DUP OK-RAT

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 65170165 Date 9-17-12 Initials RFT Region (A B (C) D)

Site _____ Location 1.4 mi N of Akaska on 303 Ave

Q_{100} = 2230 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 2230 (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 = 106 ft. Flow angle at bridge = 17 ° Abut. Skew = 0 ° Effective Skew = 17 °

Width (W_2) iteration = 90 94 _____ _____

Avg. flow depth at bridge, y_2 iteration = 7.2 7.0 _____ _____

Corrected channel width at bridge Section = W_2 times cos of flow angle = 81.89 ft* $q_2 = Q_2/W_2$ = 24.8 ft²/s

Bridge Vel, V_2 = 3.5 ft/s Final $y_2 = q_2/V_2$ = 7 ft Δh = 0.2 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 7.3 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. = dry ft

Low Steel Elev. = 12.6 ft

n (Channel) = 0.040

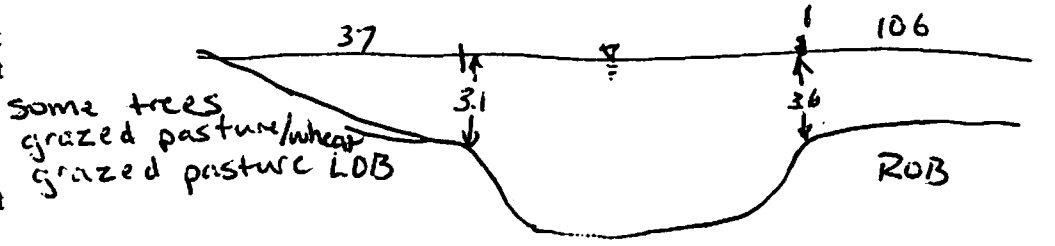
n (LOB) = 0.035

n (ROB) = 0.035

Pier Width = 1.65 ft

Pier Length = 1.65 ft

Piers for 100 yr = 4 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 90 ft

Width of left overbank flow at approach, W_{lob} = 37 ft Average left overbank flow depth, y_{lob} = 1.6 ft

Width of right overbank flow at approach, W_{rob} = 106 ft Average right overbank flow depth, y_{rob} = 3.6 ft

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

x = 4.15 From Figure 9 W_2 (effective) = 83.3 ft y_{cs} = 4.8 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 = 0.23 Using pier width a on Figure 11, ξ = 6.9 Pier scour y_{ps} = 5.5 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 1.6 ft right abutment, y_{aRT} = 3.6 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} = 6.6 and ψ_{RT} = 12.6

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 6.6 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 12.6 ft

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 6517016S Date _____ Initials _____ Region (A B (C) D)

Site _____ Location _____

Q_{500} = 4340 by: drainage area ratio ____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = _____ (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 = 106 ft. Flow angle at bridge = 17 ° Abut. Skew = 0 ° Effective Skew = 17 °

Width (W_2) iteration = 101 _____ _____ _____

Avg. flow depth at bridge, y_2 iteration = 9.2 _____ _____ _____

Corrected channel width at bridge Section = W_2 times cos of flow angle = 101.37 ft* $q_2 = Q_2/W_2$ = 42.8 ft²/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, $y_1 = \Delta h + y_2$ = 9.7 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. = dry ft

Low Steel Elev. = 12.6 ft

n (Channel) = 0.040

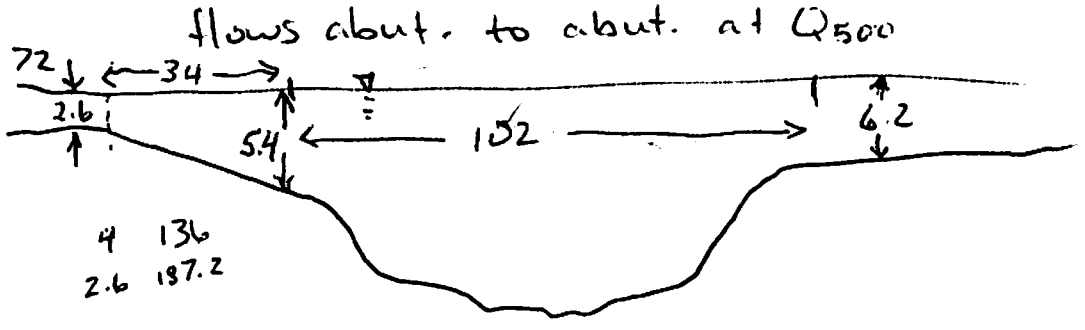
n (LOB) = 0.035

n (ROB) = 0.035

Pier Width = 1.65 ft

Pier Length = 1.65 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} = 106 ft Average left overbank flow depth, y_{lob} = 3.05 ft

Width of right overbank flow at approach, W_{rob} = 106 ft Average right overbank flow depth, y_{rob} = 6.2 ft

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

x = 8.42 From Figure 9 W_2 (effective) = 94.8 ft y_{cs} = 9.3 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, $V_1 = Q_{500}/(y_1 W_1)$ = _____ 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 = 0.27 Using pier width a on Figure 11, ξ = 6.9 Pier scour y_{ps} = 5.7 ft

PGRM: Abutment

ABUTMENT SCOUR CALCULATIONS

Average flow depth blocked by: left abutment, y_{aLT} = 3.05 ft right abutment, y_{aRT} = 6.2 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} = 11.6 and ψ_{RT} = 17.2

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 11.6 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 17.2 ft

Route 303 Ave Stream Ridge Creek MRM _____ Date 9-17-12 Initials RFT

Bridge Structure No. 65170165 Location 1.4 mi N of Akaska on 303 Ave

GPS coordinates: N 45° 21.310' taken from: USL abutment X centerline of ⇑ MRM end _____

W 100° 07.217' Datum of coordinates: WGS84 X NAD27 _____

Drainage area = 47.5 sq. mi.

The average bottom of the main channel was 15.9 ft below top of guardrail at a point 32 ft from left abutment.

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

MISCELLANEOUS CONSIDERATIONS

Flows	Q_{100} = 2230			Q_{500} = 4340		
Estimated flow passing through bridge	2230			~~2230~~ 4340		
Estimated road overflow & overtopping	0			0		
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 X No ____Marginal

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

Debris Potential? ____High ____Med X Low possibly med. some trees in channel upstream

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

ROB

bridge from L. abut

bridge from approach

Summary of Results

	Q100	Q500
Bridge flow evaluated	2230	4340
Flow depth at left abutment (yaLT), in feet	1.6	3.05
Flow depth at right abutment (yaRT), in feet	3.6	6.2
Contraction scour depth (ycs), in feet	4.8	9.3
Pier scour depth (yps), in feet	5.5	5.7
Left abutment scour depth (yas), in feet	6.6	11.6
Right abutment scour depth (yas), in feet	12.6	17.2
1Flow angle of attack	17°	17°

See Comments/Diagram for justification where required