DLZ					
CLIENT	ODOT	PROJECT NO.	1122-1001-90		
PROJECT	CUY 271				
SUBJECT	Wall SW1	BY:	A. Porter	Date:	8/15/2014
	Soil Nail Wall	CHK BY:	M. Crossley	Date:	8/15/2014
	Facing Design				

$T_{max\text{-}s}$ (from geotech)=	10	k	Perm. Face Rebar Size =	#4	
Vertical Nail Head Spacing =	3.5	ft	Perm. Face Rebar Spacing =	12	in.
Horizontal Nail Head Spacing =	3.5	ft	Perm. Facing Concrete f'_c =	4,000	psi
Spacing Ratio =	1.00		Perm. Steel Yield Strength, f_y =	60	ksi
# of Waler Bars (Horizontal) =	0		Perm. Facing Thickness =	8	in.
Waler Bar Size (Horizontal) =	#4		N_H =	4	
# of Waler Bars (Vertical) =	0		Stud Diameter =	0.5	in.
Waler Bar Size (Vertical) =	#4		Stud Length =	4.125	in.
Temp. Face WWF =	4x4-W2.9 x W2.9		Head Stud Head Thickness =	0.31	
Temp. Facing Thickness =	4	in.	Stud Type=	A307	
Temp. Facing Concrete f'_c =	4,000	psi	Headed Stud Spacing =	5	in.
Temp. Yield Strength, f_y =	60	ksi	Bearing Plate Length =	9	in.
			Bearing Plate Thickness =	0.75	in.

Temp. Rein. Ratio @ Midspan =	OK	Temp. Face Tensile Resistance =	OK
Temp. Rein. Ratio @ Nailhead =	OK	Perm. Face Tensile Resistance =	OK
Perm. Rein. Ratio =	OK	Temp. Punching Shear Resistance =	OK
Facing Head Stud Resistance =	OK	Perm. Punching Shear Resistance =	OK

Spreadsheet developed following FHWA-IF-03-017, Geotechnical Engineering Circular No.7, Soil Nail Walls 2003
Spreadsheet is only valid for equal waler bar spacing

Maximum design tensile force at the face:

$T_0 = T_{max\text{-}s}\,[0.6+0.057\,(S_{max} - 3)]$ = 10 [0.6 + 0.057 (3.5 - 3)] = 6.3 k

Temporary Facing Reinforcement

a) Reinforcement in vertical and horizontal direction in midspan (Table A.2)

$a_{vm} = a_{hm}$ = 0.087 in^2/ft for 4x4-W2.9 x W2.9

b) Reinforcement in vertical and horizontal directions around soil nail head

$a_{vm} = a_{hn} = a_{vm} + A_{vw}/S_H$ = 0.087 + (0.2 x 0) / 3.5 = 0.09 in^2/ft

c) C_F = 2.0 (Table 5.1)

d) $\rho_n = a_{vn}/0.5h$ = (0.09 / 12)/(0.5 x 4) x 100 = 0.36 %

e) $\rho_m = a_{vm}/0.5h$ = (0.087 / 12)/(0.5 x 4) x 100 = 0.36 %

f) $\rho_{min} = 0.24 \times (f'^{0.5}_c/f_y)$ = 0.24 x 4,000 $^{0.5}$ / 60 = 0.25 %

g) $\rho_{max} = 0.05\times(f'_c/f_y)(90/(90+f_y))$ = 0.05 x (4,000 / 60)x(90 / (90 + 60)) = 2 %

h) ρ_{min} < ρ_m < ρ_{max} ?

0.25 < 0.36 < 2 OK

i) ρ_{min} < ρ_n < ρ_{max} ?

0.25 < 0.36 < 2 OK

j) $\rho_{total} = \rho_n + \rho_m$ = 0.36 + 0.36 = 0.73 %

Permanent Facing Reinforcement

a) Reinforcement area per unit length

$a_{vn} = a_{vm} =$ 0.2 in^2/ft

b) Total Reinforcement in Vertical Direction (no waler bars in perm. facing)

$a_{vn} = a_{vm} =$ 0.2 in^2/ft

c) $C_F =$ 1.0 (Table 5.1)

d) $\rho_{min} = 0.24 \times (f'_c{}^{0.5}/f_y) =$ 0.24 x 4,000 $^{0.5}$ / 60 = 0.25 %

e) $\rho_{max} = 0.05x(f'_c/f_y)(90/(90+f_y)) =$ 0.05 x (4,000 / 60)x(90 / (90 + 60)) = 2 %

f) $\rho_n = \rho_m = a_{vn}/0.5h =$ (0.20 / 12)/(0.5 x 8) x 100 = 0.42 %

ρ_{min}	<	ρ_n	<	ρ_{max}	?
0.25	<	0.42	<	2	OK

g) $\rho_{total} =$ 0.83 %

Facing Tensile Flexural Resistance (R_{FF}) - Temp. and Perm. Facing

a) Facing flexural resistance (R_{FF})

Temporary: From Table 6.4a, $R_{FF} =$ 26 k

Permanent: From Table 6.4a, $R_{FF} =$ 59 k

b) Verify: $FS_{FF}\ T_0 < R_{FF}$

Temporary:	1.35	x	6.3	=	8.5	k <	26 k	OK
Permanent:	1.5	x	6.3	=	9.4	k <	59 k	OK
	(Table 5.3)							

Facing Punching Shear Resistance (R_{FP}) - Temp. and Perm. Facing

a) Facing Punching resistance (R_{FP})

Temporary: From Table 6.4b, $R_{FP} =$ 40 k

Permanent: From Table 6.4c, $R_{FP} =$ 39 k $h_c =$ 5.00

b) Verify: $FS_{FP}\ T_0 < R_{FP}$

Temporary:	1.35	x	6.3	=	8.5	k <	40 k	OK
Permanent:	1.5	x	6.3	=	9.4	k <	39 k	OK
	(Table 5.3)							

Facing Head Stud Resistance (R_{HT}) - Permanent Facing

$A_{SH} =$ 0.20 in^2

a) Maximum tensile resistance (headed-stud tensile failure) (R_{HT})

$R_{HT} = N_H\ A_{SH}\ f_y =$ 4 x 0.20 x 60 = 47.1 k

b) Verify: $FS_{HT}\ T_0 =$ 1.8 x 6.3 = 11.3 k < 47.1 k OK

(Table 5.3)