OK RT

Check

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 34241218 Date 6/9/17 Initials RaT Region (A B C D) 4 2516 Maxine II Road

Site _____ Location 1.2 mi N of Yankton/Bon Homme Co. Line

Q_{100} = 131000 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 131000 (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

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

Bridge Width = 345 ft. Flow angle at bridge = 10 ° Abut. Skew = 0 ° Effective Skew = 10 °

Width (W_2) iteration = _____ _____ _____ _____

Avg. flow depth at bridge, y_2 iteration = _____ _____ _____ _____

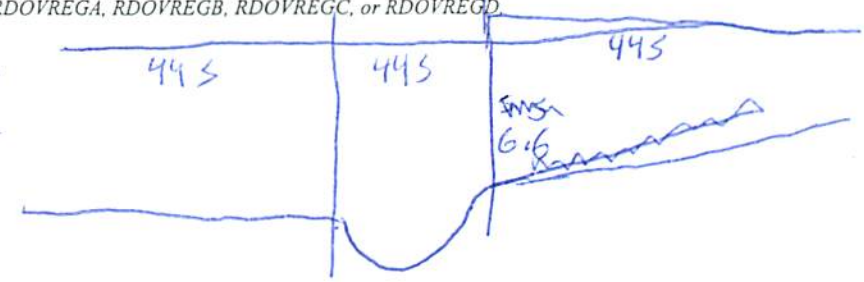
Corrected channel width at bridge Section = W_2 times cos of flow angle = 438.24 ft* $q_2 = Q_2/W_2$ = 298.9 ft²/s

Bridge Vel, V_2 = 12.3 ft/s Final $y_2 = q_2/V_2$ = 24.4 ft Δh = 3.1 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 27.5 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. = UNK ft

Low Steel Elev. = 26.4 ft see last page. 33.9 − 7.5 = 26.4

n (Channel) = 0.035

n (LOB) = 0.025

n (ROB) = 0.035

Pier Width = 2.6 ft 4.1 circular

Pier Length = 2.6 ft

Piers for 100 yr = 4 ft 8.2 / 11

CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 445 ft

Width of left overbank flow at approach, W_{lob} = 445 ft Average left overbank flow depth, y_{lob} = 13.1 ft

Width of right overbank flow at approach, W_{rob} = 445 ft Average right overbank flow depth, y_{rob} = ~~6.6~~ ft

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

x = 15.39 From Figure 9 W_2 (effective) = 427.8 ft y_{cs} = 15.2 ft

PGRM: CWCSNEW

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, $Vc = 11.17 y_1^{1/6} D_{50}^{1/3}$ = _____ 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

PGRM: Pier

L/a ratio = 1 Correction factor for flow angle of attack (from Table 1), K2 = 1

Froude # at bridge = 0.44 Using pier width a on Figure 11, ξ = 9.8 Pier scour y_{ps} = 8.6 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 13.1 ft right abutment, y_{aRT} = 6.6 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, ψ_{LT} = 23.9 and ψ_{RT} = 17.9

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 23.9 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 17.9 ft

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 34241218 Date 6/9/17 Initials RAT Region (A B (C) D)

Site _____ Location 1.2 Mi North of Yankton/Bon Homme County Line

Q_{500} = 252000 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 153942 (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 = 445 ft. Flow angle at bridge = 10 ° Abut. Skew = 0 ° Effective Skew = 10 °

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 = 438.24 ft* $q_2 = Q_2/W_2$ = 351 ft^2/s

Bridge Vel, V_2 = 13.3 ft/s Final $y_2 = q_2/V_2$ = 26.4 ft Δh = 3.6 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 30 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,

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

Water Surface Elev. = wsk ft

Low Steel Elev. = 26.4 ft

n (Channel) = 0.035

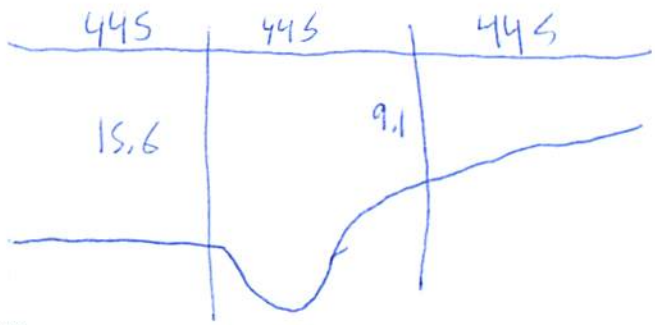
n (LOB) = 0.025

n (ROB) = 0.035

Pier Width = 2.6 ft

Pier Length = 2.6 ft

Piers for 500 yr = 4 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 445 ft

Width of left overbank flow at approach, W_{lob} = 445 ft Average left overbank flow depth, y_{lob} = 15.6 ft

Width of right overbank flow at approach, W_{rob} = 445 ft Average right overbank flow depth, y_{rob} = 9.1 ft

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

x = 20.17 From Figure 9 W_2 (effective) = 427.8 ft y_{cs} = 17.9 ft

PGRM: CWCSNEW

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, $Vc = 11.17 y_1^{1/6} D_{50}^{1/3}$ = _____ 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

PGRM: Pier

PIER SCOUR CALCULATIONS

L/a ratio = 1 Correction factor for flow angle of attack (from Table 1), K2 = 1

Froude # at bridge = 0.46 Using pier width a on Figure 11, ξ = 9.8 Pier scour y_{ps} = 8.7 ft

PGRM: Abutment

ABUTMENT SCOUR CALCULATIONS

Average flow depth blocked by: left abutment, y_{aLT} = 15.6 ft right abutment, y_{aRT} = 9.1 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, ψ_{LT} = 26 and ψ_{RT} = 20.6

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 26 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 20.6 ft

43.1EC
97.6315

Route _____ Stream James River MRM _____ Date 6/9/12 Initials RAT

Bridge Structure No. _____ Location _____

GPS coordinates: N 43° 11' 09.3" W 97° 35 [illegible] 4,1" taken from: USL abutment X centerline of ⇑ MRM end _____

Datum of coordinates: WGS84 X NAD27 _____

Drainage area = 18613.76 sq. mi.

The average bottom of the main channel was 33.9 ft below top of guardrail at a point 350 ft from left abutment.

Method used to determine flood flows: ____Freq. Anal. ____drainage area ratio X regional regression equations.

MISCELLANEOUS CONSIDERATIONS

Flows	Q_{100} = 103000			Q_{500} = 252000		
Estimated flow passing through bridge	103000			153842		
Estimated road overflow & overtopping	0			98158		
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	

5/22

2	967
5	6160
10	15100
25	37403
50	64500
100	103000
500	252000

Riprap at abutments? ____Yes ____No X Marginal on left abutment only

Evidence of past Scour? X Yes ____No ____Don't know contraction pier

Debris Potential? ____High ____Med X Low

5/24

2	1680
5	8726
10	20200
25	48300
50	82408
100	131000
500	324000

Does scour countermeasure(s) appear to have been designed?

Riprap	____Yes	X No	____Don't know	____NA
Spur Dike	____Yes	X No	____Don't know	____NA
Other _____	____Yes	X No	____Don't know	____NA

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

Material	Silt/Clay X	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

1). right OB
2). main channel
3). left OB
4). piers
5). pier scour
6). right abutment
7-8) left abutment
9). right abutment
10). main channel

Note: Bridge is sloped on a hill. measured low steel from bridge deptn. ~~With the~~ A better estimate of the depth should be made but I am to uncomfortable doing so with the high winds, height of the bridge and amount of traffic.

Summary of Results

	Q100	Q500
Bridge flow evaluated	103000	153842
Flow depth at left abutment (yaLT), in feet	13.1	15.6
Flow depth at right abutment (yaRT), in feet	6.6	9.1
Contraction scour depth (ycs), in feet	15.2	17.8
Pier scour depth (yps), in feet	8.6	8.7
Left abutment scour depth (yas), in feet	23.9	26
Right abutment scour depth (yas), in feet	17.9	20.6
1Flow angle of attack	10	0

See Comments/Diagram for justification where required