAT COUNT	BOAT COUNT
17	34	24

* These spans accommodated the greatest amount of boat traffic. TOTAL BOATS: 75

REMARKS:

- 1.) 12 Boats on the island
- 2.) Pleasure Boating
- 3.) Good mix: Fishing boats, ski boats, jet-skis, pontoon raft, water skiff raft
- 4.) Low wind
- 5.) _____
- 6.) _____
- 7.) _____
- 8.) _____
- 9.) _____
- 10.) _____

- Instructions:
1. Please count boat activity for one hour during each peak period (AM, MID, PM).
 2. Record the date and hour for each observation period.
 3. Tally the number of boats observed using each span grouping (West, Center, East) as shown above.
 4. Bridge Diagram above assumes observations made from Western end of bridge on south side.
 5. A boat may be tallied multiple times as long as it goes completely under span.

JOB: US14 Missouri River Bridge Pedestrian Counts

DATE: Saturday, July 26, 2014

TIME: 18:45 TO: 19:15

BY: Carl Osberg

WEATHER: 88 °F; Clear

LOCATION: East End of Bridge

SITE SKETCH



NUMBER OF PEDESTRIANS GOING UNDERNEATH FORT PIERRE ABUTMENT	<input type="text" value="13"/>
NUMBER OF PEDSTRIANS GOING ACROSS BRIDGE	<input type="text" value="0"/>
NUMBER OF PEDESTRIANS GOING UNDERNEATH PIERRE ABUTMENT	<input type="text" value="21"/>
NUMBER OF BICYCLES GOING UNDERNEATH FORT PIERRE ABUTMENT	<input type="text" value="2"/>
NUMBER OF BICYCLES GOING ACROSS BRIDGE	<input type="text" value="2"/>
NUMBER OF BICYCLES GOING UNDERNEATH PIERRE ABUTMENT	<input type="text" value="1"/>

TOTALS

PEDESTRIANS	<input type="text" value="34"/>	BICYCLES	<input type="text" value="5"/>	TOTAL	<input type="text" value="39"/>
-------------	---------------------------------	----------	--------------------------------	-------	---------------------------------

REMARKS

- 1.) Park very well used
- 2.) Frisbee Golf Taking Place
- 3.) Pierre Abutment Pedestrian traffic included dogs
- 4.) _____
- 5.) _____
- 6.) _____
- 7.) _____

JOB: US14 Missouri River Bridge Pedestrian Counts

DATE: Saturday, July 26, 2014

TIME: 23:00 TO: 0:00

BY: Carl Osberg

WEATHER: 88 °F; Clear

LOCATION: East End of Bridge

SITE SKETCH



NUMBER OF PEDESTRIANS GOING UNDERNEATH FORT PIERRE ABUTMENT

NUMBER OF PEDSTRIANS GOING ACROSS BRIDGE

NUMBER OF PEDESTRIANS GOING UNDERNEATH PIERRE ABUTMENT

NUMBER OF BICYCLES GOING UNDERNEATH FORT PIERRE ABUTMENT

NUMBER OF BICYCLES GOING ACROSS BRIDGE

NUMBER OF BICYCLES GOING UNDERNEATH PIERRE ABUTMENT

TOTALS

PEDESTRIANS

BICYCLES

TOTAL

REMARKS

- 1.) 2 Pedestrians fishing on Fort Pierre bank.
- 2.) 2 Pedestrians fishing on Pierre bank.
- 3.) _____
- 4.) _____
- 5.) _____
- 6.) _____
- 7.) _____

JOB: US14 Missouri River Bridge Pedestrian Counts

DATE: Sunday, July 27, 2014

TIME: 8:00 TO: 9:00

BY: Carl Osberg

WEATHER: 65 °F; Clear

LOCATION: West End of Bridge

SITE SKETCH



NUMBER OF PEDESTRIANS GOING UNDERNEATH FORT PIERRE ABUTMENT	<input type="text" value="7"/>
NUMBER OF PEDSTRIANS GOING ACROSS BRIDGE	<input type="text" value="6"/>
NUMBER OF PEDESTRIANS GOING UNDERNEATH PIERRE ABUTMENT	<input type="text" value="19"/>
NUMBER OF BICYCLES GOING UNDERNEATH FORT PIERRE ABUTMENT	<input type="text" value="3"/>
NUMBER OF BICYCLES GOING ACROSS BRIDGE	<input type="text" value="3"/>
NUMBER OF BICYCLES GOING UNDERNEATH PIERRE ABUTMENT	<input type="text" value="5"/>

TOTALS

PEDESTRIANS	<input type="text" value="32"/>	BICYCLES	<input type="text" value="11"/>	TOTAL	<input type="text" value="43"/>
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REMARKS

- 1.) Pedestrians and bikers observed crossing bridge from Pierre to eat at Perkins in Fort Pierre.
- 2.) Families eating breakfast in Steamboat Park.
- 3.) _____
- 4.) _____
- 5.) _____
- 6.) _____
- 7.) _____

Fifth Street Towers
Suite 1500
100 South Fifth Street
Minneapolis, MN 55402
Phone: (612) 370-0700
Fax: (612) 370-1378

To: Steve Gramm, SDDOT

From: Carl Osberg, URS

Date: August 13, 2014

Subject: Aesthetic Median Barriers and Crash Attenuators

Introduction

This memorandum is in response to an Aesthetic Median and Crash Attenuator survey request for the US 14 Missouri River Bridge Replacement study. Concrete Median barriers are ubiquitous along state and federal highways and bridges. These simple structures play an important role in increasing transportation safety for motorists, cyclists, and pedestrians. Typically, they are constructed of smooth precast concrete. Select architectural surface treatment may enhance the aesthetic value of a median, thereby improving the design for a new bridge spanning the Missouri River. Crash Attenuators, or cushions, play a vital role in motorist safety on state and federal highways where concrete medians or other traffic hazards pose a risk to motorists.

Data Collection – Aesthetic Concrete Barriers

In 2002, the California Department of Transportation (Caltrans) conducted a study of textured barriers including aesthetic surface treatments of single slope concrete barriers and median plantings. The study of concrete medians was performed using “Type 60” barriers which have a constant slope of 9 degrees and range in height from 32 inches to 56 inches (Figure 1).

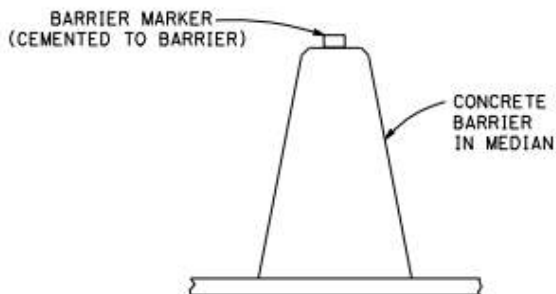


Figure 1: Caltrans Concrete Barrier Type 60

Typical aesthetic treatment consisted of sandblasting the barrier to create a specified pattern. After treatment, each barrier was subjected to standard Federal Highway Administration (FHWA) crash testing and evaluated accordingly. The FHWA also performed a separate testing analysis to verify Caltrans’ findings.

Table 1 shows a baseline comparison between the Type 60 Barrier used in California vs. the Type-F barrier commonly found in South Dakota and the surrounding Midwest.

Table 1: Untreated Concrete barrier Comparison








Untreated Barrier	FHWA Approval	Estimated 2002 Caltrans Cost	Estimated 2013 MnDOT Cost	Image
Type 60 Barrier (CA)	YES	\$30 per foot	N/A	
Type F (TL-4) Barrier	YES	N/A	\$60 per foot	

Table 2 is a summary of the testing analysis performed by Caltrans along with cost estimates on the treatment from the 2002 study and equivalent treatment performed by the Minnesota Department of Transportation (MnDOT) in 2013.

The cost of architectural treatments was large – decorated barriers cost approximately 60% more than untreated ones in the Caltrans study, and MnDOT bid letting indicates that surface treatment increased the price of a barrier from 30% - 100%. This suggests that treatment should only be applied where public demand warrants the increased cost. Further, since aesthetically treated concrete barriers are relatively uncommon, there is little data on the cost of upkeep and maintenance, and no information regarding the longevity of one pattern vs. another.

Table 2: Aesthetically treated Barrier Comparison

Aesthetically treated Barrier	Caltrans/FHWA Approval	2002 Caltrans Cost	Estimated 2013 MnDot Cost	Image
Mission Arch*	YES	\$50 per foot	N/A	
Deep Cobblestone Reveal	YES	\$50 per foot	N/A	
Drystack	YES	\$50 per foot	\$80 per foot	
Fractured Granite	YES	\$50 per foot	\$120 per foot	
Fluted Rib	NO	\$50 per foot	\$90 per foot	
Shallow Cobblestone	NO	\$50 per foot	N/A	N/A
Deep Cobblestone design	NO	\$50 per foot	N/A	N/A

* Note: *Mission Arch* is one example of an acceptable sand blast pattern that meets FHWA requirements. Other sandblasted shapes or designs may also be appropriate. See the NCHRP Report for Details.

Following upon the Caltrans research project, the National Cooperative Highway Research Program (NCHRP) published a formal report entitled “*Aesthetic Concrete Barrier Design*” in 2006. The report established guidelines recognized by the FHWA for aesthetic barrier treatment. Acceptable surface treatment depends on the width and depth of the treatment as well as the asperity angle. Figure 1 illustrates the design guidelines. It should be noted that designs outside these guidelines require formal testing and approval before they can be used on a highway or

bridge.

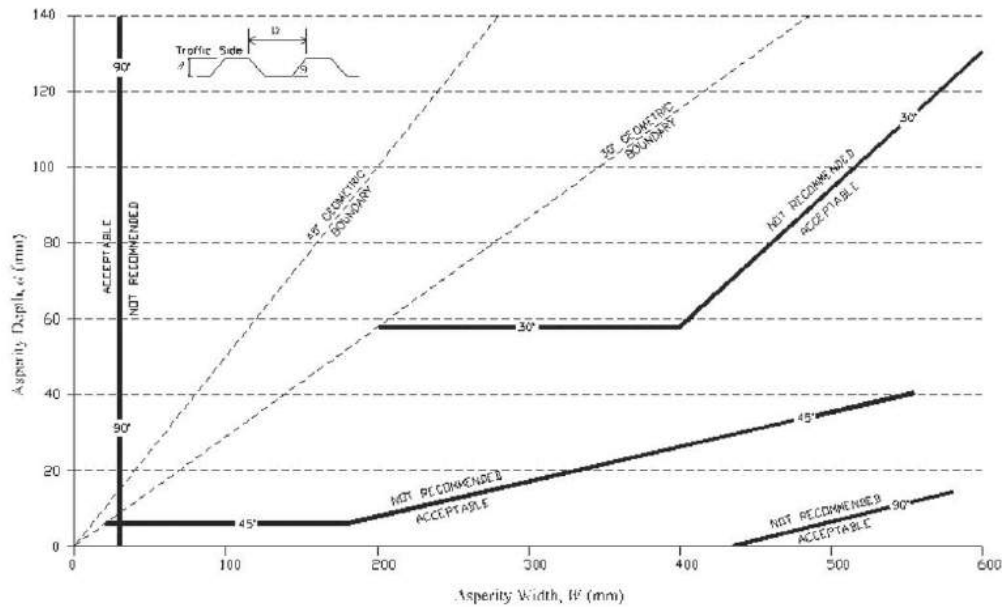


Figure 1: Final Design Guidelines for Aesthetic Surface Treatment of Safety Shape Concrete Barriers

The Caltrans study did not directly evaluate concrete median planters since a typical planter consisted of some shrub, bush, or tree contained within two unaltered Type 60 concrete barriers (See Figures 1 and 2). The FHWA does not discriminate against concrete median planters as long as the planters are constructed of approved crash barriers. According to Nick Artimovich, Highway Engineer for the FHWA Safety Design Team: “There is nothing to preclude a highway agency from filling in behind a crash-tested concrete barrier and planting flowers, grasses, or shrubs. A pair of barriers in the median could be filled in and planted in a similar manner, providing there is enough room to accommodate a shoulder on both sides.”

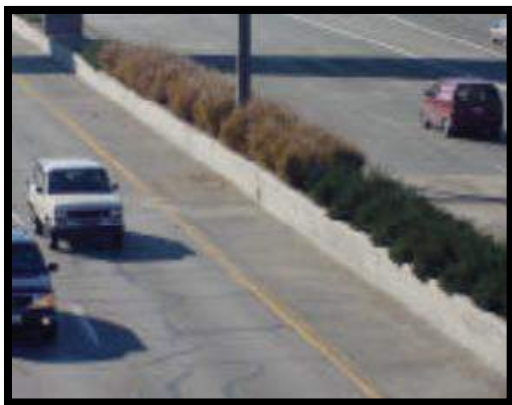


Figure 3: California Concrete Median Planter

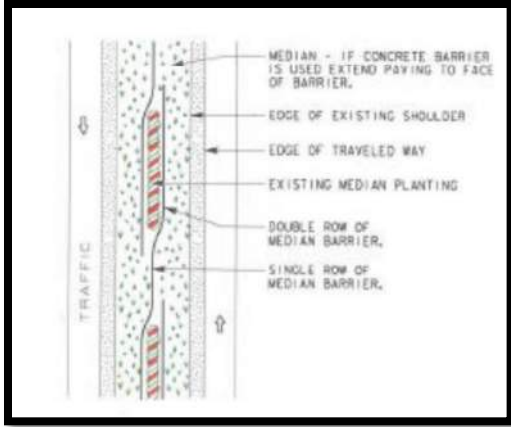


Figure 4: California Concrete Planter Plan

While concrete median planters are perfectly acceptable from a crash safety rating standpoint they can affect driver sightlines; inappropriate or untamed plantings may impair driver visibility and decrease highway safety. Further, median planters are more expensive due to routine landscaping maintenance and median maintenance may result in lane closures and commuter delays.

Conclusions and Recommendations – Aesthetic Concrete Barriers

Due to the increased cost and maintenance, it is our recommendation that aesthetic treatments be used very sparingly on any replacement for the Missouri River Bridge. One possible exception could be a planter median between the traffic lanes and the bicycle/pedestrian path on the bridge. Such a design might improve travel over the bridge for cyclists and pedestrians without harming drivers. However, any design incorporating aesthetic treatments must not sacrifice safety for visual improvements, and the additional cost must be acceptable to the taxpaying public.

Data Collection -- Crash Attenuators

According to the South Dakota Department of Transportation (SDDOT) Road Design Manual, the approach end of a concrete barrier must be transitioned to a non-gating Crash Cushion/Attenuator unless the design speed is less than 35 mph. At present, the Missouri River Bridge has a posted speed of 35 mph. A cushion sits at either end of the concrete median (See Figure 5 and Figure 6 below).



Figure 5: Crash Cushion at Western End of US 14 Missouri River Bridge



Figure 6: Crash Cushion at Eastern End of US 14 Missouri River Bridge

It is very unlikely that the design speed on any future bridge proposal would decrease below 35 mph; therefore attenuators will certainly be required in any new bridge structure. Thus, it is a matter of selecting or designing the best cushions for the project. Variables to consider include width of the obstacle, rigidity of the barrier, available space, and cost. The cost of any cushion depends on installation, routine maintenance and damage repair. Figure 7 shows a crash cushion selection guide developed by the Minnesota Department of Transportation. At a minimum, any selected attenuator must meet the TL-3 crash rating developed by AASHTO because the concrete parapets on the bridge will be designed for that rating.

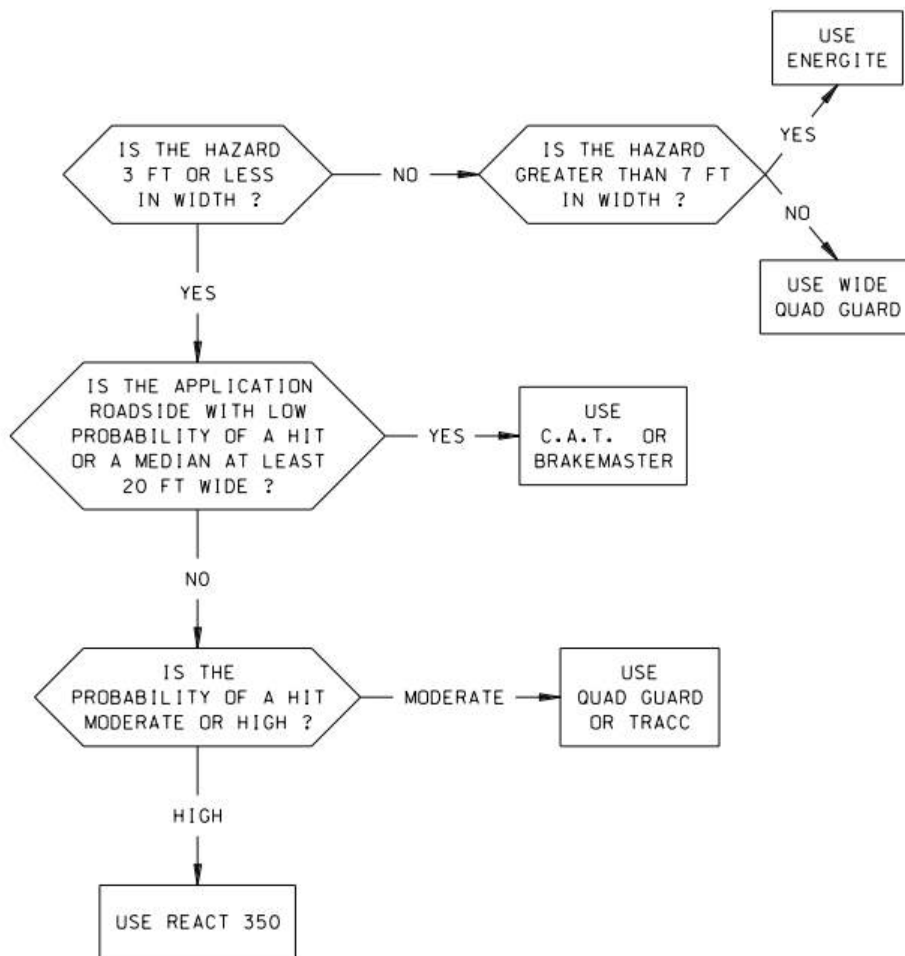


Figure 7: Guidelines for Selecting Crash Cushions (*Courtesy of MnDOT*).

Conclusions and Recommendations – Crash Attenuators

Based on the requirements outlined in this memo, there are a number of crash attenuators that would be appropriate for a new US 14 Missouri River Bridge. Depending on the final highway design and predicted crash incidence possible options include the *BRAKEMASTER 350* or *QUADGUARD Elite*. Ultimately the final selection should minimize costs while meeting approval from SDDOT, the Senior Roadway Engineer and Senior Bridge Engineer.

Fifth Street Towers
Suite 1500
100 South Fifth Street
Minneapolis, MN 55402
Phone: (612) 370-0700
Fax: (612) 370-1378

To: Steve Gramm, SDDOT
From: Carl Osberg, URS
Date: August 20, 2014
Subject: Pierre US 14 Bridge Deck Treatment Alternatives Study

Introduction

Crack formation in concrete bridge decks is a common phenomenon. While concrete bridge decking may crack under normal use conditions, crack formation is an issue when it allows water and chloride ions into the deck, potentially weakening the steel reinforcement over time. Many states, including South Dakota are interested in prolonging the lifespan of concrete bridge decks through the use of concrete sealers. This memorandum addresses the alternatives and recommendations for deck treatment for the US 14 Missouri River Bridge Replacement Study.

Concrete Sealants

Concrete sealants generally fall into three categories: barrier coatings, pore blockers, and water repellants (Figure 1). Barrier coatings are placed on top of the deck, creating an impenetrable barrier to water, salt ions, and other substances. Pore blocking treatments function just as the name suggests: blocking the pores in the treated layer, thereby preventing water and salt penetration into the deck. Water repellants penetrate into the deck, turning the affected layer from a hydrophilic material to a hydrophobic one.

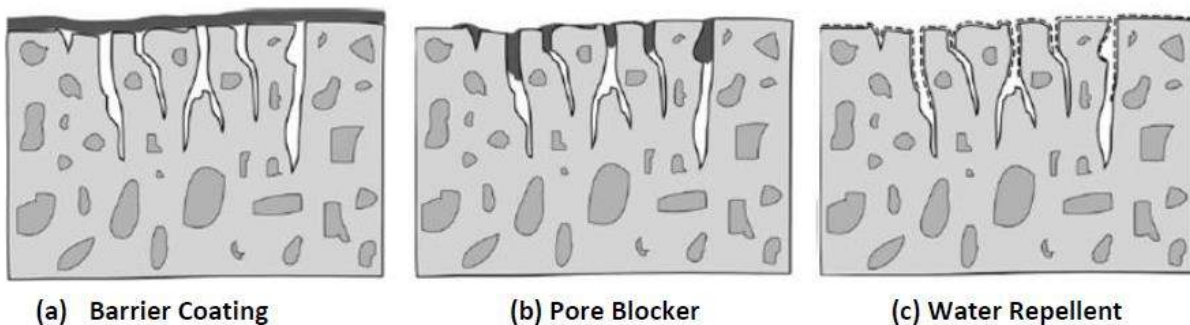


Figure 1: Concrete Sealer types (Courtesy of Idaho Department of Transportation).

South Dakota Sealant Study

In 2002, the South Dakota Department of Transportation (SDDOT) published a study entitled *Alternative Sealants for Bridge Decks*, which examined various crack-preventing (repellant and pore blocking) treatments as well as crack repair treatments (see Appendix for Executive Summary). The study did not consider any barrier type sealants because to be considered all possible treatments had to meet three criteria: 1.) be easily applied by SDDOT personnel; 2.) low cost; 3.) have a proven performance history. At the time of publication, barrier sealants were more expensive with less available performance data than today. The most significant findings in the study included the timing of application for preventative sealants, a recommendation for deck pre-treatment (or lack thereof), a recommendation to replace the statewide use of linseed oil as a sealant, and recommendations for crack repair.

For new bridges or replacement decks, applying sealants within the first three to six months was critical. Sealants are not nearly as effective if water and salt ions have already penetrated the concrete substrate. However, sealants achieved greater penetration in drier concrete. Thus, sealants should be applied as soon as the deck has reached an appropriate drying level. The study further found that pre-treatment of the deck such as sand blasting with a brush yielded mixed results. While sealants penetrated deeper on pre-treated decks, sandblasted decks exhibited the highest levels of water retention. A simple cleaning to remove dirt and debris resulted in the highest overall sealant performance.

Interestingly, the study also found the statewide practice of applying linseed oil as a deck sealant should be changed. This was based on the measured size of the concrete pores vs. the size of the linseed molecules. Concrete pores were found to be smaller than the linseed molecules thereby nullifying the effectiveness of the oil as a pore blocker. Further, despite the lower cost of linseed oil, applications had to be repeated every few years to maintain effectiveness as a surface membrane sealer. Instead of linseed oil, the most effective sealants were those containing silanes, siloxanes, or siloconates (Table 1). Silane sealants offered an additional attribute in that they allowed for vapor transmission. If such transmission is needed through the sealed surface, silane sealers were the preferred product.

Finally, the study recommended the use of crack sealing materials with a viscosity of 15 cp including Epoxy, Methyl Methacrylate (MMA), and Modified Polyurethane (MPU). Epoxy sealants for crack treatments were not recommended for crack widths exceeding 0.08 inches since epoxy sealants were less extensible than MMA or MPU (Table 2).

Table 1: SDDOT Recommended Sealant Products

Product Number	Product	Application
1	100% Silane - <i>Degussa</i>	Surface Sealer
2	40% Silane - <i>Hydrozo</i>	Surface Sealer
3	40% Silane - <i>Masterbuilders</i>	Surface Sealer
4	Reactive Methyl Methacrylate - <i>Degussa</i>	Crack Sealer
5	Modified Polyurethane - <i>Roadware</i>	Crack Sealer
6	Two Component Epoxy - <i>Unitex Pro Seal</i>	Crack/Surface Sealer
7	SDDOT Epoxy Chip Seal	Crack/Surface Sealer

Table 2: SDDOT Recommended Crack Sealant Based on Crack Width

Crack Definition	Crack Width [in]	Recommended Products
Fine	< 0.04	MMA, MPU, Epoxy
Medium	$0.04 \leq x \leq 0.08$	MMA, MPU, Epoxy
Wide	> 0.08	MMA and MPU

A number of states have performed a comparative analysis of deck treatment methods. Two states to do so with similar weather and climate to South Dakota are Minnesota and Idaho.

Comparative Sealant Study: Minnesota

In 2009 the Minnesota Department of Transportation (MnDOT) published a study conducted by the Department of Civil Engineering at the University of Minnesota entitled *Crack and Concrete Sealant Deck Performance* (see Appendix for Executive Summary). The purpose of the study was to examine the role of deck sealants and crack sealers in extending reinforced concrete deck life and establish best practice recommendations for Minnesota and throughout the Midwest. The Minnesota study confirmed many of the findings of the South Dakota study. Some of the unique findings or contrasting results as compared to South Dakota are discussed here.

Moisture content is an important factor in ensuring the highest possible penetration depth into the deck; the concrete should be as dry as possible before applying any sealant. Too much moisture decreased the penetration depth of all the most common sealants including silanes, siloxanes, and silane/siloxane mixtures. This applied not only to moisture content based on the age of the concrete but also excess moisture following weather events or wet cleaning of the deck before treatment. Typically, a two day drying time was recommended following any power washing or other wet cleaning method. At the time of the Minnesota study, no further research had been done regarding deck pre-treatment and sealant penetration; the authors neither confirmed nor denied the South Dakota study recommendation of a “do nothing” [except remove excess debris] pre-treatment. However, they found that the recommendation contradicted the practice of all the surveyed states; every respondent used some method of deck pretreatment before applying sealant. Regardless of whether SDDOT chooses to pretreat the deck on the future bridge, applying sealant to dry concrete will yield the best results.

Regarding deck sealants, the Minnesota study went a little further in comparing the carrying agents for each of the sealants: solvent based sealants were compared to water based sealants. The researchers found that solvent based sealants typically outperformed water based sealants; further, regardless of initial application, reapplication of sealants must be done using solvent based products. However, there were tradeoffs for selecting solvent based sealants. Solvent based products are much higher in VOC content, which may exclude them from use in environmentally sensitive locations. Water based sealants also evaporated more slowly, which is preferable for applications under hot or windy conditions since excessive evaporation results in a thinner layer of sealant in the deck. For the solvent based sealants, a high solids content was also desirable. Sealants with a solids content of 40% were used most frequently based on their performance in chloride ingress testing as well their superior depth penetration. However, for water based sealants, there was little difference in terms of performance between the products with a high solids content vs. a lower one. Finally, silane based sealants outperformed siloxane or mixed-based sealants in both depth of penetration and resistance to chloride ingress.

For crack sealers, the Minnesota study yielded slightly different results than South Dakota. High

Molecular Weight Methacrylates (HMWM) yielded the best performance in terms of depth of crack penetration due to its lower viscosity. Both HMWM and MMA sealers outperformed Epoxy products in terms of depth penetration. However, the Minnesota study found that Epoxy sealers had superior bond strength to HMWM or MMA products. Thus, in contrast to South Dakota, the Minnesota study recommended Epoxy sealers for large deck cracks where increased bond strength is more important. Also, the Epoxy sealers were typically applied to individual cracks, while HMWM products were typically applied in a flood coat to the entire deck. Therefore, the proper sealant choice may depend upon the extent of the cracking in the deck.

Comparative Sealant Study: Idaho

In 2011, researchers at Boise State University published a study for the Idaho Department of Transportation entitled *Investigation of Concrete Sealer Products to Extend Concrete Pavement Life – Phase 1* (see Appendix for Executive Summary). In the study, researchers compared five deck sealant/crack sealer treatments: silane, epoxy, HMWM, and two dual treatments: silane basecoat with an epoxy topcoat, and a silane basecoat with an HMWM topcoat. Each treatment was evaluated based on the following laboratory tests:

1. Water vapor transmission
2. Saltwater absorption
3. Chloride permeability
4. Sealer penetration depth or coating thickness
5. Resistance to alkali
6. Ultraviolet (UV) weathering and cyclic saltwater ponding
7. Freeze-thaw resistance

The Idaho study was unique from the other two states in that it was the only one to consider a dual treatment approach. After analysis and comparison, the Idaho Study reached the following conclusions: Dual treatments systems offer the best protection for decks. However, for concrete surfaces exposed to higher volumes of traffic, a silane sealer was recommended since any barrier coating would be subject to wear and require frequent recoating. Silane sealers were also recommended when vapor transmission was required of the top layer of decking.

Conclusions and recommendations

Based on the comparative studies, the URS Team recommends a silane deck sealant be applied to any future US 14 Missouri River Bridge Structure. The sealant should be applied to a clean dry surface after 90 day concrete strength is reached. Selection of a water based silane vs. a solvent based product will depend on the final recommendations of the environmental study, but given the sensitive ecosystems surrounding the bridge including the river life and parks, a water based silane may prove the superior choice. Finally, given the results of the traffic study performed by URS, a barrier topcoat is not recommended at this time. Surface cracking should be treated with an epoxy or HMWM sealer, selected at the discretion of SDDOT.

1.0 EXECUTIVE SUMMARY

Early age cracking of new and overlaid Portland Cement Concrete (PCC) bridge decks is widely regarded as a long-term durability and maintenance problem because many of these cracks run through the deck and allow the rapid ingress of moisture and chloride ions into the deck and onto the bridge superstructure and substructure. National Cooperative Highway Research Program (NCHRP) *Report 380 – Transverse Cracking in Newly Constructed Bridge Decks* developed guidelines for reducing transverse deck cracking on new bridge decks, and suggested possible crack and deck sealing strategies. Research is underway looking into the use of Class F fly ash, silica fume, and ground granulated blast furnace slag (GGBFS) as mineral admixtures in structural concrete to reduce concrete permeability and early age cracking.

Currently, SDDOT uses linseed oil/mineral spirit treatments as a penetrating deck sealer on older decks and applies epoxy treatments to random cracking, especially on overlays, where the incidence of cracking is light to moderate. For severe cracking problems SDDOT employs a thin epoxy chip seal it developed for sealing entire decks, which still allows moisture vapor transmission. SDDOT has sufficient tools for sealing cracks on decks, but lacks guidelines as to which particular treatment strategy is appropriate for a given set of circumstances. Numerous product descriptions and studies are available regarding PCC crack/surface treatments. However, as stated in the Request-For-Proposal (RFP), there are few, if any, guidelines describing:

- 1) When to apply,
- 2) What to apply, and
- 3) How to apply the treatments.

The objectives and tasks for this project were accomplished by gathering and evaluating agency, field, laboratory, and literature data. A major portion of this research project focused on determining the optimum timing for treatment application.

FINDINGS & CONCLUSIONS

The following findings and conclusions are presented for this project.

1. It appears that bridge deck cracking is occurring on most of SDDOT's bridge decks.
2. Application of crack and deck sealing treatments after chloride ingress is not the approach most beneficial to extending bridge deck service lives. However, it is acknowledged that slowing additional chloride and water ingress will provide additional life to older bridges. Treating older bridge decks will just not be as effective as treating prior to chloride exposure.
3. Crack and deck sealing products with viscosities less than 15 cp appear to achieve good penetration (i.e. = 0.10 in.) into cracks and deck surface, respectively.
4. Linseed oil should not be classified or used as a penetrating sealer because its molecular size is bigger than the size of the concrete pore openings. Therefore, it functions primarily as a temporary surface membrane sealer.

IMPLEMENTATION RECOMMENDATIONS

The following implementation recommendations are presented for this project.

1. SDDOT's bridge deck crack and surface sealing activities should be conducted within 3 to 6 months after construction and repeated every 5 years. Existing bridge decks should be treated to minimize further chloride and water ingress, thus reducing corrosion potential.
2. SDDOT should replace linseed oil with penetrating sealers (i.e. – silanes, siloxanes, and siliconates) that incorporate alkyl groups larger than methoxy and ethoxy groups as their concrete bridge deck surface sealing materials.
3. SDDOT should use concrete crack sealing materials (i.e. – Methyl Metacrylate (MMA), Modified Polyurethane (MPU), Epoxy, etc.) with viscosities = 15 cp. If crack widths are = 0.040 in., epoxy should not be used because their extensibility properties are generally less than that of MMA and MPU.

Executive Summary

The objective of this research project was to define the current state-of-the-art regarding the use of bridge deck sealants and crack sealers to extend the life of reinforced concrete bridge decks. The role of deck sealants and crack sealers is to prevent chloride ion ingress, originating from deicing materials spread on the road, from penetrating into the concrete bridge deck and corroding the steel reinforcing bars. The prevention of corrosion in reinforcing bars is important because corrosion generates expansion and produces local tensile forces in the concrete deck. Due to the weakness of concrete to carry tensile forces, the deck will spall and eventually deteriorate.

The report includes the information generated from a literature review and survey on current and significant studies in the field of deck and crack sealing. The intent of the survey is to determine common practices for the use and application of these sealers in different states throughout the United States. After all of the information is collected and compiled from the literature review and the survey, the best materials and practices are recommended for use in Minnesota and throughout the Midwest.

The first option for slowing chloride ingress is to coat the entire deck with a penetrating or barrier sealer. Many of the issues regarding this practice are considered. The report discusses how solids content for a penetrating sealer affects penetration depth and effectiveness. A discussion is included regarding the potential negative effects to steel reinforcement when chloride ions are already present in the deck prior to sealant application. Information on the effectiveness of recoating a bridge with penetrating sealer is also discussed, as well as the number of coats before reapplication becomes ineffective.

Because chloride ions can penetrate the cracks much faster than solid concrete, cracks pose a more immediate danger to the reinforcement. By preventing this fast ingress of chloride ions, potential years can be added to the life of a deck. Important issues such as the amount of time a sealed crack can prevent chloride ingress are discussed. Expansion and contraction of cracks due to traffic loading and thermal cycles will also vary the effectiveness of sealed cracks. Information is collected regarding whether new cracks can form near repaired cracks. The length of time crack sealing products must be allowed to cure before normal traffic is allowed to traverse the bridge deck is documented. Finally questions regarding the past performance of crack sealants are also answered.

The report consists of five chapters. Chapters 1 and 2 provide a synthesis of the literature review on the background, application, and performance of concrete deck sealants and crack sealers, respectively. Chapter 3 presents a summary of the survey conducted by Mn/DOT. The survey, as previously mentioned, is used to determine the current selection criteria, materials, application practices, and findings from different states in the United States. Chapter 4 discusses the results of several chloride studies conducted in Minnesota. Chapter 5 combines the information gathered Chapters 1 through 4 to create an assessment of all selection criteria, materials, application practices, and performance. Finally, Chapter 6 draws some conclusions from the

previous sections, develops recommendations, and identifies areas which could benefit from further research.

Chapter 1 addresses commonly used deck sealants. Sealants are typically classified into two categories (e.g., penetrating sealants and film formers). Penetrating sealants (e.g., silane, siloxane) are used to create a hydrophobic barrier on the concrete surface to repel water and chloride ions. Film formers (e.g., linseed oil, epoxy) are used to form an impenetrable barrier to block the water and chloride particles from penetrating into the concrete substrate. Four performance measures are used to evaluate the test results for concrete deck sealants obtained from the source literature, namely chloride ingress, absorption, depth of penetration, and vapor permeability. Variables that affect the performance of deck sealants include concrete parameters such as moisture content at time of application and water-cement ratio. Other concrete parameters such as finishing and curing, surface preparation, coverage rate, abrasion, and freeze-thaw exposure are also discussed in the report. The environmental conditions (e.g., temperature and wind speed) at the time of application can have a direct effect on sealant performance.

Chapter 2 addresses concrete crack sealers, the most common which are epoxy, high molecular weight methacrylate (HMWM), methacrylate, and polyurethane. HMWM sealers have a low viscosity and are typically applied using a flood coat. Epoxy sealers typically have a higher bond strength, higher viscosity, and are typically (but not exclusively) applied to individual cracks. The four performance measures used for evaluating crack sealing performance are depth of penetration, bond strength, seepage, and chloride ingress and corrosion. General trends such as lifespan of sealed cracks, presence of re-cracking, and track-free time for sealers are also discussed. Variables affecting performance such as effect of temperature, moisture, crack cleanliness, and crack age are also discussed.

Chapters 3 and 4 document a performance survey and a chloride study, respectively. Approximately 20 people throughout the Midwest and the United States participated in the survey. The survey focused on materials, application procedures, application timing, and material testing used. The chloride study investigated how the application of concrete deck sealants and crack sealers affected the chloride levels in the bridge deck. The effect that sealing had on deck inspections was also taken into consideration. Most of the information covered in the chloride study either reiterated the results determined from the literature review or was inconclusive.

The product assessment chapter (Chapter 5) compiles the information from the first four chapters. The deck sealant section of this chapter reiterates the superior performance of silane over either siloxane or linseed oil, and that solvent-based penetrating sealants perform better than their water-based counterparts. Moreover, water-based sealants were found to be inadequate for reapplication, and a high content of solids was determined to be beneficial for penetration depth and resistance to chloride ions. The most common product that fits this description is a solvent-based silane with a 40 percent solids concentration. The crack sealer portion of this chapter indicates that HMWM and epoxy sealers can both be effectively used. HMWM products are best suited for decks with extensive cracking due to the flood-coat application procedure, and they are beneficial for decks with fine cracks due to their very low viscosity. Epoxy sealers are more

effective for decks with few cracks because they are typically applied to individual cracks, and epoxy is better suited for larger cracks because they have higher bond strengths.

Finally the last chapter of the report (Chapter 6) discusses conclusions and recommendations for material selection, application, and testing. The following conclusions and recommendations are pertinent to concrete bridge deck sealants:

- 90-day ponding (AASHTO T259) and absorption (ASTM C642) tests are commonly used acceptance tests.
- NCHRP 244 Series II testing is widely used to quantify performance.
- NCHRP 244 Series II requires 75 percent reduction in water absorption and chloride intrusion while maintaining 100 percent vapor transmission.
- Depth of penetration and chloride content tests are the most common QA/QC tests conducted on bridge decks, if any are used, but the results are highly variable.
- Silane products typically outperform Siloxane products.
- Water-based products are not suitable for reapplication.
- Solvent-based products typically outperform water-based products.
- High solids content is typically desirable.
- S40Si is the commonly produced sealant that best fits the criteria above.
- Sealants should be applied between temperatures of 40 and 100°F.
- A drying period of at least two days should be enforced if the deck is moist.

The conclusions and recommendations for the crack sealers are as follows:

- Many states do not conduct acceptance tests to identify acceptable crack sealing products, and products are typically chosen based on well-known research (e.g., Pincheira 2005).
- Depth of penetration and chloride content tests are the most common QA/QC tests conducted on bridge decks, if any are used, but the results are highly variable.
- HMWM products typically provide better penetration (suited for smaller cracks).
- Epoxy products typically provide higher bond strength.
- Although test results are variable, epoxy sealers tend to demonstrate good resistance to freeze-thaw effects.
- Crack sealers should be selected with:
 - viscosity less than 500 cP (or 25 cP for HMWM sealers),
 - tensile strength more than 8 MPa, and
 - tensile elongation larger than 10 percent.
- Crack sealers should be applied between temperatures of 45 and 90 °F.
- If possible, crack sealers should be applied between the 11:00 pm and 7:00 am.
- Some form of surface preparation should be used to clean the cracks.
- A drying period of two to three days should be enforced if the deck is moist.

Executive Summary

Portland cement concrete pavements (PCCPs), including bridge decks, are susceptible to deterioration and decreased service life caused by the ingress of water. Water can dissolve and transport deleterious chemicals into PCCPs through cracks and the concrete surface such as de-icing salts, carbon dioxide, dissolved oxygen and sulfates. Damaging chemical reactions, such as alkali silica reactions (ASR), require water for the reaction to develop and once ASR gels are present, water causes the gel to expand. Freeze-thaw induced expansion pressure is also enabled by the presence of water. Surface applied concrete sealers have demonstrated the ability to increase service life of PCCPs by limiting the ingress of water and deleterious chemicals into concrete.

Concrete sealers are classified as being penetrating water repellents, pore blockers or barrier coatings. Water repellents can penetrate into the concrete and render the concrete hydrophobic allowing for vapor transmission. They are not as susceptible to surface wear and ultraviolet (UV) exposure as other sealers but are limited by only being able to seal narrow cracks (<0.6 mm). Pore blockers fill in pores within the concrete surface. They can provide limited vapor transmission, but are somewhat susceptible to surface wear. Barrier coatings completely seal the concrete by providing a coating impervious to water and can also penetrate and seal cracks. They provide little vapor transmission and are susceptible to surface wear and UV exposure.

Concrete sealers are being increasingly used by the Idaho Transportation Department (ITD) in an attempt to protect and extend service life of bridges and pavement. However, little has been done in Idaho to establish either a long-term field observation program to measure the sealer effects and impacts under true field conditions of Idaho or perform a comprehensive region-specific laboratory analysis and evaluation process of suitable compounds. Thus, before proper deployment and long-term field evaluation of concrete sealers and their effects on the projected longevity of the pavements can be done under actual conditions of Idaho, an extensive laboratory evaluation process of suitable compounds, laboratory sealer evaluation protocol development, and application/reapplication protocol development need to be performed. Phase I of this study, the focus of this research, addresses these needs. Phase II will utilize methods researched in Phase I to evaluate surface applied concrete sealers on actual PCCP in a field setting.

Concrete sealer testing methods used by transportation agencies, product manufacturers and researchers vary considerably. Often, results are not comparable as sample preparation, evaluation techniques, field conditions, and application methods are different from study to study. Several studies have recommended the adoption of a standardized method of testing to facilitate the development of a national database on concrete sealers to ease the selection and appropriate use of surface applied concrete sealers. In response to this recommendation, the National Cooperative Highway Research Program commissioned *NCHRP 20-07/Tosk 235 Development of Testing Protocols for Surface Applied Concrete Sealer Treatments* to Wiss, Janney, Elstner Associates, Inc. (WJE) in 2007. This task was completed in 2009 and is currently being reviewed for inclusion into the American Association of State Highway Transportation Officials (AASHTO) *M244 Standard Specification for Use of Protective Sealers for Portland Cement Concrete*. The testing methods offered by WJE are based on existing testing methods

from AASHTO, the American Society for Testing and Materials (ASTM), the Alberta Transportation Department, Oklahoma Department of Transportation, and others. A draft of this report was obtained during the literature review of this study and the methods suggested by WJE were utilized in this study in anticipation of these testing methods becoming the new AASHTO standard protocol for testing surface applied concrete sealers.

In this research, five surface applied concrete sealer treatments were evaluated in the laboratory to test their ability to limit the ingress of water and chlorides into Portland cement concrete pavement. The treatments selected were:

1. Silane (water repellent)
2. Epoxy (barrier coating)
3. High molecular weight methacrylate (HMWM) (barrier coating/pore blocker)
4. Silane basecoat with an epoxy topcoat (dual treatment)
5. Silane basecoat with a HMWM topcoat (dual treatment)

These treatments were selected based on a matrix of characteristics developed from the literature review by Boise State University (BSU), a matrix developed in 1994 by Phillip Cady for the National Cooperative Highway Research Program (NCHRP) Synthesis 209 regarding concrete sealers, and input from ITD personnel. Only one brand of each compound was analyzed in the initial phase of this study as this research is a general comparison of the different types of concrete sealers. As a consequence, the results of this study do not represent the performance of all brands for each sealer type and it is likely some brands will perform better than others in a direct comparison. Laboratory samples, consisting of 4 inch cubes and 12 inch x 12 inch by 3 inch thick slabs, were cast using a mix design utilized by ITD. The mix for the PCCPs used locally available aggregate sources. The treatments were evaluated in the following tests in the laboratory relative to control (unsealed) samples:

- 1) Water vapor transmission
- 2) Saltwater absorption
- 3) Chloride permeability
- 4) Sealer penetration depth or coating thickness
- 5) Resistance to alkali
- 6) Ultraviolet (UV) weathering and cyclic saltwater ponding
- 7) Freeze-thaw resistance

In addition, the same treatments were applied at four field locations near Boise in Southwest Idaho to initiate a long-term field study to be completed in the phase II of this study. Only the initial water absorption performance (time zero) was evaluated using core samples from field sites in the laboratory. The duration of the initial phase of this study was insufficient to be able to analyze long-term (4 years +) performance of the field site applications.

The dual treatments comprised of a silane basecoat and an epoxy or HMWM topcoat consistently exhibited the best performance in preventing saltwater absorption, minimizing chloride permeability, resistance to alkali, UV weathering and cyclic saltwater ponding and freeze-thaw resistance tests. Of

single sealer treatments, the epoxy, silane and HMWM had the best performance in descending order in the same tests. Only the silane exhibited a consistently measurable depth of penetration and prevented significant vapor transmission. The dual treatments also exhibited the least water absorption for the initial, time zero, field cores extracted from each of the four field sites. Dual treatments offer the advantage of a deep penetrating sealer (silane) combined with a barrier coating type sealer (epoxy or HMWM) able to seal cracks to limit the ingress of water and chemicals. Dual treatments offer the best protection for PCCPs. If vapor transmission is of concern, the silane sealer's performance consistently surpassed threshold values recommended in the literature and would be recommended.



MEMORANDUM

Fifth Street Towers
Suite 1500
100 South Fifth Street
Minneapolis, MN 55402
Phone: (612) 370-0700
Fax: (612) 370-1378

To: Steve Gramm, SDDOT

From: Carl Osberg URS

Date: August 22, 2014

Subject: Section 404 Permits for the US 14 Missouri River Bridge

Introduction

Section 404 of the Clean Water Act (CWA) regulates the discharge of dredged or fill material into navigable waters at specified disposal sites. Dredged or fill material is defined broadly to include any material that results from farming, construction, maintenance, or any material *“incidental to any activity having as its purpose bringing an area of the navigable waters into a use to which it was not previously subject.”* Under section 404 of the CWA, the U.S. Army Corp of Engineers (USACE) is authorized to prohibit the designation of any location as a disposal site where the *“discharge of such materials into such area will have an unacceptable adverse effect on municipal water supplies, shellfish beds and fishery areas (including spawning and breeding areas), wildlife, or recreational areas.”* Section 404 is very relevant to the US 14 Missouri River Bridge Study since the eventual demolition of the existing Lt. Commander John C Waldron Bridge and replacement with a new structure will inevitably result in the discharge of material into the Missouri River.

Planning for Permitting

Given the large scale of the project and the potential for adverse environmental impacts it is certain that any demolition or new construction in the US 14 Missouri River Bridge Study area will require permits from the USACE. This includes any temporary construction or temporary river diversion. Jeffrey Breckenridge, P.E., the Regulatory Project Manager for the South Dakota Regulatory Office of the Army Corp of Engineers confirmed this with URS. Therefore, as the US 14 Missouri River Bridge Study proceeds, one goal of the project may be reducing the number of permits required to help ensure a demolition and construction schedule that is as smooth as possible (See attached email).

Guidance for a Greener, Smoother Project

It is advised that a Least Environmentally Damaging Practical Alternative (LEDPA) evaluation memo or report be provided to the Corps in parallel with the EA process. This would aid in the application & public interest process. For example, according to Mr. Breckenridge, problems with previous projects arose when the actors failed to adequately remove debris from the river. One strategy to avoid this would be to deconstruct the existing structure and piece it out by truck or barge. If quicker demolition is preferred, another option is to enact the demolition over a barge in the river so that the resulting waste doesn't enter the water. It should be noted that the USACE does not consider the removal and replacement of an existing structure as environmentally offsetting. Both the demolition and the new construction would be evaluated as adding new material to the river. Further, a permit would only be issued once the entire project plan and construction sequencing were reviewed and approved; it is unlikely that stages of demolition or construction would be evaluated separately. Thus, a demolition and construction plan which fully considers and mitigates the negative environmental impacts is crucial to the success of the project. However, according to USACE the 0.5 acres threshold between a nationwide and individual permit pertains to permanent fill only and not to temporary fill used for construction. Furthermore the USACE doesn't consider pilling/sheet piling to be fill so cofferdams won't contribute to the temporary or permanent 404 permit fill quantities.

Recommendations

URS recommends that the South Dakota Department of Transportation maintain open communication with USACE. Once a full project plan is developed for the removal and construction of a new US 14 Missouri River bridge, it should be sent to USACE immediately to avoid possible delays and mitigate potential problems before they arise.

SECTION 404 OF THE CLEAN WATER ACT

- A. The Secretary may issue permits, after notice and opportunity for public hearings for the discharge of dredged or fill material into the navigable waters at specified disposal sites. Not later than the fifteenth day after the date an applicant submits all the information required to complete an application for a permit under this subsection, the Secretary shall publish the notice required by this subsection.
- B. Subject to subsection (c) of this section, each such disposal site shall be specified for each such permit by the Secretary
 - 1. through the application of guidelines developed by the Administrator, in conjunction with the Secretary, which guidelines shall be based upon criteria comparable to the criteria applicable to the territorial seas, the contiguous zone, and the ocean under section 403(c), and
 - 2. in any case where such guidelines under clause (1) alone would prohibit the specification of a site, through the application additionally of the economic impact of the site on navigation and anchorage.
- C. The Administrator is authorized to prohibit the specification (including the withdrawal of specification) of any defined area as a disposal site, and he is authorized to deny or restrict the use of any defined area for specification (including the withdrawal of specification) as a disposal site, whenever he determines, after notice and opportunity for public hearings, that the discharge of such materials into such area will have an unacceptable adverse effect on municipal water supplies, shellfish beds and fishery areas (including spawning and breeding areas), wildlife, or recreational areas. Before making such determination, the Administrator shall consult with the Secretary. The Administrator shall set forth in writing and make public his findings and his reasons for making any determination under this subsection.
- D. The term "Secretary" as used in this section means the Secretary of the Army, acting through the Chief of Engineers.
- E.
 - 1. In carrying out his functions relating to the discharge of dredged or fill material under this section, the Secretary may, after notice of opportunity for public hearing, issue general permits on a State, regional, or nationwide basis for any category of activities involving discharges of dredged or fill material if the Secretary determines that the activities in such category are similar in nature, will cause only minimal adverse environmental effects when performed separately, and will have only minimal cumulative adverse effects on the environment. Any general permit issued under this subsection shall
 - a. be based on the guidelines described in subsection (b)(1) of this section, and
 - b. set forth the requirements and standards which shall apply to any activity authorized by such general permit.
 - 2. No general permit issued under this subsection shall be for a period of more than five years after the date of its issuance and such general permit may be revoked or modified by the Secretary if, after opportunity for

public hearing, the Secretary determines that the activities authorized by such general permit have an adverse impact on the environment or such activities are more appropriately authorized by individual permits.

F.

1. Except as provided in paragraph (2) of this subsection, the discharge of dredge or fill material -
 - a. from normal farming, silviculture, and ranching activities such as plowing, seeding, cultivating, minor drainage, harvesting for the production of food, fiber, and forest products, or upland soil and water conservation practices;
 - b. for the purpose of maintenance, including emergency reconstruction of recently damaged parts, of currently serviceable structures such as dikes, dams, levees, groins, riprap, breakwaters, causeways, and bridge abutments or approaches, and transportation structures;
 - c. for the purpose of construction or maintenance of farm or stock ponds or irrigation ditches, or the maintenance of drainage ditches;
 - d. for the purpose of construction of temporary sedimentation basins on a construction site which does not include placement of fill material into the navigable waters;
 - e. for the purpose of construction or maintenance of farm roads or forest roads, or temporary roads for moving mining equipment, where such roads are constructed and maintained, in accordance with best management practices, to assure that flow and circulation patterns and chemical and biological characteristics of the navigable waters are not impaired, that the reach of the navigable waters is not reduced, and that any adverse effect on the aquatic environment will be otherwise minimized;
 - f. resulting from any activity with respect to which a State has an approved program, under section 208(b)(4) which meets the requirements of subparagraphs (B) and (C) of such section, is not prohibited by or otherwise subject to regulation under this section or section 301(a) or 402 of this Act (except for effluent standards or prohibitions under section 307).
2. Any discharge of dredged or fill material into the navigable waters incidental to any activity having as its purpose bringing an area of the navigable waters into a use to which it was not previously subject, where the flow or circulation of navigable waters may be impaired or the reach of such waters be reduced, shall be required to have a permit under this section.

G.

1. The Governor of any State desiring to administer its own individual and general permit program for the discharge of dredged or fill material into the navigable waters (other than those waters which are presently used, or are susceptible to use in their natural condition or by reasonable improvement as a means to transport interstate or foreign commerce

shoreward to their ordinary high water mark, including all waters which are subject to the ebb and flow of the tide shoreward to their mean high water mark, or mean higher high water mark on the west coast, including wetlands adjacent thereto), within its jurisdiction may submit to the Administrator a full and complete description of the program it proposes to establish and administer under State law or under an interstate compact. In addition, such State shall submit a statement from the attorney general (or the attorney for those State agencies which have independent legal counsel), or from the chief legal officer in the case of an interstate agency, that the laws of such State, or the interstate compact, as the case may be, provide adequate authority to carry out the described program.

2. Not later than the tenth day after the date of the receipt of the program and statement submitted by any State under paragraph (1) of this subsection, the Administrator shall provide copies of such program and statement to the Secretary and the Secretary of the Interior, acting through the Director of the United States Fish and Wildlife Service.
3. No later than the ninetieth day after the date of the receipt by the Administrator of the program and statement submitted by any State, under paragraph (1) of this subsection, the Secretary and the Secretary of the Interior, acting through the Director of the United States Fish and Wildlife Service, shall submit any comments with respect to such program and statement to the Administrator in writing.

H.

1. Not later than the one-hundred-twentieth day after the date of the receipt by the Administrator of a program and statement submitted by any State under paragraph (1) of this subsection, the Administrator shall determine, taking into account any comments submitted by the Secretary and the Secretary of the Interior, acting through the Director of the United States Fish and Wildlife Service, pursuant to subsection (g) of this section, whether such State has the following authority with respect to the issuance of permits pursuant to such program:
 - a. To issue permits which -
 - i. apply, and assure compliance with, any applicable requirements of this section, including, but not limited to, the guidelines established under subsection (b)(1) of this section, and sections 307 and 403 of this Act;
 - ii. are for fixed terms not exceeding five years; and
 - iii. can be terminated or modified for cause including, but not limited to, the following:
 - I. violation of any condition of the permit;
 - II. obtaining a permit by misrepresentation, or failure to disclose fully all relevant facts;
 - III. change in any condition that requires either a temporary or permanent reduction or elimination of the permitted discharge.

- b.** To issue permits which apply, and assure compliance with, all applicable requirements of section 308 of this Act, or to inspect, monitor, enter, and require reports to at least the same extent as required in section 308 of this Act.
 - c.** To assure that the public, and any other State the waters of which may be affected, receive notice of each application for a permit and to provide an opportunity for public hearing before a ruling on each such application.
 - d.** To assure that the Administrator receives notice of each application (including a copy thereof) for a permit.
 - e.** To assure that any State (other than the permitting State), whose waters may be affected by the issuance of a permit may submit written recommendation to the permitting State (and the Administrator) with respect to any permit application and, if any part of such written recommendations are not accepted by the permitting State, that the permitting State will notify such affected State (and the Administrator) in writing of its failure to so accept such recommendations together with its reasons for so doing.
 - f.** To assure that no permit will be issued if, in the judgement of the Secretary, after consultation with the Secretary of the department in which the Coast Guard is operating, anchorage and navigation of any of the navigable waters would be substantially impaired thereby.
 - g.** To abate violations of the permit or the permit program, including civil and criminal penalties and other ways and means of enforcement.
 - h.** To assure continued coordination with Federal and Federal-State water-related planning and review processes.
2. If, with respect to a State program submitted under subsection (g)(1) of this section, the Administrator determines that such State -
- A.** has the authority set forth in paragraph (1) of this subsection, the Administrator shall approve the program and so notify (i) such State, and (ii) the Secretary, who upon subsequent notification from such State that it is administering such program, shall suspend the issuance of permits under subsections (a) and (e) of this section for activities with respect to which a permit may be issued pursuant to such State program; or
 - B.** does not have the authority set forth in paragraph (1) of this subsection, the Administrator shall so notify such State, which notification shall also describe the revisions or modifications necessary so that such State may resubmit such program for a determination by the Administrator under this subsection.
3. If the Administrator fails to make a determination with respect to any program submitted by a State under subsection (g)(1) of this section within one-hundred-twenty days after the date of the receipt of such program, such program shall be deemed approved pursuant to paragraph (2)(A) of

this subsection and the Administrator shall so notify such State and the Secretary who, upon subsequent notification from such State that it is administering such program, shall suspend the issuance of permits under subsection (a) and (e) of this section for activities with respect to which a permit may be issued by such State.

4. After the Secretary receives notification from the Administrator under paragraph (2) or (3) of this subsection that a State permit program has been approved, the Secretary shall transfer any applications for permits pending before the Secretary for activities with respect to which a permit may be issued pursuant to such State program to such State for appropriate action.
 5. Upon notification from a State with a permit program approved under this subsection that such State intends to administer and enforce the terms and conditions of a general permit issued by the Secretary under subsection (e) of this section with respect to activities in such State to which such general permit applies, the Secretary shall suspend the administration and enforcement of such general permit with respect to such activities.
- I. Whenever the Administrator determines after public hearing that a State is not administering a program approved under section (h)(2)(A) of this section, in accordance with this section, including, but not limited to, the guidelines established under subsection (b)(1) of this section, the Administrator shall so notify the State, and, if appropriate corrective action is not taken within a reasonable time, not to exceed ninety days after the date of the receipt of such notification, the Administrator shall:
1. withdraw approval of such program until the Administrator determines such corrective action has been taken, and
 2. notify the Secretary that the Secretary shall resume the programs for the issuance of permits under subsection (a) and (e) of this section for activities with respect to which the State was issuing permits and that such authority of the Secretary shall continue in effect until such time as the Administrator makes the determination described in clause (1) of this subsection and such State again has an approved program.
- J. Each State which is administering a permit program pursuant to this section shall transmit to the Administrator
1. a copy of each permit application received by such State and provide notice to the Administrator of every action related to the consideration of such permit application, including each permit proposed to be issued by such State, and
 2. a copy of each proposed general permit which such State intends to issue. Not later than the tenth day after the date of the receipt of such permit application or such proposed general permit, the Administrator shall provide copies of such permit application or such proposed general permit to the Secretary and the Secretary of the Interior, acting through the Director of the United States Fish and Wildlife Service. If the Administrator intends to provide written comments to such State with respect to such permit application or such proposed general permit, he

shall so notify such State not later than the thirtieth day after the date of the receipt of such application or such proposed general permit and provide such written comments to such State, after consideration of any comments made in writing with respect to such application or such proposed general permit by the Secretary and the Secretary of the Interior, acting through the Director of the United States Fish and Wildlife Service, not later than the ninetieth day after the date of such receipt. If such State is so notified by the Administrator, it shall not issue the proposed permit until after the receipt of such comments from the Administrator, or after such ninetieth day, whichever first occurs. Such State shall not issue such proposed permit after such ninetieth day if it has received such written comments in which the Administrator objects (A) to the issuance of such proposed permit and such proposed permit is one that has been submitted to the Administrator pursuant to subsection (h)(1)(E), or (B) to the issuance of such proposed permit as being outside the requirements of this section, including, but not limited to, the guidelines developed under subsection (b)(1) of this section unless it modified such proposed permit in accordance with such comments. Whenever the Administrator objects to the issuance of a permit under the preceding sentence such written objection shall contain a statement of the reasons for such objection and the conditions which such permit would include if it were issued by the Administrator. In any case where the Administrator objects to the issuance of a permit, on request of the State, a public hearing shall be held by the Administrator on such objection. If the State does not resubmit such permit revised to meet such objection within 30 days after completion of the hearing or, if no hearing is requested within 90 days after the date of such objection, the Secretary may issue the permit pursuant to subsection (a) or (e) of this section, as the cause may be, for such source in accordance with the guidelines and requirements of this Act.

- K. In accordance with guidelines promulgated pursuant to subsection (i)(2) of section 304 of this Act, the Administrator is authorized to waive the requirements of subsection (j) of this section at the time of the approval of a program pursuant to subsection (h)(2)(A) of this section or any category (including any class, type, or size within such category) of discharge within the State submitting such program.
- L. The Administrator shall promulgate regulations establishing categories of discharges which he determines shall not be subject to the requirements of subsection (j) of this section in any State with a program approved pursuant to subsection (h)(2)(A) of this section. The Administrator may distinguish among classes, types, and sizes within any category of discharges.
- M. Not later than the ninetieth day after the date on which the Secretary notifies the Secretary of the Interior, acting through the Director of the United States Fish and Wildlife Service that
 - 1. an application for a permit under subsection (a) of this section has been received by the Secretary, or
 - 2. the Secretary proposes to issue a general permit under subsection (e) of this section, the Secretary of the Interior, acting through the Director of the

United States Fish and Wildlife Service, shall submit any comments with respect to such application or such proposed general permit in writing to the Secretary.

- N. Nothing in this section shall be construed to limit the authority of the Administrator to take action pursuant to section 309 of this Act.
- O. A copy of each permit application and each permit issued under this section shall be available to the public. Such permit application or portion thereof, shall further be available on request for the purpose of reproduction.
- P. Compliance with a permit issued pursuant to this section, including any activity carried out pursuant to a general permit issued under this section, shall be deemed compliance, for purposes of sections 309 and 505, with sections 301, 307, and 403.
- Q. Not later than the one-hundred-eightieth day after the date of enactment of this subsection, the Secretary shall enter into agreements with the Administrator, the Secretaries of the Departments of Agriculture, Commerce, Interior, and Transportation, and the heads of other appropriate Federal agencies to minimize, to the maximum extent practicable, duplication, needless paperwork, and delays in the issuance of permits under this section. Such agreements shall be developed to assure that, to the maximum extent practicable, a decision with respect to an application for a permit under subsection (a) of this section will be made not later than the ninetieth day after the date the notice of such application is published under subsection (a) of this section.
- R. The discharge of dredged or fill material as part of the construction of a Federal project specifically authorized by Congress, whether prior to or on or after the date of enactment of his subsection, is not prohibited by or otherwise subject to regulation under this section, or a State program approved under this section, or section 301(a) or 402 of the Act (except for effluent standards or prohibitions under section 307), if information on the effects of such discharge, including consideration of the guidelines developed under subsection (b)(1) of this section, is included in an environmental impact statement for such project pursuant to the National Environmental Policy Act of 1969 and such environmental impact statement has been submitted to Congress before the actual discharge of dredged or fill material in connection with the construction of such project and prior to either authorization of such project or an appropriation of funds for each construction.
- S.
 - 1. Whenever on the basis of any information available to him the Secretary finds that any person is in violation of any condition or limitation set forth in a permit issued by the Secretary under this section, the Secretary shall issue an order requiring such persons to comply with such condition or limitation, or the Secretary shall bring a civil action in accordance with paragraph (3) of this subsection.
 - 2. A copy of any order issued under this subsection shall be sent immediately by the Secretary to the State in which the violation occurs and other affected States. Any order issued under this subsection shall be by personal service and shall state with reasonable specificity the nature of

the violation, specify a time for compliance, not to exceed thirty days, which the Secretary determines is reasonable, taking into account the seriousness of the violation and any good faith efforts to comply with applicable requirements. In any case in which an order under this subsection is issued to a corporation, a copy of such order shall be served on any appropriate corporate officers.

3. The Secretary is authorized to commence a civil action for appropriate relief, including a permanent or temporary injunction for any violation for which he is authorized to issue a compliance order under paragraph (1) of this subsection. Any action under this paragraph may be brought in the district court of the United States for the district in which the defendant is located or resides or is doing business, and such court shall have jurisdiction to restrain such violation and to require compliance. Notice of the commencement of such action shall be given immediately to the appropriate State.
4.
 - Any person who willfully or negligently violates any condition or limitation in a permit issued by the Secretary under this section shall be punished by a fine of not less than \$2,500 nor more than \$25,000 per day of violation, or by imprisonment for not more than one year, or by both. If the conviction is for a violation committed after a first conviction of such person under this paragraph, punishment shall be by fine of not more than \$50,000 per day of violation, or by imprisonment for not more than two years, or by both.
 - A. For the purposes of this paragraph, the term "person" shall mean, in addition to the definition contained in section 502(5) of this Act, any responsible corporate officer.
5. Any person who violates any condition or limitation in a permit issued by the Secretary under this section, and any person who violates any order issued by the Secretary under paragraph (1) of this subsection, shall be subject to a civil penalty not to exceed \$10,000 per day of such violation.
- T. Nothing in this section shall preclude or deny the right of any State or interstate agency to control the discharge of dredged or fill material in any portion of the navigable waters within the jurisdiction of such State, including any activity of any Federal agency, and each such agency shall comply with such State or interstate requirements both substantive and procedural to control the discharge of dredged or fill material to the same extent that any person is subject to such requirements. This section shall not be construed as affecting or impairing the authority of the Secretary to maintain navigation.

Eric,

More than likely some portion of the bridge demolition will require Section 404 of the Clean Water Act permitting. Possible issues associated with the existing bridge demolition requiring Section 404 of the Clean Water Act any discharge of fill material such as the construction of temporary work platforms for equipment, temporary isolation/diversion of portions of the river, and the discharge of bridge debris into the river. At this point, without knowing the details of the dropping of the bridge structure into the river, it is difficult to determine whether or not it is permissible from an environmental or public interest standpoint. Especially when considering that there may be less environmentally damaging practicable alternatives, some possible options to evaluate would be dropping it on a barge, piecing it out, etc...

Jeffrey L. Breckenridge, P.E.
Regulatory Project Manager
South Dakota Regulatory Office

-----Original Message-----

From: Stasch, Eric D NWO
Sent: Friday, April 18, 2014 12:51 PM
To: Breckenridge, Jeff L NWO
Subject: FW: US14/US83/SD34 Over Missouri River - Demo of Existing Bridge (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Is there any Regulatory issues I need to include in a response to this??

-----Original Message-----

From: Barker, Kevin [<mailto:kevin.barker@urs.com>]
Sent: Friday, April 18, 2014 11:58 AM
To: Stasch, Eric D NWO
Cc: Costello, Donald; Osberg, Carl
Subject: [EXTERNAL] US14/US83/SD34 Over Missouri River - Demo of Existing Bridge

Mr. Stasch:

URS is developing the conceptual means and methods for the removal of the existing US14/US83/SD34 over the Missouri River between Pierre and Fort Pierre. We are initiating contact to discuss the ACOE requirements for the bridge removal.

We have had discussions with the Coast Guard regarding removal of the existing bridge and they have indicated that dropping the structure into the water is acceptable to them. There will be a requirement to provide a 150' wide cleared channel within 24 hours. Is this alternative acceptable to the ACOE? Will the Coast Guard requirements be sufficient or will there be additional requirements or limitations, such as time of year, this activity could be performed?