OK RT

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 50100125 Date 6/26/12 Initials R.e.T Region (A B C D)

Site _____ Location 2.5 mi N of Hartford on 464 Ave

Q_{500} = Q10 2310 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. Y

Bridge discharge (Q_2) = 2310 (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 = 107 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 = 100.5 ft* $q_2 = Q_2/W_2$ = 23 ft^2/s

Bridge Vel, V_2 = 3.4 ft/s Final $y_2 = q_2/V_2$ = 6.8 ft Δh = 0.2 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 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. = 0-1.1 ft

Low Steel Elev. = 8.4 ft

n (Channel) = 0.035

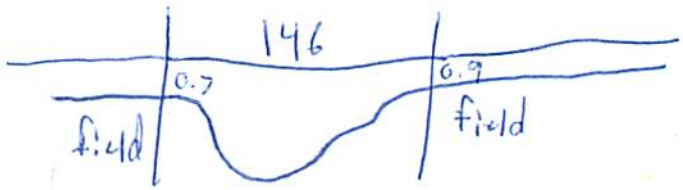
n (LOB) = 0.030

n (ROB) = 0.035

Pier Width = 2.3 ft 7.4

Pier Length = 2.3 ft T_1

Piers for 100 yr = 2 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 146 ft

Width of left overbank flow at approach, W_{lob} = 107 ft Average left overbank flow depth, y_{lob} = 0.7 ft

Width of right overbank flow at approach, W_{rob} = 107 ft Average right overbank flow depth, y_{rob} = 0.9 ft

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

x = 4.15 From Figure 9 W_2 (effective) = 95.9 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 = 8.9 Pier scour y_{ps} = 7.1 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 0.7 ft right abutment, y_{aRT} = 0.9 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} = 3.1 and ψ_{RT} = 3.9

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 3.1 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 3.9 ft

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 50100125 Date 6/26/12 Initials RJ Region (A B C D)

Site _____ Location 2.5 mi N of Hartford on 464 Ave

Q_{500} = Q25 3560 by: drainage area ratio ____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 3562 (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 = 107 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 = 100.65 ft* $q_2 = Q_2/W_2$ = ~~34.94~~ 35.4 ft^2/s

Bridge Vel, V_2 = 4.2 ft/s Final $y_2 = q_2/V_2$ = 8.4 ft Δh = 0.4 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 8.8 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,

Water Surface Elev. = 91.1 ft

Low Steel Elev. = 8.4 ft

n (Channel) = 0.035

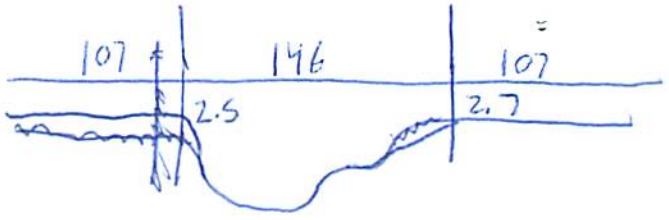
n (LOB) = 0.030

n (ROB) = 0.030

Pier Width = 2.3 ft

Pier Length = 2.3 ft

Piers for 500 yr = 2 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 146 ft

Width of left overbank flow at approach, W_{lob} = 107 ft Average left overbank flow depth, y_{lob} = 2.5 ft

Width of right overbank flow at approach, W_{rob} = 107 ft Average right overbank flow depth, y_{rob} = 2.7 ft

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

x = 7.59 From Figure 9 W_2 (effective) = 96 ft y_{cs} = 8.4 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 = 0.26 Using pier width a on Figure 11, ξ = 6.9 Pier scour y_{ps} = 7.3 ft

PGRM: Abutment

ABUTMENT SCOUR CALCULATIONS

Average flow depth blocked by: left abutment, y_{aLT} = 2.5 ft right abutment, y_{aRT} = 2.7 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} = 10.2 and ψ_{RT} = 11

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 10.2 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 11 ft

96° 55' 49.152
43° 40' 3.18

96.93032
43.66755

Route 464 Ave Stream W. Br. Skunk Ck MRM _____ Date 6/26/12 Initials RAT

Bridge Structure No. 50100125 Location 2.5 mi N of Hartford on 464 Ave

GPS coordinates: N 43° 40' 3.3" taken from: USL abutment X centerline of ⫛ MRM end _____

W 96° 55' 49.4" Datum of coordinates: WGS84 X NAD27 _____

Drainage area = 74.72 sq. mi.

The average bottom of the main channel was 12.8 ft below top of guardrail at a point 45 ft from left abutment.

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

74.72
6/15

2	596
5	1500
10	2310
25	3580
50	4700
100	5920
500	9150

MISCELLANEOUS CONSIDERATIONS

Flows	Q_{100} = Q_{10} 2310			Q_{500} = Q_{25} 3580		
Estimated flow passing through bridge	2310			3562		
Estimated road overflow & overtopping	0			18		
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? X Yes ____No ____Marginal

Evidence of past Scour? X Yes ____No ____Don't know some pier/contraction. minor abutment

Debris Potential? ____High ____Med X Low

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

Riprap	X Yes	____No	____Don't know	____NA
Spur Dike	____Yes	X No	____Don't know	____NA
Other _____	____Yes	X No	____Don't know	____NA

use quartz

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 c/s
2). main channel
3). right c/s
4). pier
5). right abutment
6). left abutment
7). pier scour.
8). left abutment
9). right abutment.
10). main channel

Summary of Results

	~~Q100~~ Q_{10}	~~Q500~~ Q_{25}
Bridge flow evaluated	2310	3562
Flow depth at left abutment (yaLT), in feet	0.7	2.5
Flow depth at right abutment (yaRT), in feet	0.9	2.7
Contraction scour depth (ycs), in feet	4.5	8.4
Pier scour depth (yps), in feet	7.1	7.3
Left abutment scour depth (yas), in feet	3.1	10.2
Right abutment scour depth (yas), in feet	3.9	11
1Flow angle of attack	20	20

See Comments/Diagram for justification where required