Dup OK-RJT

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SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 33288023 Date 10-4-12 Initials RFT Region (A B (C) D)

Site ______ Location nr Blunt on 308 Ave

Q_{100} (12) = 4310 by: drainage area ratio ____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 4310 (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 = 102 ft. Flow angle at bridge = 6 ° Abut. Skew = 0 ° Effective Skew = 6 °

Width (W_2) iteration = 102

Avg. flow depth at bridge, y_2 iteration = 9.2

Corrected channel width at bridge Section = W_2 times cos of flow angle = 101.44 ft* $q_2 = Q_2/W_2$ = 42.5 ft^2/s

Bridge Vel, V_2 = 4.6 ft/s Final $y_2 = q_2/V_2$ = 9.2 ft Δh = 0.4 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 9.6 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.

y_2 7 9 is abut.-to abut. flow

Water Surface Elev. = 20.8 ft

Low Steel Elev. = 12.5 ft

n (Channel) = .045

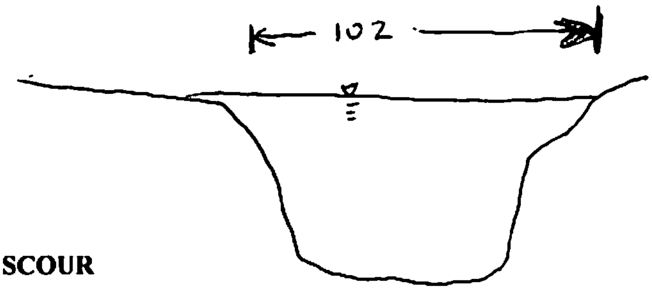
n (LOB) = .065 trees, scrub

n (ROB) = .030 grassy yard

Pier Width = 1.65 ft

Pier Length = 1.7 ft

\# Piers for 100 yr = 4 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 102 ft

Width of left overbank flow at approach, W_{lob} = 12 ft Average left overbank flow depth, y_{lob} = 0.15 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 = 0.73 From Figure 9 W_2 (effective) = 94.8 ft y_{cs} = 1.1 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, $V_1 = Q_{100}/(y_1 W_1)$ = ______ 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 = 0.27 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} = 0.15 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} = 0.7 and ψ_{RT} = 0

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 0.7 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 0 ft

44° 30.45594'
99° 59.3454' 308 Ave 44.507599
99.98909 103497 = L 1962

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 33288023 Date ____________ Initials ________ Region (A B (C) D)

Site ____________________ Location ______________________________

Q_{500} (25) = 10200 by: drainage area ratio ____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 9713 (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 = 102 ft. Flow angle at bridge = 6 ° Abut. Skew = 0 ° Effective Skew = 6 °

Width (W_2) iteration = 102 ______ ______ ______

Avg. flow depth at bridge, y_2 iteration = 13.8 ______ ______ ______

Corrected channel width at bridge Section = W_2 times cos of flow angle = 101.44 ft* $q_2 = Q_2/W_2$ = 95.8 ft^2/s

Bridge Vel, V_2 = 6.9 ft/s Final $y_2 = q_2/V_2$ = 13.8 ft Δh = 1 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 14.8 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.

road over flow begins at $y_2 \approx 13.8$ assume this is $Q_{max\ scour}$

Water Surface Elev. = ≈20.8 ft

Low Steel Elev. = 12.5 ft

n (Channel) = .045

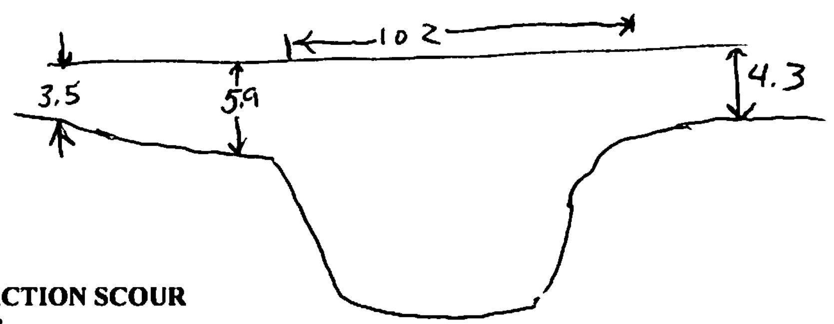
n (LOB) = .065

n (ROB) = .030

Pier Width = 1.45 ft

Pier Length = 1.1 ft

Piers for 500 yr = 4 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 102 ft

Width of left overbank flow at approach, W_{lob} = 102 ft Average left overbank flow depth, y_{lob} = 4.7 ft

Width of right overbank flow at approach, W_{rob} = 102 ft Average right overbank flow depth, y_{rob} = 4.3 ft

<u>Live Bed Contraction Scour</u> (use if bed material is small cobbles or finer)

x = 5.79 From Figure 9 W_2 (effective) = 94.8 ft y_{cs} = 6.5 ft

PGRM: CWCSNEW

<u>Clear Water Contraction Scour</u> (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 $D_{50} >= D_{c50}$, χ = 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 = 0.33 Using pier width a on Figure 11, ξ = 6.9 Pier scour y_{ps} = 5.8 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 4.7 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} = 14.5 and ψ_{RT} = 13.8

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 14.5 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 13.8 ft

Route 308 Ave Stream ______ MRM ______ Date ______ Initials ______

Bridge Structure No. 33288023 Location nr Blunt on 308 Ave

GPS coordinates: 44° 30.471' taken from: USL abutment ✓ centerline of ⇑ MRM end ______

99° 59.328' Datum of coordinates: WGS84 ✓ NAD27 ______

Drainage area = 103.69 sq. mi.

The average bottom of the main channel was 16.1 ft below top of guardrail at a point 35 ft from left abutment.

Method used to determine flood flows: ___Freq. Anal. ___drainage area ratio X regional regression equations.

MISCELLANEOUS CONSIDERATIONS

Flows	Q~~100~~10 = 4310			Q~~500~~25 = 10200		
Estimated flow passing through bridge	4310			9713		
Estimated road overflow & overtopping	0			486		
Consideration	Yes	No	Possibly	Yes	No	Possibly
Chance of overtopping		✓		✓		
Chance of Pressure flow		✓		✓		
Armored appearance to channel		✓			✓	
Lateral instability of channel		✓			✓	

Riprap at abutments? ___Yes ✓ No ___Marginal

Evidence of past Scour? ___Yes ___No ✓ Don't know no obvious scour

Debris Potential? X High X Med ___Low some trees, beaver activity at this bridge

there is a low (≈1ft) beaver dam near downstream face of bridge

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

Riprap ___Yes ✓ No ___Don't know ___NA

Spur Dike ___Yes ___No ___Don't know ✓ NA

Other ______ ___Yes ___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

Str. no

approach from bridge

LOB from bridge

ROB from ~~bridg~~ road

bridge section from LOB

left abut. under bridge

rt. abut. under bridge

Summary of Results

	Q~~100~~10	Q~~500~~25
Bridge flow evaluated	4310	9713
Flow depth at left abutment (yaLT), in feet	0.15	4.7
Flow depth at right abutment (yaRT), in feet	0	4.3
Contraction scour depth (ycs), in feet	1.1	6.5
Pier scour depth (yps), in feet	5.7	5.8
Left abutment scour depth (yas), in feet	0.7	14.5
Right abutment scour depth (yas), in feet	0	13.8
l Flow angle of attack	6°	6°

See Comments/Diagram for justification where required