OK RT

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 50070098 Date 6/26/12 Initials RL Region (A B (C) D)

Site ______ Location 5.2 mi N & 2 mi W of Hartford on 461 Ave

Q_{100} = 4760 by: drainage area ratio ___ flood freq. anal. ___ regional regression eq. X

Bridge discharge (Q_2) = 4760 (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 = 109 ft. Flow angle at bridge = 10 ° Abut. Skew = 0 ° Effective Skew = 10 °

Width (W_2) iteration = 107.34 ___ ___ ___

Avg. flow depth at bridge, y_2 iteration = 9.4 ___ ___ ___

Corrected channel width at bridge Section = W_2 times cos of flow angle = 107.34 ft* $q_2 = Q_2/W_2$ = 44.3 ft²/s

Bridge Vel, V_2 = 4.7 ft/s Final $y_2 = q_2/V_2$ = 9.4 ft Δh = 0.4 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 9.8 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. = 0-0.5 ft

Low Steel Elev. = 12.0 ft

n (Channel) = 0.040

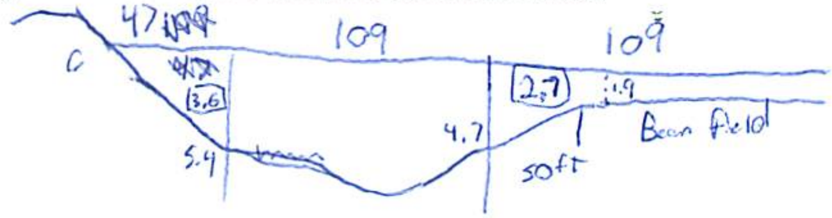
n (LOB) = 0.035

n (ROB) = 0.030

Pier Width = 1.8 ft

Pier Length = 1.85 ft

Piers for 100 yr = 2 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 109 ft

Width of left overbank flow at approach, W_{lob} = 47 ft Average left overbank flow depth, y_{lob} = 3.6 ft

Width of right overbank flow at approach, W_{rob} = 109 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 = 3.05 From Figure 9 W_2 (effective) = 103.7 ft y_{cs} = 3.6 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 = 1.0278 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 = 7.4 Pier scour y_{ps} = 6 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 3.6 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} = 12.6 and ψ_{RT} = 11

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 12.6 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 11 ft

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 50070098 Date 6/26/12 Initials [illegible] Region (A B C D)

Site _____ Location 5.2 mi N & 2 mi W of Hartford on 461 Ave

Q_{500} = 7350 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 7350 (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 = 109 ft. Flow angle at bridge = 10 ° Abut. Skew = 0 ° Effective Skew = 10 °

Width (W_2) iteration = _____ _____ _____ _____

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

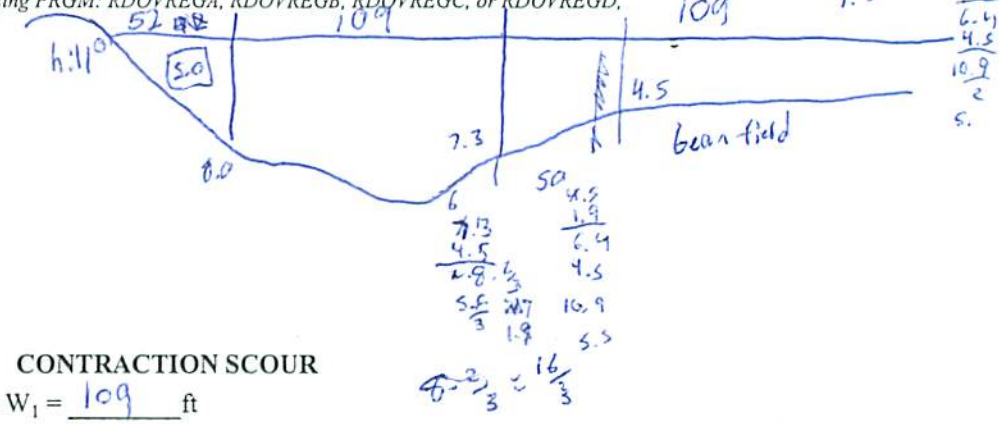
Corrected channel width at bridge Section = W_2 times cos of flow angle = 107.34 ft* $q_2 = Q_2/W_2$ = 68.8 ft^2/s

Bridge Vel, V_2 = 5.9 ft/s Final $y_2 = q_2/V_2$ = 11.7 ft Δh = 0.7 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 12.4 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,



Water Surface Elev. = 0-0.8 ft

Low Steel Elev. = 12.0 ft

n (Channel) = 0.040

n (LOB) = 0.035

n (ROB) = 0.030

Pier Width = 1.8 ft

Pier Length = 1.95 ft

Piers for 500 yr = 2 ft

CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 109 ft

Width of left overbank flow at approach, W_{lob} = 52 ft Average left overbank flow depth, y_{lob} = 5.0 ft

Width of right overbank flow at approach, W_{rob} = 109 ft Average right overbank flow depth, y_{rob} = 5.5 ft

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

x = 6.67 From Figure 9 W_2 (effective) = 103.7 ft y_{cs} = 7.5 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, $V_1 = Q_{500}/(y_1 W_1)$ = _____ 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 = 1.0278 Correction factor for flow angle of attack (from Table 1), K2 = 1

Froude # at bridge = 0.3 Using pier width a on Figure 11, ξ = 7.4 Pier scour y_{ps} = 6.2 ft

PGRM: Abutment

ABUTMENT SCOUR CALCULATIONS

Average flow depth blocked by: left abutment, y_{aLT} = 5.0 ft right abutment, y_{aRT} = 5.5 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} = 15 and ψ_{RT} = 15.9

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 15 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 15.9 ft

96° 59' 25.692"
43° 42' 24.372"

96.99047
43,70677

Route 461 Ave Stream West Branch Skunk Clk MRM _____ Date 6/26/12 Initials RaT

Bridge Structure No. 5007098 Location 5.2 mi N & 2 mi W of Hartford on 461 Ave

GPS coordinates: N 43° 42' 24.3" W 93° 59' 25.6" taken from: USL abutment X centerline of ⇑ MRM end _____

Datum of coordinates: WGS84 X NAD27 _____

Drainage area = 57.36 sq. mi.

The average bottom of the main channel was 16.2 ft below top of guardrail at a point 164 ft from left abutment.

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

57.36

6/13

2	468
5	1190
10	1840
25	2870
50	3770
100	4760
500	7380

MISCELLANEOUS CONSIDERATIONS

Flows	Q_{100} = 4760			Q_{500} = 7380		
Estimated flow passing through bridge		4760			7380	
Estimated road overflow & overtopping		0			0	
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? ____Yes X No ____Marginal

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

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). pier
5). right abutment
6). pier scour
7). right abutment
8-9). left abutment
10). main channel

Summary of Results

	Q100	Q500
Bridge flow evaluated	4760	7380
Flow depth at left abutment (yaLT), in feet	3.6	~~5~~ 5.0
Flow depth at right abutment (yaRT), in feet	2.7	~~5.0~~ 5.5
Contraction scour depth (ycs), in feet	3.6	7.5
Pier scour depth (yps), in feet	6	6.2
Left abutment scour depth (yas), in feet	12.6	15
Right abutment scour depth (yas), in feet	11	15.9
1Flow angle of attack	10	10

See Comments/Diagram for justification where required