



**FORM DQP 2.01-1
LEVEL 1 CHECK PRINT SIGN-OFF SHEET**

Client Name: Ohio Department of Transportation
 Job Title: Cleveland Innerbelt Design-Build Contract
 Job Number: CUY-90-14.90
 Document Title: Bulkhead Wall - RFI 00157

Check Level (Mark One): 1A 100% Document Check
 1B 100% Input Check

Enter description below:

	Print Name	Signature	Date
<input checked="" type="checkbox"/> Originator	<u>Larry Rolwes</u>	<u>[Signature]</u>	<u>11/21/11</u>
<input checked="" type="checkbox"/> Checker	<u>dim Truesdell</u>	<u>[Signature]</u>	<u>11/21/11</u>
<input checked="" type="checkbox"/> Backchecker	<u>Larry Rolwes</u>	<u>[Signature]</u>	<u>11/21/11</u>
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Insert an "X" in the box to indicate a required QC activity.

For	Cleveland - Bulkheads	Job No.	49633	Sheet No.	
Made by	LER	Checked by	JT	Backchecked by	LER
Date	11/21/11	Date	11/21/11	Date	11/21/11

DEAD MAN CAP BEAM DESIGN - LONGITUDINAL BENDING

RFI 157

Section Geometry

Width:	b = 60.000 in	$I_g = 6298560 \text{ in}^4$	
Total Depth (inc. red. for wear):	D = 108.000 in *	$f_{cr} = 740 \text{ psi}$	(LRFD AASHTO 5.4.2.6)
Cover Prim. Bar:	$c_p = 2.000 \text{ in}$	$1.2 * M_{cr} = 103576320 \text{ lb-in}$	
Cover on Sec. Bar:	$c_s = 2.000 \text{ in}$	$x = 6.39 \text{ in}$	
Side Cover:	$c_{side} = 2.000 \text{ in}$	$\beta = 0.85$	($f'_c \leq 4000 \text{ psi}$)
Stirrups/Outer Bar:	#5 bar	2-Layer Spac.	$d_{stirrup} = 0.625 \text{ in}$
Primary Bars:	5.00 #5	$A_s = 1.550 \text{ in}^2$	$d_s = 0.625 \text{ in}$
Secondary Bars:	5.00 #5	$A'_s = 1.550 \text{ in}^2$	$d'_s = 0.625 \text{ in}$
Eff. Depth for Primary Bars:	$d = 105.063 \text{ in}$		
Eff. Depth for Secondary Bars:	$d' = 2.938 \text{ in}$		* Changed per RFI 00157

Materials

Concrete Compression Strength:	$f'_c = 4000 \text{ psi}$
Concrete Modulus of Elasticity:	$E_c = 3605000 \text{ psi}$
Modular Ratio:	$n = 8$
Reinforcing Yield Strength:	$f_y = 60000 \text{ psi}$
Reinforcing Modulus of Elasticity:	$E_s = 29000 \text{ ksi}$
Crack Width Parameter:	$\gamma = 1 \text{ k/in}$

Flexure - Crack Control

$f_s = 12.86 \text{ ksi}$
$f_c = 0.10$
$d_c = 2.9375 \text{ in}$
$\beta_s = 1.040$
$s_{min} = 46.46 \text{ in}$

OK

Resistance Factors

Flexure and Tension:	$\phi = 0.90$	*
Shear and Torsion:	$\phi = 0.90$	

Shear and Torsion

$A_{cp} = 6480 \text{ in}^2$	$A_v = 0.62 \text{ in}^2$
$P_{cp} = 336 \text{ in}$	$A_t = 0.31 \text{ in}^2$
$A_{oh} = 5724 \text{ in}^2$	$p_h = 318 \text{ in}$
$A_o = 4866 \text{ in}^2$	

$V_c = 797.4 \text{ kip}$	No Shear Rein. Reqd.
$T_{cr} = 2635 \text{ kip-ft}$	No Torsional Rein. Reqd.

Loads

$M_u = 238.00 \text{ k-ft}$	
$M_s = 171.00 \text{ k-ft}$	
$V_u = 155.0 \text{ kip}$	
$T_u = 0.0 \text{ kip}$	(Corresponding to Shear)

$(A_v/s) = 0.000 \text{ in}^2/\text{in}/2\text{legs}$
$(A_t/s) = 0.000 \text{ in}^2/\text{in}/\text{leg}$
$0.00 \text{ in}^2/\text{in}/2\text{legs}$

$s_{req} = \#DIV/0!$	in
$s_{min} = 12.40$	in (for min. rein. required)
$s_{max_v} = 24$	in See ACI 11.6.3.1, 11.6.3.7, and 11.6.6 for additional requirements for sections resisting torsion.
$s_{max_t} = 12$	in

Flexure - Strength

Analyze as Doubly Reinforced (Y/N): n

Flexural Strength:

$R_n = 4.79 \text{ psi}$	
$m = 17.65$	$A_s F_y = 93000 \text{ lb}$
$\rho = 0.0001$	$a = 0.46 \text{ in}$
$A_{s_{req}} = 0.63 \text{ in}^2$	$\phi M_n = 731.21 \text{ kip-ft}$
OK	OK

Minimum Steel:

$R_n = 173.77 \text{ psi}$	$4/3 R_n = 6$
$m = 17.65$	$m = 17.65$
$\rho_{min_1} = 0.0030$	$\rho_{min_2} = 0.0001$
$A_{s_{min1}} = 18.91 \text{ in}^2$	$A_{s_{min2}} = 0.63 \text{ in}^2$

OK

Maximum Steel:

*The maximum steel requirement has been removed. This provision is compensated for by adjusting the resistance factor based on whether the section is tension controlled, compression controlled, or in transition. A section is tension controlled if $c/d \leq 0.375$ and $\phi = 0.90$

$c = a/\beta = 0.54 \text{ in}$	
$c/d = 0.01$	≤ 0.375 , Tension Controlled

(Use this for single and double reinforcement)

Check section dims per ACI 11.6.3.1a

$$0.025 \leq 0.569 \text{ OK}$$

Minimum torsional reinforcement per ACI 11.6.5.2

$(A_{v+2t}/s) = 0.050 \text{ in}^2/\text{in}/2\text{legs}$	(outer legs only)
$s = 12.40 \text{ in}$	

Additional longitudinal reinforcement:

$$A_1 = 0.00 \text{ in}^2$$

Min. longitudinal reinforcing:

$(A_v/s) = 0.025 \text{ in}^2/\text{in}/\text{leg}$
$A_{1_{min}} = 26.22 \text{ in}^2$

Fatigue

$M_{DL} = 0 \text{ kip-ft}$	0.000 ksi
$M_{LL_{min}} = 0 \text{ kip-ft}$	0.000 ksi
$M_{LL_{max}} = 0 \text{ kip-ft}$	0.000 ksi
Actual Range = 0.000 ksi	
Allowable Range = 23.400 ksi OK	