ok RJ

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 50129066 Date 6/27/12 Initials RJ Region (A B C D)

Site _____ Location 2.5 mi N of Lyons on 250 St

Q_{100} = Q5 2820 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 2820 (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 = 142 ft. Flow angle at bridge = 25 ° Abut. Skew = 0 ° Effective Skew = 25 °

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 = 128.7 ft* $q_2 = Q_2/W_2$ = 21.9 ft^2/s

Bridge Vel, V_2 = 3.3 ft/s Final $y_2 = q_2/V_2$ = 6.6 ft Δh = 0.2 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 6.8 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. = 071.7 ft

Low Steel Elev. = 7.6 ft

n (Channel) = 0.040

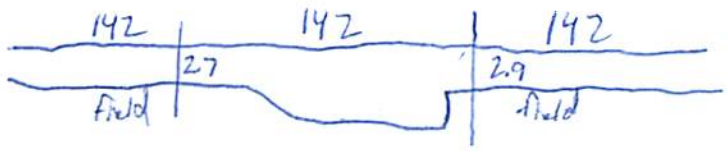
n (LOB) = 0.030

n (ROB) = 0.030

Pier Width = 1.85 ft

Pier Length = 1.85 ft

Piers for 100 yr = 4 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 142 ft

Width of left overbank flow at approach, W_{lob} = 142 ft Average left overbank flow depth, y_{lob} = 2.7 ft

Width of right overbank flow at approach, W_{rob} = 142 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 = 6 From Figure 9 W_2 (effective) = 121.3 ft y_{cs} = 6.7 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

PGRM: Pier

PIER SCOUR CALCULATIONS

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

Froude # at bridge = 0.23 Using pier width a on Figure 11, ξ = 7.5 Pier scour y_{ps} = 6 ft

PGRM: Abutment

ABUTMENT SCOUR CALCULATIONS

Average flow depth blocked by: left abutment, y_{aLT} = 2.7 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, ψ_{LT} = 11 and ψ_{RT} = 11.3

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 11 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 11.3 ft

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 50129060 Date 6/27/12 Initials nJ Region (A B C D)

Site _____ Location 2.5 mi N of Lyons on 250 St

Q_{500} = Q10 4340 by: drainage area ratio ____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 3731 (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

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

Bridge Width = 142 ft. Flow angle at bridge = 25 ° Abut. Skew = 0 ° Effective Skew = 25 °

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 = 128.7 ft* $q_2 = Q_2/W_2$ = 29 ft^2/s

Bridge Vel, V_2 = 3.8 ft/s Final $y_2 = q_2/V_2$ = 7.6 ft Δh = 0.3 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 7.9 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,

Water Surface Elev. = 0-1.7 ft

Low Steel Elev. = ~~7.6~~ 7.6 ft

n (Channel) = ~~0.035~~ 0.040

n (LOB) = ~~0.030~~ 0.030

n (ROB) = 0.030

Pier Width = 1.85 ft

Pier Length = 1.85 ft

Piers for 500 yr = 4 ft

CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 142 ft

Width of left overbank flow at approach, W_{lob} = 142 ft Average left overbank flow depth, y_{lob} = 3.8 ft

Width of right overbank flow at approach, W_{rob} = 142 ft Average right overbank flow depth, y_{rob} = 4.0 ft

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

x = 0.96 From Figure 9 W_2 (effective) = 121.3 ft y_{cs} = 9.9 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 = 0.24 Using pier width a on Figure 11, ξ = 7.5 Pier scour y_{ps} = 6.1 ft

PGRM: Abutment

ABUTMENT SCOUR CALCULATIONS

Average flow depth blocked by: left abutment, y_{aLT} = 3.8 ft right abutment, y_{aRT} = 4.0 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} = 12.9 and ψ_{RT} = 13.3

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 12.9 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 13.3 ft

96° 52' 20.565"
43° 45' 39.852"

96.87235
43.76107

Route 250 St Stream Skunk Ck MRM _____ Date 6/27/12 Initials RAT

Bridge Structure No. 501 24060 Location 2.5 mi N of Lyons on 250 St

GPS coordinates: N 43° 45' 40.6" W 96° 52' 20.5" taken from: USL abutment X centerline of ⇑ MRM end _____

Datum of coordinates: WGS84 X NAD27 _____

Drainage area = 286.19 sq. mi.

The average bottom of the main channel was 11.4 ft below top of guardrail at a point 51 ft from left abutment.

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

MISCELLANEOUS CONSIDERATIONS

Flows	~~Q_{100}~~ = Q_S 2830			Q_{500} = Q_{yo} 4380		
Estimated flow passing through bridge	2830			3731		
Estimated road overflow & overtopping	0			649		
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	

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2	1130
5	2820
10	4380
25	6840
50	9020
100	11400
500	18000

Riprap at abutments? ____Yes X No ____Marginal some abutment, pier & contraction

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

Debris Potential? ____High ____Med X Low

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

Summary of Results

	~~Q100~~ Q_S	~~Q500~~ Q_K
Bridge flow evaluated	2830	3731
Flow depth at left abutment (yaLT), in feet	2.7	3.8
Flow depth at right abutment (yaRT), in feet	2.9	4.0
Contraction scour depth (ycs), in feet	6.7	9.9
Pier scour depth (yps), in feet	6	6.1
Left abutment scour depth (yas), in feet	11	12.9
Right abutment scour depth (yas), in feet	11.3	13.3
1Flow angle of attack	25	25

See Comments/Diagram for justification where required