OK RT

SW of Brook. rgs

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 06137200 Date 5/16/12 Initials CW/RAT/RFT Region (A B C D)

Site _____ Location 0.3mi W of intersection of 216 St & 468 Ave

Q_{100} = 610 661 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. ✓

Bridge discharge (Q_2) = 681 (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 = 54 ft. Flow angle at bridge = 35 ° Abut. Skew = 0 ° Effective Skew = 35 °

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 = 44.23 ft* $q_2 = Q_2/W_2$ = 15.4 ft^2/s

Bridge Vel, V_2 = 2.6 ft/s Final $y_2 = q_2/V_2$ = 5.5 ft Δh = 0.1 ft

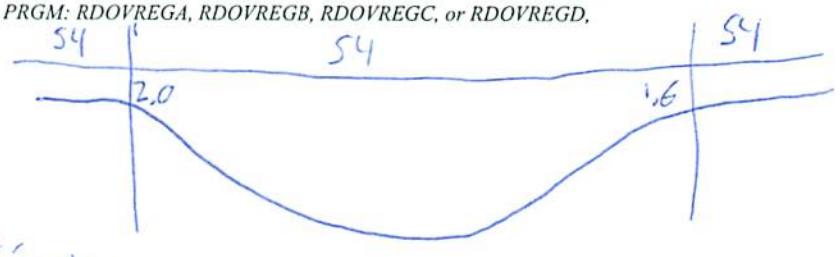
Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 5.7 ft

road over 6.4

* *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. = 2.9 ft

Low Steel Elev. = 6.9 ft

n (Channel) = 0.046

n (LOB) = 0.035

n (ROB) = 0.035

Pier Width = 1.5 ft diameter

Pier Length = 1.5 ft 2 sets circular

Piers for 100 yr = 2 ft

CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 156 ft

Width of left overbank flow at approach, W_{lob} = 54 ft Average left overbank flow depth, y_{lob} = 2.0 ft

Width of right overbank flow at approach, W_{rob} = 54 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 = 15.39 From Figure 9 W_2 (effective) = 41.7 ft y_{cs} = 16.8 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 = 6.4 Pier scour y_{ps} = 5.1 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 2.0 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} = 6.2 and ψ_{RT} = 6.6

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 15 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 12.1 ft

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 06137200 Date 5/16/12 Initials CW/RAT/RFT Region (A B C D)

Site _____ Location 0.3 mi W of intersection of 216 St & 468 Ave

Q_{500} = Qyc - 1070 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. ✓

Bridge discharge (Q_2) = 1057 (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 = 54 ft. Flow angle at bridge = 35 ° Abut. Skew = 0 ° Effective Skew = 35 °

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 = 44.23 ft* $q_2 = Q_2/W_2$ = 23.9 ft^2/s

Bridge Vel, V_2 = 3.5 ft/s Final $y_2 = q_2/V_2$ = 6.9 ft Δh = 0.2 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 7.1 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. = 2.9 ft

Low Steel Elev. = 6.7 ft

n (Channel) = 0.040

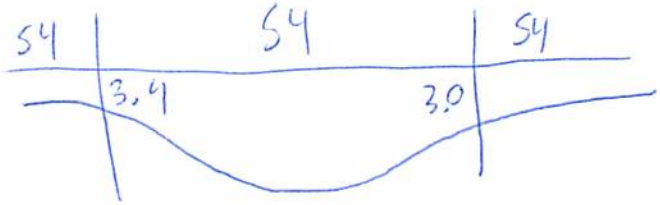
n (LOB) = 0.035

n (ROB) = 0.035

Pier Width = 1.5 ft

Pier Length = 1.5 ft

Piers for 500 yr = 2 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 156 ft

Width of left overbank flow at approach, W_{lob} = 54 ft Average left overbank flow depth, y_{lob} = 3.4 ft

Width of right overbank flow at approach, W_{rob} = 54 ft Average right overbank flow depth, y_{rob} = 3.0 ft

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

x = ~~19.18~~ 25.41 From Figure 9 W_2 (effective) = ~~51~~ 41.2 ft y_{cs} = ~~17.7~~ 20.6 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

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 = 6.4 Pier scour y_{ps} = 5.2 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 3.4 ft right abutment, y_{aRT} = 3.0 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} = 12.2 and ψ_{RT} = 11.5

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 22.2 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 20.9 ft

Route 216th St Stream _____ MRM _____ Date 5/16/12 Initials CW, RAT/RFT

Bridge Structure No. 06137200 Location 0.3 mi W of intersection of 216 St & 468 Ave

GPS coordinates: N 40° 15' 14.1" taken from: USL abutment X centerline of ↑↑ MRM end _____

W 96° 51' 17.9" Datum of coordinates: WGS84 _____ NAD27 _____

Drainage area = 12.93 sq. mi.

The average bottom of the main channel was _____ ft below top of guardrail at a point 17 ft from left abutment.

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

8/22

2	164
5	433
10	682
25	1070
50	1410
100	1780
500	2760

MISCELLANEOUS CONSIDERATIONS

Flows	Q_{100} = 661			Q_{500} = 1070		
Estimated flow passing through bridge	651			1057		
Estimated road overflow & overtopping	0			13		
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? ____Yes ____No X Marginal possible scour if fill/no pier

Evidence of past Scour? ____Yes ____No ____Don't know

Debris Potential? ____High ____Med X Low

5/14

2	164
5	432
10	651
25	1070
50	1410
100	1780
500	2750

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

2234 Str. no.
2235 ~~LOB~~ from bridge
2236 ROB from bridge
2237 LOB from bridge
2238 bridge from approach
2239 LOB from approach
2240 ROB from LOB
2241 left abut.
2242 right abut.

Summary of Results

	~~Q100~~ 10	~~Q500~~ 25
Bridge flow evaluated	651	1057
Flow depth at left abutment (yaLT), in feet	2.0	3.4
Flow depth at right abutment (yaRT), in feet	1.6	3.0
Contraction scour depth (ycs), in feet	16.6	~~17.2~~ 20.6
Pier scour depth (yps), in feet	5.1	5.2
Left abutment scour depth (yas), in feet	15	22.2
Right abutment scour depth (yas), in feet	12.1	20.9
1Flow angle of attack	35	35

See Comments/Diagram for justification where required