OK RJ

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 07340106 Date 7/24/12 Initials RJT Region (A B C D)

Site _____ Location 7.4 mi N of Claremont on 410 Ave

Q_{100} = Q2 227 by: drainage area ratio ____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 227 (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 = 65 ft. Flow angle at bridge = 90 ° Abut. Skew = 0 ° Effective Skew = 90 °

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 = 49.79 ft* $q_2 = Q_2/W_2$ = 4.6 ft^2/s

Bridge Vel, V_2 = 1.1 ft/s Final $y_2 = q_2/V_2$ = 4 ft Δh = 0 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 4 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, left 2.4

Water Surface Elev. = 4.0 ft

Low Steel Elev. = 7.5 ft

n (Channel) = 0.040

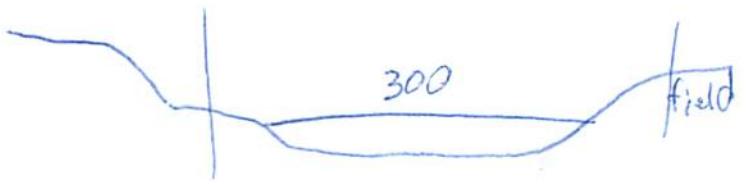
n (LOB) = 0.040

n (ROB) = 0.060

Pier Width = 1.35 ft

Pier Length = ~~1.35~~ 1.35 ft

Piers for 100 yr = 2 ft



320

CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = ~~300~~ 300 ft

Width of left overbank flow at approach, W_{lob} = ~~65~~ 320 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 = 21.45 From Figure 9 W_2 (effective) = 47.1 ft y_{cs} = 18.5 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, $V_1 = Q_{100}/(y_1 W_1)$ = _____ 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 = 0.1 Using pier width a on Figure 11, ξ = 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} = 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. 07340106 Date 7/21/12 Initials DAT Region (A B C (D))

Site _____ Location 7.4 mi N of Claremont on 410 Ave

Q_{500} = Q5 840 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 731 (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 = 65 ft. Flow angle at bridge = 40 ° Abut. Skew = 0 ° Effective Skew = 40 °

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 = 49.79 ft* $q_2 = Q_2/W_2$ = 14.7 ft^2/s

Bridge Vel, V_2 = 2 ft/s Final $y_2 = q_2/V_2$ = 7.5 ft Δh = 0.1 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 7.6 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.

Water Surface Elev. = 4.0 ft

Low Steel Elev. = 7.5 ft

n (Channel) = 0.040

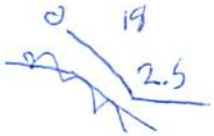
n (LOB) = 0.040

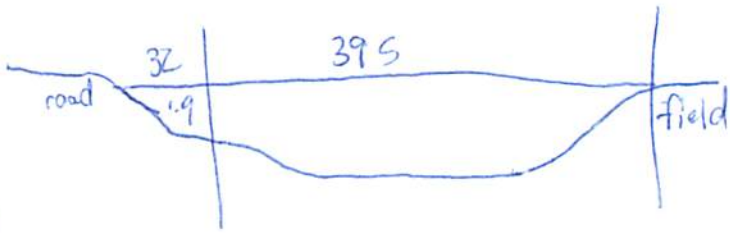
n (ROB) = 0.040

Pier Width = 1.35 ft

Pier Length = 1.35 ft

Piers for 500 yr = 2 ft





CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 395 ft

Width of left overbank flow at approach, W_{lob} = 32 ft Average left overbank flow depth, y_{lob} = 2.5·0.8 + 2.5/2·1.9 ft

Width of right overbank flow at approach, W_{rob} = 0 ft Average right overbank flow depth, y_{rob} = 2.5·0 ft

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

x = 56.66 From Figure 9 W_2 (effective) = 47.1 ft y_{cs} = 18.5 ft 32

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 = 0.13 Using pier width a on Figure 11, ξ = 6 Pier scour y_{ps} = 4.4 ft

PGRM: Abutment

ABUTMENT SCOUR CALCULATIONS

Average flow depth blocked by: ~~left abutment~~, y_{aLT} = 1.9 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} = 7.8 and ψ_{RT} = 0

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 14.2 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 0 ft

98.020E

45,78265

45°46' 57.5"
98° 1' 14.2"

Route 410 Ave Stream Crow Ck Ditch MRM _____ Date 7/12/12 Initials ART

Bridge Structure No. 07340106 Location 7.4 mi N of Clermont on 410 Ave

GPS coordinates: N 45° 46' 56.8" taken from: USL abutment X centerline of ⇑ MRM end _____

W 95° 10' 14.11" Datum of coordinates: WGS84 X NAD27 _____

Drainage area = 611.40 sq. mi.

The average bottom of the main channel was 11.4 ft below top of guardrail at a point 50 ft from left abutment.

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

MISCELLANEOUS CONSIDERATIONS

Flows	~~Q100~~ = Q2 227			~~Q500~~ = Q5 840		
Estimated flow passing through bridge	227			731		
Estimated road overflow & overtopping	0			109		
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	

7/12

2	227
5	840
10	1610
25	3140
50	4750
100	6790
500	13500

Riprap at abutments? ____Yes ____No X Marginal

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

Debris Potential? ____High X Med ____Low -some dead trees

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 X	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 obs
2). main channel
3). right obs
4). right abutment
5). pier
6-7). left abutment
8). right abutment
9). main channel

Summary of Results

	~~Q100~~ Q2	~~Q500~~ Q5
Bridge flow evaluated	227	731
Flow depth at left abutment (yaLT), in feet	0	1.9
Flow depth at right abutment (yaRT), in feet	0	0
Contraction scour depth (ycs), in feet	18.5	18.5
Pier scour depth (yps), in feet	4.2	4.4
Left abutment scour depth (yas), in feet	0	~~0~~ 14.7
Right abutment scour depth (yas), in feet	0	0
1Flow angle of attack	40	40

See Comments/Diagram for justification where required