

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 06120012 Date 5-18-12 Initials CW/RAT Region (A B C D) Brookings Co
 Site _____ Location 466 Arc, 3 mi S, 1 mi E of SW corner of Estelle Ave
 $Q_{100} = Q_2 = 3920$ by: drainage area ratio _____ flood freq. anal. _____ regional regression eq.
 Bridge discharge (Q_2) = 3920 (should be Q_{100} unless there is a relief bridge, road overflow, or bridge overtopping)

Analytical Procedure for Estimating Hydraulic Variables Needed to Apply Method

Bridge Width = 245 ft. Flow angle at bridge = 60 ° Abut. Skew = 0 ° Effective Skew = 60 °
 Width (W_2) iteration = _____
 Avg. flow depth at bridge, y_2 iteration = _____

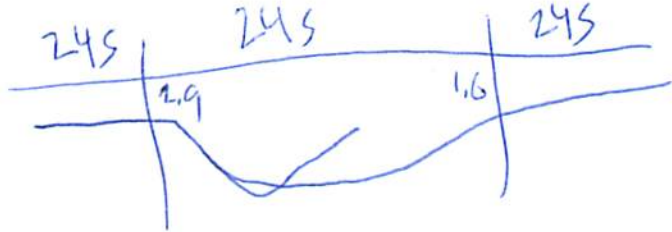
Corrected channel width at bridge Section = W_2 times cos of flow angle = 122.6 ft* $q_2 = Q_2/W_2 = 32$ ft²/s

Bridge Vel, $V_2 = 4$ ft/s Final $y_2 = q_2/V_2 = 8$ ft $\Delta h = 0.3$ ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2 = 8.3$ ft

* NOTE: repeat above calculations until y_2 changes by less than 0.2 Effective pier width = $L \sin(q) + a \cos(q)$
 If y_2 is above LS, then account for Road Overflow using PRGM: RDOVREGA, RDOVREGB, RDOVREGC, or RDOVREGD.

Water Surface Elev. = 1 ft
 Low Steel Elev. = 9.2 ft -2.9 13 14.1
 n (Channel) = 0.033 2 -4.9 9.2
 n (LOB) = 0.033
 n (ROB) = 0.033
 Pier Width = 2 ft
 Pier Length = 9.4 ft $3.9 + 4.5 + 1$
 # Piers for 100 yr = 6 ft



CONTRACTION SCOUR

Width of main channel at approach section $W_1 = 245$ ft
 Width of left overbank flow at approach, $W_{lob} = 245$ ft Average left overbank flow depth, $y_{lob} = 2.9$ ft
 Width of right overbank flow at approach, $W_{rob} = 245$ ft Average right overbank flow depth, $y_{rob} = 1.6$ ft

Live Bed Contraction Scour (use if bed material is small cobbles or finer)

$x = 14.78$ From Figure 9 W_2 (effective) = 110.5 ft $y_{cs} = 14.7$ ft

Clear Water Contraction Scour (use if bed material is larger than small cobbles)

Estimated bed material $D_{50} =$ _____ ft Average approach velocity, $V_1 = Q_{100}/(y_1 W_1) =$ _____ ft/s

Critical approach velocity, $V_c = 11.17 y_1^{1/6} D_{50}^{1/3} =$ _____ ft/s

If $V_1 < V_c$ and $D_{50} \geq 0.2$ ft, use clear water equation below, otherwise use live bed scour equation above.

$D_{c50} = 0.0006 (q_2/y_1)^{7/6} =$ _____ ft If $D_{50} \geq D_{c50}$, $\chi = 0.0$

Otherwise, $\chi = 0.122 y_1 [q_2 / (D_{50}^{1/3} y_1^{7/6})]^{6/7} - y_1 =$ _____ From Figure 10, $y_{cs} =$ _____ ft

PIER SCOUR CALCULATIONS

L/a ratio = 4.7 Correction factor for flow angle of attack (from Table 1), $K_2 = 2.7$
 Froude # at bridge = 0.25 Using pier width a on Figure 11, $\xi = 4$ Pier scour $y_{ps} = 17.5$ ft

ABUTMENT SCOUR CALCULATIONS

Average flow depth blocked by: left abutment, $y_{aLT} = 2.9$ ft right abutment, $y_{aRT} = 1.6$ ft
 Shape coefficient $K_1 = 1.00$ for vertical-wall, 0.82 for vertical-wall with wingwalls, 0.55 for spill-through
 Using values for y_{aLT} and y_{aRT} on figure 12, $\psi_{LT} = 11.3$ and $\psi_{RT} = 1.6$
 Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55) = 11.3$ ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55) = 6.6$ ft

PRGM: "RegionA", "RegionB", "RegionC", or "RegionD"

PRGM: Contract

PRGM: CWCNEW

PRGM: Pier

PRGM: Abutment

SCOUR ANALYSIS AND REPORTING FORM

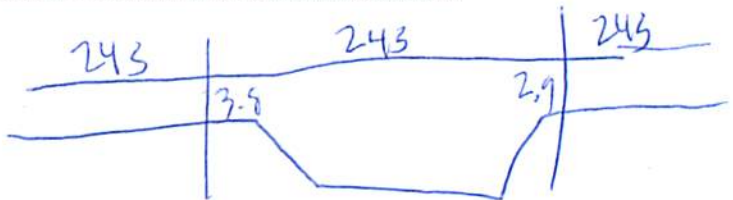
Bridge Structure No. 06120012 Date _____ Initials _____ Region (A B C D) D
 Site _____ Location 466 Ave, 3 mi S, 1 mi E of SW corner of Estelline
 $Q_{500} = Q_{10}$ 6250 by: drainage area ratio _____ flood freq. anal. _____ regional regression eq.
 Bridge discharge (Q_2) = 5207 (should be Q_{500} unless there is a relief bridge, road overflow, or bridge overtopping)

Analytical Procedure for Estimating Hydraulic Variables Needed to Apply Method

Bridge Width = 245 ft. Flow angle at bridge = 50 ° Abut. Skew = 0 ° Effective Skew = 50 °
 Width (W_2) iteration = _____
 Avg. flow depth at bridge, y_2 iteration = _____
 Corrected channel width at bridge Section = W_2 times cos of flow angle = 122.5 ft* $q_2 = Q_2/W_2 = \frac{5207}{245} = 21.25$ ft²/s
 Bridge Vel, $V_2 = \frac{5207}{245 \times 4.6} = 9.2$ ft/s Final $y_2 = q_2/V_2 = \frac{21.25}{9.2} = 2.3$ ft $\Delta h = 10.9$ ft
 Average main channel depth at approach section, $y_1 = \Delta h + y_2 = 10.9 + 2.3 = 13.2$ ft

* NOTE: repeat above calculations until y_2 changes by less than 0.2 Effective pier width = $L \sin(\alpha) + a \cos(\alpha)$
 If y_2 is above LS, then account for Road Overflow using PRGM: RDOVREGA, RDOVREGB, RDOVREGC, or RDOVREGD.

Water Surface Elev. = 1 ft
 Low Steel Elev. = 9.2 ft
 n (Channel) = 0.033
 n (LOB) = 0.033
 n (ROB) = 0.035
 Pier Width = 2 ft
 Pier Length = 9.9 ft
 # Piers for 500 yr = 6 ft



CONTRACTION SCOUR

Width of main channel at approach section $W_1 = 245$ ft
 Width of left overbank flow at approach, $W_{lob} = 245$ ft Average left overbank flow depth, $y_{lob} = 3.8$ ft
 Width of right overbank flow at approach, $W_{rob} = 245$ ft Average right overbank flow depth, $y_{rob} = 2.9$ ft

Live Bed Contraction Scour (use if bed material is small cobbles or finer)

$x = 19.32$ From Figure 9 W_2 (effective) = 110.5 ft $y_{cs} = 17.3$ ft

Clear Water Contraction Scour (use if bed material is larger than small cobbles)

Estimated bed material $D_{50} =$ _____ ft Average approach velocity, $V_1 = Q_{500}/(y_1 W_1) =$ _____ ft/s

Critical approach velocity, $V_c = 11.17 y_1^{1/6} D_{50}^{1/3} =$ _____ ft/s

If $V_1 < V_c$ and $D_{50} > 0.2$ ft, use clear water equation below, otherwise use live bed scour equation above.

$D_{c50} = 0.0006 (q_2 / y_1^{7/6})^3 =$ _____ ft If $D_{50} > D_{c50}$, $\chi = 0.0$

Otherwise, $\chi = 0.122 y_1 [q_2 / (D_{50}^{1/3} y_1^{7/6})]^{6/7} - y_1 =$ _____ From Figure 10, $y_{cs} =$ _____ ft

PIER SCOUR CALCULATIONS

L/a ratio = 4.7 Correction factor for flow angle of attack (from Table 1), $K_2 = 2.7$
 Froude # at bridge = 0.27 Using pier width a on Figure 11, $\xi = 8$ Pier scour $y_{ps} = 17.7$ ft

ABUTMENT SCOUR CALCULATIONS

Average flow depth blocked by: left abutment, $y_{aLT} = 3.8$ ft right abutment, $y_{aRT} = 2.9$ ft
 Shape coefficient $K_1 = 1.00$ for vertical-wall, 0.82 for vertical-wall with wingwalls, 0.55 for spill-through

Using values for y_{aLT} and y_{aRT} on figure 12, $\psi_{LT} = 12.9$ and $\psi_{RT} = 11.3$
 Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55) = 12.9$ ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55) = 11.3$ ft

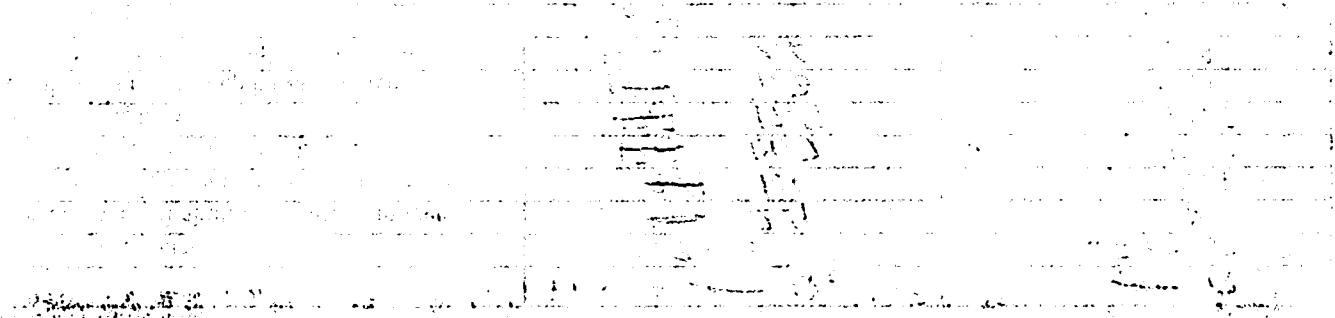
PGRM: "RegionA", "RegionB", "RegionC", or "RegionD"

PGRM: Contract

PGRM: CWCSNEW

PGRM: Pie

PGRM: Abutment



This drawing illustrates the detailed construction of the component shown above. It includes a series of dimensions and annotations that define the geometry and tolerances of the part. The text is arranged in a structured manner, likely corresponding to a technical specification or a set of manufacturing instructions.

The following text provides further details regarding the material specifications, surface treatments, and assembly requirements for this component. It is essential for ensuring the part's performance and longevity in its intended application.

Additional notes and clarifications are provided to address any potential ambiguities in the drawing. These notes are crucial for the manufacturing process and for the proper installation and use of the component.

The drawing is a technical representation of a physical object, and its accuracy is paramount. Any deviations from the specified dimensions or materials could result in a component that does not function as intended.

In conclusion, this technical drawing and its associated text provide a comprehensive guide for the production and use of the component. It is a key document in the engineering and manufacturing process.

Route 466 Ave Stream Big Sioux River MRM _____ Date _____ Initials _____
 Bridge Structure No. 06120012 Location 466 Ave, 3mi S + 1mi E of SW corner Estelline
 GPS coordinates: N 440 31' 49.61" taken from: USL abutment centerline of ft MRM end
W 9160 53" 20.24" Datum of coordinates: WGS84 NAD27

Drainage area = 1484 sq. mi.
 The average bottom of the main channel was 141 ft below top of guardrail at a point 112 ft from left abutment.
 Method used to determine flood flows: ___ Freq. Anal. ___ drainage area ratio regional regression equations.

MISCELLANEOUS CONSIDERATIONS

Flows	$Q_{100} = Q_5 = 3920$			$Q_{500} = Q_{10} = 6280$		
Estimated flow passing through bridge	<u>3920</u>			<u>5207</u>		
Estimated road overflow & overtopping				<u>1093</u>		
Consideration	Yes	No	Possibly	Yes	No	Possibly
Chance of overtopping		X				X
Chance of Pressure flow		X		X		
Armored appearance to channel		X			X	
Lateral instability of channel		X			X	

5/13
 2 | 1480
 5 | 3920
 10 | 6280
 25 | 10200
 50 | 13700
 100 | 17800
 500 | 29000

Riprap at abutments? ___ Yes ___ No Marginal *- on right bank - yes*
 Evidence of past Scour? Yes ___ No ___ Don't know *- left - no*
 Debris Potential? ___ High ___ Med Low *- pier continued*

Does scour countermeasure(s) appear to have been designed?
 Riprap ___ Yes No ___ Don't know ___ NA
 Spur Dike ___ Yes No ___ Don't know ___ NA
 Other ___ Yes No ___ Don't know ___ NA

Bed Material Classification Based on Median Particle Size (D_{50})

Material Silt/Clay Sand ___ Gravel ___ Cobbles ___ Boulders ___
 Size range, in mm <0.062 0.062-2.00 2.00-64 64-250 >250

Comments, Diagrams & orientation of digital photos
 2337 Str. no.
 2338 approach from bridge
 2339 ROB from bridge
 2340 LOB from bridge
 2341 Bridge from approach

2342 bridge from rt. abutment
 2343 bridge from approach

Summary of Results

	$Q_{100} Q_5$	$Q_{500} Q_{10}$
Bridge flow evaluated	<u>3920</u>	<u>5207</u>
Flow depth at left abutment (yaLT), in feet	<u>2.9</u>	<u>3.9</u>
Flow depth at right abutment (yaRT), in feet	<u>1.6</u>	<u>2.9</u>
Contraction scour depth (yca), in feet	<u>14.7</u>	<u>17.3</u>
Pier scour depth (ypp), in feet	<u>17.5</u>	<u>17.7</u>
Left abutment scour depth (yas), in feet	<u>11.3</u>	<u>12.9</u>
Right abutment scour depth (yars), in feet	<u>6.6</u>	<u>11.3</u>
Flow angle of attack	<u>60°</u>	<u>60°</u>

See Comments/Diagram for justification where required