OK RT

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 50199170 Date 6/20/12 Initials RAT Region (A B [✓ C] D)
Site ______ Location Silver Ck & 60th St. N or SD38A
Q_{100} = 4320 by: drainage area ratio ____ flood freq. anal. ____ regional regression eq. X
Bridge discharge (Q_2) = 4320 (should be Q_{100} unless there is a relief bridge, road overflow, or bridge overtopping)

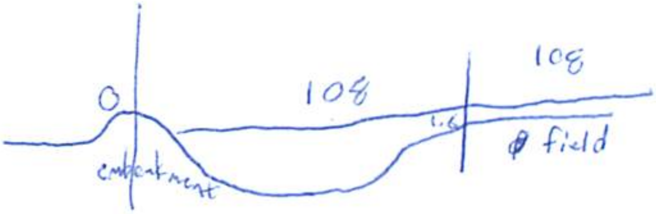
Analytical Procedure for Estimating Hydraulic Variables Needed to Apply Method

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

Bridge Width = 99 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 = 99 ft* $q_2 = Q_2/W_2$ = 43.6 ft^2/s
Bridge Vel, V_2 = 4.7 ft/s Final $y_2 = q_2/V_2$ = 9.3 ft Δh = 0.4 ft
Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 9.8 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. = 0-6.4 ft 15.6
Low Steel Elev. = 11.8 ft −3.8
11.8
n (Channel) = 0.035
n (LOB) = 0.030
n (ROB) = 0.040
Pier Width = 1.65 ft
Pier Length = 1.65 ft
Piers for 100 yr = 3 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 109 ft
Width of left overbank flow at approach, W_{lob} = 0 ft Average left overbank flow depth, y_{lob} = 0 ft
Width of right overbank flow at approach, W_{rob} = 108 ft Average right overbank flow depth, y_{rob} = 1.6 ft

Live Bed Contraction Scour (use if bed material is small cobbles or finer)
x = 1.93 From Figure 9 W_2 (effective) = 94.1 ft y_{cs} = 2.5 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, $V_1 = Q_{100}/(y_1W_1)$ = ____ 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 = 6.9 Pier scour y_{ps} = 5.7 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 0 ft right abutment, y_{aRT} = 1.6 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} = 0 and ψ_{RT} = 6.6
Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 0 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 6.6 ft

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 5099170 Date 6/20/12 Initials RAL Region (A B [✓ C] D)
Site ____ Location Silver Ck & 60th St N or SD38A
Q_{500} = 6927 by: drainage area ratio ____ flood freq. anal. ____ regional regression eq. X
Bridge discharge (Q_2) = 6927 (should be Q_{500} unless there is a relief bridge, road overflow, or bridge overtopping)

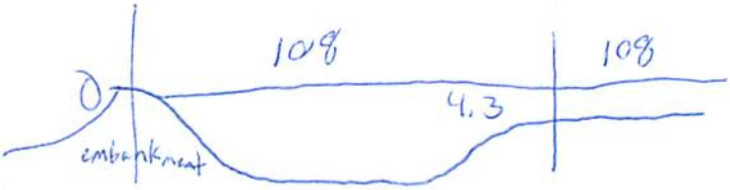
PGRM: "RegionA", "RegionB", "RegionC", or "RegionD"

Analytical Procedure for Estimating Hydraulic Variables Needed to Apply Method

Bridge Width = 99 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 = 99 ft* $q_2 = Q_2/W_2$ = 70 ft^2/s
Bridge Vel, V_2 = 5.9 ft/s Final $y_2 = q_2/V_2$ = 11.8 ft Δh = 0.7 ft
Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 12.5 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. = 0-6.1 ft
Low Steel Elev. = 11.9 ft
n (Channel) = ~~0.040~~ 0.035
n (LOB) = 0.030
n (ROB) = 0.040
Pier Width = 1.65 ft
Pier Length = 1.65 ft
Piers for 500 yr = 3 ft



PGRM: Contract

CONTRACTION SCOUR

Width of main channel at approach section W_1 = 108 ft
Width of left overbank flow at approach, W_{lob} = 0 ft Average left overbank flow depth, y_{lob} = 0 ft
Width of right overbank flow at approach, W_{rob} = 108 ft Average right overbank flow depth, y_{rob} = 4.3 ft

Live Bed Contraction Scour (use if bed material is small cobbles or finer)
x = 3.98 From Figure 9 W_2 (effective) = 94.1 ft y_{cs} = 4.6 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, $V_1 = Q_{500}/(y_1W_1)$ = ____ 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

PGRM: Pie

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 = 6.9 Pier scour y_{ps} = 5.8 ft

PGRM: Abutment

ABUTMENT SCOUR CALCULATIONS

Average flow depth blocked by: left abutment, y_{aLT} = 0 ft right abutment, y_{aRT} = 4.3 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} = 0 and ψ_{RT} = 13.8
Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 0 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 13.8 ft

96° 43' 54.02"
43° 36' 7.272"

167
96.73987
43.60202

SD38A

Route 60th St N Stream Silver Ck MRM [illegible] Date 6/20/12 Initials RAT

Bridge Structure No. 50199170 Location Silver Ck & 60th St N or SD38A

GPS coordinates: N 43° 36' 7.4" taken from: USL abutment X centerline of ⇑ MRM end ~~X~~

W 96° 43' 52.6" Datum of coordinates: WGS84 X NAD27 ____

Drainage area = 32.59 sq. mi.

The average bottom of the main channel was 15.6 ft below top of guardrail at a point 70 ft from left abutment.

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

32.59

6/18

~~8/25~~

2	459
5	1130
10	1730
25	2650
50	3450
100	4320
500	6580

MISCELLANEOUS CONSIDERATIONS

Flows	Q100 = 4320			Q500 = 6580		
Estimated flow passing through bridge	4320			6580		
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	

Riprap at abutments? X Yes ____ No ____ Marginal mostly on ~~right hand side~~ left abutment marginal on ~~left~~ right

Evidence of past Scour? X Yes ____ No ____ Don't know lots of contraction, some abutment

Debris Potential? ____ High ____ Med X Low

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

Riprap X Yes ____ No ____ Don't know ____ NA rose quartz along left abutment

Spur Dike ____ Yes X No ____ Don't know ____ NA

Other ____________ X Yes ~~X~~ No ____ Don't know ____ NA - embankment built up along left abutment

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

Summary of Results

	Q100	Q500
Bridge flow evaluated	4320	6580
Flow depth at left abutment (yaLT), in feet	0	0
Flow depth at right abutment (yaRT), in feet	1.6	4.3
Contraction scour depth (ycs), in feet	2.5	4.6
Pier scour depth (yps), in feet	5.7	5.5
Left abutment scour depth (yas), in feet	0	0
Right abutment scour depth (yas), in feet	6.6	13.8
1Flow angle of attack	0	0

See Comments/Diagram for justification where required