OK RT

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 12216030 Date 6/11/12 Initials RaT Region (A B C D) 6

Site _____ Location 4.4 mi N & 1.4 mi W of Platte on 271 St

Q_{100} = Qpe 1060 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = _____ (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 = 67 ft. Flow angle at bridge = 15 ° Abut. Skew = 0 ° Effective Skew = 15 °

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 = 64.72 ft* $q_2 = Q_2/W_2$ = 16.4 ft^2/s

Bridge Vel, V_2 = 2.9 ft/s Final $y_2 = q_2/V_2$ = 5.7 ft Δh = 0.2 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 5.9 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. = 0-0.2 ft

Low Steel Elev. = 6.9 ft

n (Channel) = 0.045

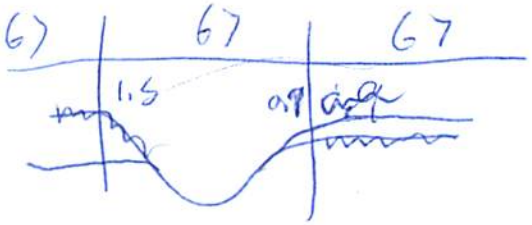
n (LOB) = 0.030

n (ROB) = 0.030

Pier Width = 1.35 ft

Pier Length = 1.35 ft

Piers for 100 yr = 3 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 67 ft

Width of left overbank flow at approach, W_{lob} = 67 ft Average left overbank flow depth, y_{lob} = 1.5 ft

Width of right overbank flow at approach, W_{rob} = 67 ft Average right overbank flow depth, y_{rob} = 0.9 ft

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

x = 2.04 From Figure 9 W_2 (effective) = 60.7 ft y_{cs} = 2.6 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 = 0.21 Using pier width a on Figure 11, ξ = 6 Pier scour y_{ps} = 4.7 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 1.5 ft right abutment, y_{aRT} = 0.9 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, ψ_{LT} = ≈ 6.3 and ψ_{RT} = 3.9

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 6.3 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 3.9 ft

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 12216030 Date 6/11/17 Initials FAT Region (A B C D)

Site _____ Location 4.4 mi N & 1.4 mi W of Platte

Q_{500} = Q25 2150 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 1502 (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 = 67 ft. Flow angle at bridge = 15 ° Abut. Skew = 0 ° Effective Skew = 15 °

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 = 64.72 ft* $q_2 = Q_2/W_2$ = 23.2 ft^2/s

Bridge Vel, V_2 = 3.4 ft/s Final $y_2 = q_2/V_2$ = 6.8 ft Δh = 0.2 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 7 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. = 6-0.2 ft

Low Steel Elev. = 6.9 ft

n (Channel) = 0.045

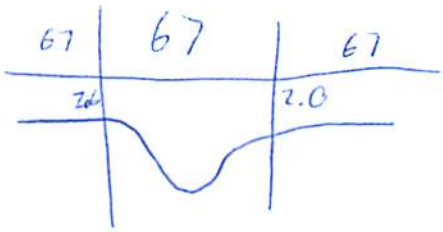
n (LOB) = 0.030

n (ROB) = 0.030

Pier Width = 1.35 ft

Pier Length = 1.35 ft

Piers for 500 yr = 3 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 67 ft

Width of left overbank flow at approach, W_{lob} = 67 ft Average left overbank flow depth, y_{lob} = 2.6 ft

Width of right overbank flow at approach, W_{rob} = 67 ft Average right overbank flow depth, y_{rob} = 2.0 ft

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

x = 4.39 From Figure 9 W_2 (effective) = 60.7 ft y_{cs} = 5 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, $V_1 = Q_{500}/(y_1W_1)$ = _____ ft/s

Critical approach velocity, $Vc = 11.17y_1^{1/6}D_{50}^{1/3}$ = _____ 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, $\chi = 0.122y_1[q_2/(D_{50}^{1/3}y_1^{7/6})]^{6/7} - y_1$ = _____ 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 = 0.23 Using pier width a on Figure 11, ξ = 6 Pier scour y_{ps} = 4.8 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 2.6 ft right abutment, y_{aRT} = 2.0 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} = 10.6 and ψ_{RT} = 8.2

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 10.6 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 8.2 ft

98° 52' 21.144"
43° 27 23.659"

96.87251
43.45658
PS 67

pass
bottom
right

Route 271 St Stream _____ MRM _____ Date 6/11/12 Initials Rat

Bridge Structure No. 12216030 Location 4.4 mi N & 1.4 mi W of Platte

GPS coordinates: N 41° 30' 27.240" W 98° 52' 21.37" taken from: USL abutment X centerline of ⇑ MRM end _____

Datum of coordinates: WGS84 X NAD27 _____

Drainage area = 118.9 sq. mi.

The average bottom of the main channel was 10.6 ft below top of guardrail at a point 22 ft from left abutment.

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

6/4

8/23

2	~~125~~ 126
5	526
10	1060
25	2180
50	3360
100	4900
500	10100

MISCELLANEOUS CONSIDERATIONS Q25

Flows	~~Q100~~ = Q10 1060			Q500 = 2450		
Estimated flow passing through bridge	1060			1502		
Estimated road overflow & overtopping	0			676		
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	

Riprap at abutments? X Yes ____No ____Marginal along left abutment (channel is about 4ft wide flowing directly into left abutment)

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

Debris Potential? ____High ____Med X Low - pier contraction, abutment

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

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

rose quartz on left abutment

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). left OB
2). main channel
3). right OB
4-5) left abutment
6-7). right abutment
8-14) piers
15). Bridge entrance
16. main channel

Summary of Results

	~~Q100~~ Q10	Q500 Q25
Bridge flow evaluated	1060	1502
Flow depth at left abutment (yaLT), in feet	1.5	2.6
Flow depth at right abutment (yaRT), in feet	0.9	2.0
Contraction scour depth (ycs), in feet	2.6	5
Pier scour depth (yps), in feet	~~4.7~~ 4.7	4.8
Left abutment scour depth (yas), in feet	6.3	10.6
Right abutment scour depth (yas), in feet	3.9	6.2
1Flow angle of attack	15	15

See Comments/Diagram for justification where required