

OK RT

between 189 + 190

SCOUR ANALYSIS AND REPORTING FORM

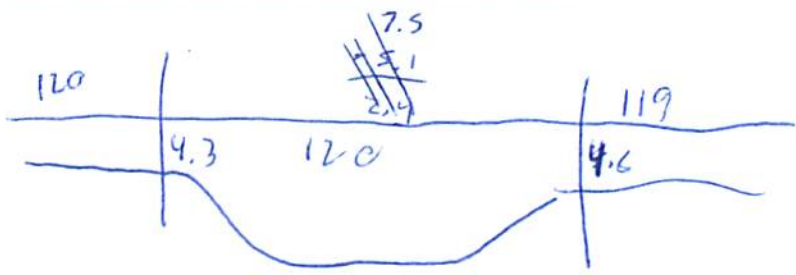
Bridge Structure No. 20170235 Date 5-18-12 Initials CW/RaT Region (A B C D) D
 Site _____ Location 5.5 mi N of Astoria on 483 Ave
 $Q_{100} =$ 2250 by: drainage area ratio _____ flood freq. anal. _____ regional regression eq.
 Bridge discharge (Q_2) = 2250 (should be Q_{100} unless there is a relief bridge, road overflow, or bridge overtopping)

Analytical Procedure for Estimating Hydraulic Variables Needed to Apply Method

Bridge Width = 119 ft. Flow angle at bridge = 25 ° Abut. Skew = 0 ° Effective Skew = 25 °
 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 = 107.95 ft* $q_2 = Q_2/W_2 =$ 20.9 ft²/s
 Bridge Vel, $V_2 =$ 3.2 ft/s Final $y_2 = q_2/V_2 =$ 6.4 ft $\Delta h =$ 0.2 ft
 Average main channel depth at approach section, $y_1 = \Delta h + y_2 =$ 6.7 ft

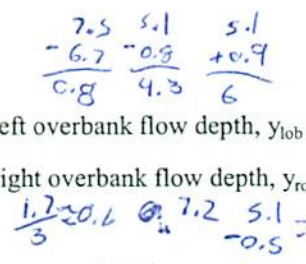
* NOTE: repeat above calculations until y_2 changes by less than 0.2 Effective pier width = $L \sin(q) + a \cos(q)$
 If y_2 is above LS, then account for Road Overflow using PRGM: RDOVREGA, RDOVREGB, RDOVREGC, or RDOVREGD.

Water Surface Elev. = 1.0 ft
 Low Steel Elev. = 9.0 ft
 n (Channel) = 0.060
 n (LOB) = 0.060
 n (ROB) = 0.060
 Pier Width = 1.7 ft
 Pier Length = 1.7 ft
 # Piers for 100 yr = 4 ft



CONTRACTION SCOUR

Width of main channel at approach section $W_1 =$ 119 ft
 Width of left overbank flow at approach, $W_{lob} =$ ~~119~~ ft Average left overbank flow depth, $y_{lob} =$ 4.3 ft
 Width of right overbank flow at approach, $W_{rob} =$ 119 ft Average right overbank flow depth, $y_{rob} =$ ~~4.6~~ ft
 Live Bed Contraction Scour (use if bed material is small cobbles or finer)
 $x =$ 9.17 From Figure 9 W_2 (effective) = 106.1 ft $y_{cs} =$ 10.1 ft



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, $V_c = 11.17 y_1^{1/6} D_{50}^{1/3} =$ _____ ft/s
 If $V_1 < V_c$ and $D_{50} \geq 0.2$ 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 $D_{50} \geq D_{c50}$, $\chi = 0.0$
 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

L/a ratio = 1.4 Correction factor for flow angle of attack (from Table 1), $K_2 =$ 1
 Froude # at bridge = 0.22 Using pier width a on Figure 11, $\xi =$ 7 Pier scour $y_{ps} =$ 5.6 ft

ABUTMENT SCOUR CALCULATIONS

Average flow depth blocked by: left abutment, $y_{aLT} =$ 4.3 ft right abutment, $y_{aRT} =$ 4.6 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, $\psi_{LT} =$ 13.8 and $\psi_{RT} =$ 14.3
 Left abutment scour, $y_{as} = \psi_{LT} (K_1/0.55) =$ 25.1 ft Right abutment scour $y_{as} = \psi_{RT} (K_1/0.55) =$ 26 ft

PRGM: "RegionA", "RegionB", "RegionC", or "RegionD"

PRGM: Contract

PRGM: CWCSNEW

PRGM: Pier

PRGM: Abutment

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 20170235 Date _____ Initials _____ Region (A B C D) (C)
 Site _____ Location 5.5 mi N of Astoria on 483 Ave
 $Q_{500} =$ 3510 by: drainage area ratio _____ flood freq. anal. _____ regional regression eq.
 Bridge discharge (Q_2) = 3510 (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

Bridge Width = ~~107.85~~ 119 ft Flow angle at bridge = 25 ° Abut. Skew = 0 ° Effective Skew = 25 °
 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 = 107.85 ft* $q_2 = Q_2/W_2 =$ 32.5 ft²/s

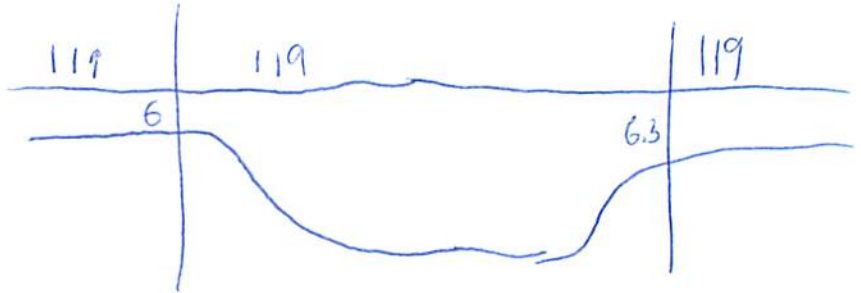
Bridge Vel, $V_2 =$ 4 ft/s Final $y_2 = q_2/V_2 =$ 8.1 ft $\Delta h =$ 0.3 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2 =$ 6.4 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. = 1.0 ft
 Low Steel Elev. = 4.0 ft
 n (Channel) = 0.06
 n (LOB) = 0.06
 n (ROB) = 0.06
 Pier Width = 1.7 ft
 Pier Length = 1.7 ft
 # Piers for 500 yr = 4



CONTRACTION SCOUR

Width of main channel at approach section $W_1 =$ 119 ft
 Width of left overbank flow at approach, $W_{lob} =$ 119 ft Average left overbank flow depth, $y_{lob} =$ 6 ft
 Width of right overbank flow at approach, $W_{rob} =$ 119 ft Average right overbank flow depth, $y_{rob} =$ 6.3 ft

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

$x =$ 13.26 From Figure 9 W_2 (effective) = 101.1 ft $y_{cs} =$ 14.1 ft

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, $V_c = 11.17 y_1^{1/6} D_{50}^{1/3} =$ _____ ft/s

If $V_1 < V_c$ and $D_{50} \geq 0.2$ 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 $D_{50} \geq D_{c50}$, $\chi = 0.0$

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

L/a ratio = 1 Correction factor for flow angle of attack (from Table 1), $K_2 =$ 1
 Froude # at bridge = 0.25 Using pier width a on Figure 11, $\xi =$ 7 Pier scour $y_{ps} =$ 5.7 ft

ABUTMENT SCOUR CALCULATIONS

Average flow depth blocked by: left abutment, $y_{aLT} =$ 6 ft right abutment, $y_{aRT} =$ 6.3 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, $\psi_{LT} =$ 16.8 and $\psi_{RT} =$ 17.3
 Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55) =$ 30.0 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55) =$ 31.5 ft

PRGM: "RegionA", "RegionB", "RegionC", or "RegionD"

PRGM: Contract

PRGM: CWCSNEW

PRGM: Pier

PRGM: Abutment

Route 483 Av Stream Cobb Ck MRM _____ Date _____ Initials _____
 Bridge Structure No. 20170235 Location 5.5 mi. N of Astoria on 483 Av
 GPS coordinates: N 44° 36' 16.3" taken from: USL abutment centerline of \uparrow MRM end _____
W 96° 32' 26.51" Datum of coordinates: WGS84 NAD27 _____

Drainage area = 23.72 sq. mi.
 The average bottom of the main channel was 12.3 ft below top of guardrail at a point 29 ft from left abutment.
 Method used to determine flood flows: ___ Freq. Anal. ___ drainage area ratio regional regression equations.

5/17
8/23

MISCELLANEOUS CONSIDERATIONS

Flows	Q ₁₀₀ = <u>2250</u>			Q ₅₀₀ = <u>3510</u>		
Estimated flow passing through bridge	<u>2250</u>			<u>3510</u>		
Estimated road overflow & overtopping						
Consideration	Yes	No	Possibly	Yes	No	Possibly
Chance of overtopping		<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	
Chance of Pressure flow		<input checked="" type="checkbox"/>				<input checked="" type="checkbox"/>
Armored appearance to channel		<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	
Lateral instability of channel		<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	

2 200
5 531
10 842
25 1340
50 1770
100 2250
500 3510

Riprap at abutments? ___ Yes No ___ Marginal
 Evidence of past Scour? Yes ___ No ___ Don't know abutment
 Debris Potential? ___ High Med ___ Low

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 (D₅₀)

Material Silt/Clay 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
2320 Str. no.
2321 eroded abutment under bridge
2322 under bridge from rt. abut.
2323 approach section from bridge
2324 ROB from bridge
2325 LOB from bridge
2326 bridge from right ditch

Summary of Results

	Q ₁₀₀	Q ₁₀₀	Q ₅₀₀
Bridge flow evaluated	<u>483</u>	<u>2250</u>	<u>3510</u>
Flow depth at left abutment (yaLT), in feet	<u>4.7</u>	<u>4.3</u>	<u>6</u>
Flow depth at right abutment (yaRT), in feet	<u>10.</u>	<u>4.6</u>	<u>6.3</u>
Contraction scour depth (yca), in feet		<u>18.1</u>	<u>14.1</u>
Pier scour depth (yp), in feet		<u>5.6</u>	<u>5.7</u>
Left abutment scour depth (yas), in feet		<u>25.1</u>	<u>30.6</u>
Right abutment scour depth (yas), in feet		<u>26</u>	<u>31.5</u>
Flow angle of attack		<u>25°</u>	<u>25</u>

See Comments/Diagram for justification where required