OK RT

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 07122333 Date 7/19/12 Initials RaT Region (A B C D)

Site _____ Location 10th Ave SE & Moccasin Ck

Q_{100} = Q10 728 by: drainage area ratio____ flood freq. anal. _____ regional regression eq. X

Bridge discharge (Q_2) = 728 (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 = 62 ft. Flow angle at bridge = 20 ° Abut. Skew = 0 ° Effective Skew = 20 °

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 = 58.24 ft* $q_2 = Q_2/W_2$ = 12.5 ft^2/s

Bridge Vel, V_2 = 1.8 ft/s Final $y_2 = q_2/V_2$ = 6.9 ft Δh = 0.1 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 6.9 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.-0.6 ft

Low Steel Elev. = 9.1 ft

n (Channel) = 0.033

n (LOB) = 0.030

n (ROB) = 0.030

Pier Width = ~~0.25~~ 1.25 ft

Pier Length = 1 ft

Piers for 100 yr = 1 ft

12.6
5.2
7.4

CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 125 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} = 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 = 0.23 From Figure 9 W_2 (effective) = 57 ft y_{cs} = 9.1 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

PGRM: Pier

PIER SCOUR CALCULATIONS

L/a ratio = 0.8 Correction factor for flow angle of attack (from Table 1), K2 = 1

Froude # at bridge = 0.12 Using pier width a on Figure 11, ξ = 2.6 Pier scour y_{ps} = 4.1 ft

PGRM: Abutment

ABUTMENT SCOUR CALCULATIONS

Average flow depth blocked by: left abutment, y_{aLT} = 0 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 and ψ_{RT} = 0

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

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 07122333 Date 7/19/12 Initials RAT Region (A B C D)

Site 07122333 Location 10th Ave SE & Moccasin Ck

~~Q_{500}~~ = Q25 1470 by: drainage area ratio ____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 1232 (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 = 62 ft. Flow angle at bridge = 20 ° Abut. Skew = 0 ° Effective Skew = 20 °

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 = 58.26 ft* $q_2 = Q_2/W_2$ = 21.1 ft^2/s

Bridge Vel, V_2 = 2.3 ft/s Final $y_2 = q_2/V_2$ = 9.1 ft Δh = 0.1 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 9.2 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. = 06.6 ft

Low Steel Elev. = 9.1 ft

n (Channel) = 0.033

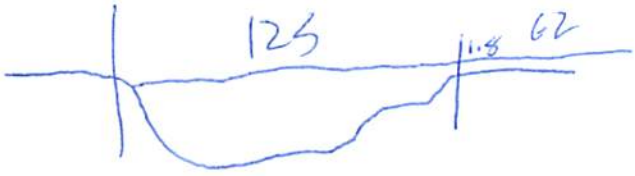
n (LOB) = 0.030

n (ROB) = 0.030

Pier Width = 1.25 ft

Pier Length = 1 ft

Piers for 500 yr = 1 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 125 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} = 62 ft Average right overbank flow depth, y_{rob} = 1.8 ft

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

x = 11.7 From Figure 9 W_2 (effective) = 57 ft y_{cs} = 12.7 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 = 0.8 Correction factor for flow angle of attack (from Table 1), K2 = 1

Froude # at bridge = 0.13 Using pier width a on Figure 11, ξ = 5.6 Pier scour y_{ps} = 4.2 ft

PGRM: Abutment

ABUTMENT SCOUR CALCULATIONS

Average flow depth blocked by: left abutment, y_{aLT} = 0 ft right abutment, y_{aRT} = 1.8 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} = 7.4

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 0 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 11.1 ft

98.47151
45.45465

98° 28' 17.436"
45° 27' 16.74"

Route 10th Ave SE Stream Moccasin Ck MRM _____ Date 7/19/12 Initials RaT

Bridge Structure No. 07122333 Location 10th Ave SE & Moccasin Ck

GPS coordinates: N 45° 27' 16.91" W 96° 28' 17.4" taken from: USL abutment X centerline of ⇑ MRM end _____

Datum of coordinates: WGS84 X NAD27 _____

Drainage area = 67.21 sq. mi.

The average bottom of the main channel was 13.2 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.

7/2 8/23

MISCELLANEOUS CONSIDERATIONS

Flows	~~Q100~~ = Q10 728			Q500 = Q25 1470		
Estimated flow passing through bridge	728			1232		
Estimated road overflow & overtopping	0			236		
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	

2	87
5	363
10	728
25	1470
50	2240
100	3230
500	6470

Riprap at abutments? ____Yes X No ____Marginal minor pier contraction

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

Debris Potential? ____High ____Med X 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). left OB
2). main channel
3). right OB
4-5). left abutment
6-7). right abutment
8). pier

9). main channel

Summary of Results

	~~Q100~~ Q10	~~Q500~~ Q25
Bridge flow evaluated	728	1232
Flow depth at left abutment (yaLT), in feet	0	0
Flow depth at right abutment (yaRT), in feet	0	1.8
Contraction scour depth (ycs), in feet	9.1	12.7
Pier scour depth (yps), in feet	4.1	4.2
Left abutment scour depth (yas), in feet	0	0
Right abutment scour depth (yas), in feet	0	11.1
1Flow angle of attack	20	20

See Comments/Diagram for justification where required