Ok RT

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 6411069 Date 5/27/202 Initials rat Region (A B C D)

Site _____ Location 0.6 mi S of HWY 48 on 481 Ave

Q_{100} = 5650 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 5650 (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 = 103 ft. Flow angle at bridge = 5 ° Abut. Skew = 0 ° Effective Skew = 5 °

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 = 102.61 ft* $q_2 = Q_2/W_2$ = 55.1 ft^2/s

Bridge Vel, V_2 = 5.3 ft/s Final $y_2 = q_2/V_2$ = 10.5 ft Δh = 0.6 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 11 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. = 0-4.8 ft

Low Steel Elev. = 11.6 ft

n (Channel) = 0.050

n (LOB) = ~~0.000~~ 0.070

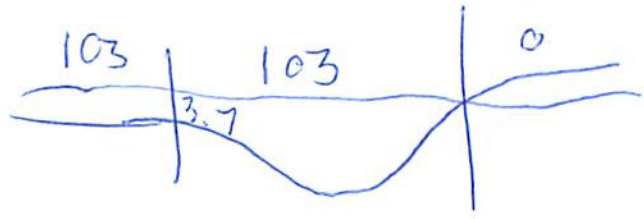
n (ROB) = 0.030

Pier Width = 4.1 ft

Pier Length = 1.1 ft

Piers for 100 yr = 2 ft

16.10 − 4.4 = 11.6



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 103 ft

Width of left overbank flow at approach, W_{lob} = 103 ft Average left overbank flow depth, y_{lob} = 3.7 ft

Width of right overbank flow at approach, W_{rob} = 0 ft Average right overbank flow depth, y_{rob} = 0 ft

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

x = 1.59 From Figure 9 W_2 (effective) = 100.4 ft y_{cs} = 2.1 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, $Vc = 11.17y_1^{1/6}D_{50}^{1/3}$ = _____ 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

PGRM: Pier

PIER SCOUR CALCULATIONS

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

Froude # at bridge = 0.29 Using pier width a on Figure 11, ξ = 5.2 Pier scour y_{ps} = 4.3 ft

PGRM: Abutment

ABUTMENT SCOUR CALCULATIONS

Average flow depth blocked by: left abutment, y_{aLT} = 3.7 ft right abutment, y_{aRT} = 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} = 12.7 and ψ_{RT} = 0

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 12.7 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 0 ft

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 64116169 Date 5/27/12 Initials RAT Region (A B C D)

Site _____ Location 0.6 mi S of HWY 48 on 481 Ave

Q_{500} = 6980 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 6938 (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 = 103 ft. Flow angle at bridge = 5 ° Abut. Skew = 0 ° Effective Skew = 5 °

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 = 1026 ft* $q_2 = Q_2/W_2$ = 67.6 ft^2/s

Bridge Vel, V_2 = 11.58 ft/s Final $y_2 = q_2/V_2$ = 11.6 ft Δh = 0.7 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 12.3 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. = 0-4.4 ft

Low Steel Elev. = 11.6 ft

n (Channel) = 0.050

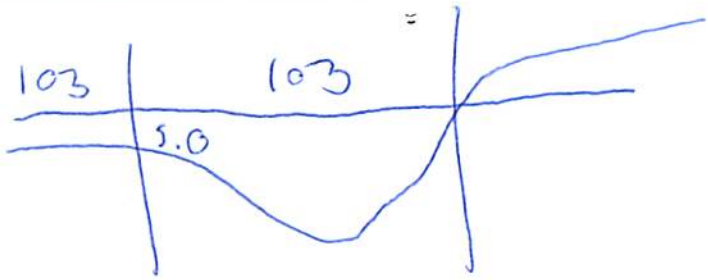
n (LOB) = 0.070

n (ROB) = 0.030

Pier Width = 1.1 ft

Pier Length = 1.1 ft

Piers for 500 yr = 2 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 103 ft

Width of left overbank flow at approach, W_{lob} = 103 ft Average left overbank flow depth, y_{lob} = 5.0 ft

Width of right overbank flow at approach, W_{rob} = 0 ft Average right overbank flow depth, y_{rob} = 0 ft

PGRM: CWCSNEW

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

x = 2.33 From Figure 9 W_2 (effective) = 100.4 ft y_{cs} = 2.9 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, $Vc = 11.17 y_1^{1/6} D_{50}^{1/3}$ = _____ 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 = 0.3 Using pier width a on Figure 11, ξ = 5.2 Pier scour y_{ps} = 4.3 ft

PGRM: Abutment

ABUTMENT SCOUR CALCULATIONS

Average flow depth blocked by: left abutment, y_{aLT} = 5 ft right abutment, y_{aRT} = 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} = 1.5 and ψ_{RT} = 0

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 1.5 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 0 ft

Route 481 Ave Stream Drainage Ditch MRM _____ Date 5/27/12 Initials R-a

Bridge Structure No. 6411069 Location 0.6 mi S of HWY 48 on 481 Ave

GPS coordinates: N 42° 50' 14.41" W 96° 35' 12.0" taken from: USL abutment X centerline of ⫯ MRM end _____

Datum of coordinates: WGS84 X NAD27 _____

Drainage area = 37.62 sq. mi.

The average bottom of the main channel was 16.0 ft below top of guardrail at a point 23 ft from left abutment.

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

5/21

~~8/26~~

MISCELLANEOUS CONSIDERATIONS

Flows	~~Q_{100}~~ = Q_{50} 5650			Q_{500} = Q_{100} = 6980		
Estimated flow passing through bridge	5650			6938		
Estimated road overflow & overtopping	0			42		
Consideration	Yes	No	Possibly	Yes	No	Possibly
Chance of overtopping		X				X
Chance of Pressure flow		X		X		~~X~~
Armored appearance to channel		X			X	
Lateral instability of channel		Y			Y	

2	862
5	1990
10	2960
25	4420
50	5650
100	6980
500	10400

Riprap at abutments? ____Yes X No ____Marginal

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

Debris Potential? ____High Y Med ____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). main channel
2). piers
3). left ab.
4). left ab.
5. right ab
6. right ab.
7). right OB
8). main channel
9). left OB

Summary of Results

	~~Q_{100}~~ 50	~~Q_{500}~~ 100
Bridge flow evaluated	5650	6938
Flow depth at left abutment (yaLT), in feet	3.7	5.0
Flow depth at right abutment (yaRT), in feet	0	0
Contraction scour depth (ycs), in feet	2.1	2.9
Pier scour depth (yps), in feet	4.3	4.3
Left abutment scour depth (yas), in feet	12.7	15
Right abutment scour depth (yas), in feet	0	0
1Flow angle of attack	5	5

See Comments/Diagram for justification where required