check pier pic   OK RT

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 42020201 Date 5/25/12 Initials RaT Region (A B (C) D)

Site ____________ Location 9.1 mi S of Lennox on 466 Ave

Q_{100} = 5840 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. ____

Bridge discharge (Q_2) = ____________ (should be Q_{100} unless there is a relief bridge, road overflow, or bridge overtopping)

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

Analytical Procedure for Estimating Hydraulic Variables Needed to Apply Method

Bridge Width = 149 ft. Flow angle at bridge = 0 ° Abut. Skew = 0 ° Effective Skew = 0 °

Width (W_2) iteration = 149 120 125 ____

Avg. flow depth at bridge, y_2 iteration = 8.9 9.8 9.6 ____

Corrected channel width at bridge Section = W_2 times cos of flow angle = 125 ft* $q_2 = Q_2/W_2$ = 46.7 ft^2/s

Bridge Vel, V_2 = 4.8 ft/s Final $y_2 = q_2/V_2$ = 9.6 ft Δh = 0.5 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 10.1 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 ft

Low Steel Elev. = 14.5 ft 19.9 −5.4 14.5

n (Channel) = 0.030

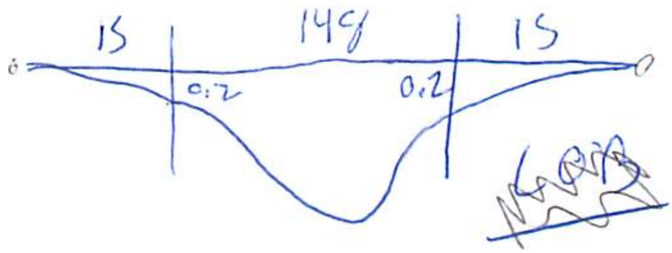
n (LOB) = 0.030

n (ROB) = 0.030

Pier Width = 3 ft circular

Pier Length = 3 ft

\# Piers for 100 yr = 2 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 149 ft

Width of left overbank flow at approach, W_{lob} = 15 ft Average left overbank flow depth, y_{lob} = 0.2 ft

Width of right overbank flow at approach, W_{rob} = 15 ft Average right overbank flow depth, y_{rob} = 0.2 ft

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

x = 2.47 From Figure 9 W_2 (effective) = 119 ft y_{cs} = 3 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, $V_1 = Q_{100}/(y_1W_1)$ = ________ ft/s

Critical approach velocity, $V_c = 11.17y_1^{1/6}D_{50}^{1/3}$ = ________ 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 = 0.27 Using pier width a on Figure 11, ξ = 10.7 Pier scour y_{ps} = 9.8 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 0.2 ft right abutment, y_{aRT} = 0.2 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} = 1 and ψ_{RT} = 1

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 1 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 1 ft

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 42020201 Date 5/25/12 Initials RAL Region (A B (C) D)

Site ________ Location 9.1 mi S of Lennox on 466 Ave

Q_{500} = 11200 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 11200 (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 = 146 ft. Flow angle at bridge = 0 ° Abut. Skew = 0 ° Effective Skew = 0 °

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 = 146 ft* $q_2 = Q_2/W_2$ = 75.7 ft^2/s

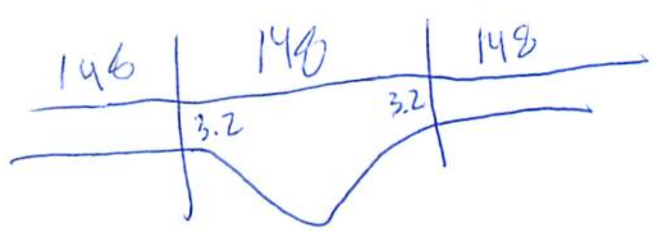
Bridge Vel, V_2 = 6.2 ft/s Final $y_2 = q_2/V_2$ = 12.3 ft Δh = 0.8 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 13.1 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 ft
Low Steel Elev. = 14.6 ft
n (Channel) = 0.030
n (LOB) = 0.030
n (ROB) = 0.030
Pier Width = 3 ft
Pier Length = 3 ft
\# Piers for 500 yr = 2 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 148 ft

Width of left overbank flow at approach, W_{lob} = 146 ft Average left overbank flow depth, y_{lob} = 3.2 ft

Width of right overbank flow at approach, W_{rob} = 144 ft Average right overbank flow depth, y_{rob} = 3.2 ft

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

x = 3.16 From Figure 9 W_2 (effective) = 142 ft y_{cs} = 3.7 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, $V_1 = Q_{500}/(y_1W_1)$ = ________ ft/s

Critical approach velocity, $V_c = 11.17y_1^{1/6}D_{50}^{1/3}$ = ________ 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 = 0.31 Using pier width a on Figure 11, ξ = 10.7 Pier scour y_{ps} = 9 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 3.2 ft right abutment, y_{aRT} = 3.2 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} = 11.9 and ψ_{RT} = 11.9

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 11.9 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 11.9 ft

Route 466 Ave Stream Saddle Ck MRM ________ Date 5/25/12 Initials RaT

Bridge Structure No. 42020201 Location 9.1 mi S of Lennox on 466 Ave

GPS coordinates: N 43° 12' 46.9" W 96° 53' 7.2" taken from: USL abutment X centerline of ⇑ MRM end ____

Datum of coordinates: WGS84 X NAD27 ____

Drainage area = 90.98 sq. mi.

The average bottom of the main channel was 19.6 ft below top of guardrail at a point 80 ft from left abutment.

Method used to determine flood flows: ____ Freq. Anal. ____ drainage area ratio X regional regression equations.

MISCELLANEOUS CONSIDERATIONS

Flows	Q_{100} = 5890			Q_{500} = 11200		
Estimated flow passing through bridge	5840			11200		
Estimated road overflow & overtopping	0			0		
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	

8/24 (crossed out)

2	1060
5	2780
10	4490
25	7420
50	10200
100	13500
500	2350

5/22

2	309
5	909
10	1590
25	2880
50	4190
100	5840
500	11200

Riprap at abutments? ____ Yes ____ No X Marginal

Evidence of past Scour? X Yes ____ No ____ Don't know contraction pier

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 X	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). main channel
2). R. ab
3). piers
4). L ab
5). Lab
6). Pier scour.
7). ROB
8). Main channel
9). ~~LOB~~ Main channel
10). LOB

Summary of Results

	Q100	Q500
Bridge flow evaluated	5840	11200
Flow depth at left abutment (yaLT), in feet	0.2	3.2
Flow depth at right abutment (yaRT), in feet	0.2	3.2
Contraction scour depth (ycs), in feet	3	3.7
Pier scour depth (yps), in feet	6.8	9
Left abutment scour depth (yas), in feet	1	11.9
Right abutment scour depth (yas), in feet	1	11.9
1Flow angle of attack	0	0

See Comments/Diagram for justification where required