12/19/2024

8680-00-04 Superior Bong Bridge B-16-38 Douglas County

B-16-38

Design Calculations

Prepared by



Madison, WI

Project: USH 2 over St. Louis River				
Structure Number: B-16-38		Project #: 22114		K L
Task: Light Pole CIP Anchor Analysis - loadin	g parallel to face of Parapet		Ē	ngineering
Design By: WAH	Date: 12/18/2024	Checked By: SKH	Date: 12	2/19/2024
	CONCRETE MASONRY	CIP ANCHOR DESIGN PROGR	AM	
DESIGN LOADS:				ter loads on single anchor or on group
actored Tension Force, Nu = actored Shear Force, Vu =			11.03'-k *12"/'/10"	13.24 kips 0.59 kips
NCHOR PROPERTIES:				1 inches
roposed Anchor Size = nalyze as Single Anchor or Group = ' Group, # of Anchors Effective in Tension = ' Group, # of Anchors Effective in Shear = ield Strength of Anchor, fy = ensile Strength of Anchor, fut =		For force in rebar of	or bolt only (not concrete) or bolt only (not concrete) or bolt only (not concrete)	Group 2 anchors 6 anchors 55 ksi 75 ksi
ondition of Concrete = Dry or Wet (Saturated) = Cracked or Uncracked at Service Loads = Compressive Strength = roposed Embedmen Depth = bepth of Member =		c	DK, Below Limit of 20*Dia.	Saturated Cracked 4000 psi 16 inches 19 inches
ingle Anchor Edge Distance & Spacing: Torqued or Not Torgued = Minimum Edge Distance = Minimum Spacing = Left Side:	Note	: See ACI 17.4.2.3 when located near 3 or more	edges	Not Torqued 2 inches 4 inches
Edge or Anchor = Distance to Edge or Anchor Spacing = Right Side:		OK, Meets Minimum Ed	lge Distance Requirement	Edge 6.125 inches
Edge or Anchor = Distance to Edge or Anchor Spacing = Front: Edge or Anchor =		OK, Meets Minim	num Spacing Requirement	Anchor 5.75 inches Edge
Distance to Edge or Anchor Spacing = Back: Edge or Anchor =			lge Distance Requirement	24 inches Edge
Distance to Edge or Anchor Spacing =		OK, Meets Minimum Ed	lge Distance Requirement	13 inches
NCHOR GEOMETRIC PROPERTIES: etermine Projected Concrete Breakout Area of a Singl	e Anchor A. No:			
_Nco = 9 * hef^2 =				2304.0 inches^2
= min(1.5*hef, spacing/2, edge distance {ca}) Left: S = Right: S = Front: S = Back: S =			-	6.125 inches 2.875 inches 24 inches 13 inches
_Nc =				333.0 inches^2
alculate A_Nc per ACI Figure 17.4.2.1 for Anchor Grou .5*hef = Vidth of Group = lepth of Group =	p 24 inch 18 inch 36 inch	es		
_Nc =				648 inches^2
alculate A_vc per ACI Figure 17.5.2.1b for Anchor Grou a1 = Distance from C/L anchor to edge of concrete in di .5*Ca1 = Member Depth, ha = Vidth of Group = lepth of Group =		19.00 18	inches inches inches inches inches	
_vc =				342.0 inches^2

CIP ANCHOR TENSILE RESISTANCE:			
Nominal Tensile Resistance, Nr = phi_ts*Nsa <= phi_tc*Ncb <= phi_tc*Na			
Phi Factors: Steel Classification =		Ductile	ACI 2.3
Supplementary Reinforcement Included =		Yes	ACI 17.3.3
phi_ts =		0.75	
phi_tc =		0.75	
phi_tc_pullout =		0.75	
Determine Nominal Steel Strength of Anchor in Tension, Nsa = Ase,N * f_uta:			ACI 17.4.1.2
Effective Cross-Sectional Area of Anchor in Tension, A_se,N:			710717711112
Anchor Size =	override	inches	
Area, A_se,N =		0.61 inches^2	
Tensile Strength of Anchor, futa <= 1.9*fy <= 125 ksi fy =		55 ksi	
fu =		75 ksi	
1.9*fy =	override	104.5 ksi	
Controlling Tensile Strenght, f_uta =		75 ksi	
Nsa =		45.5 kips	
phi_ts*Nsa =		34.1 kips	
Determine Nominal Concrete Breakout Strength of a Single Anchor in Tension, Ncb = A_nc * Nb / (9*hef^2 Psi Factors:	2) * psi_ed,N * psi_c,N	* psi_cp,N:	ACI 17.4.2.1a
psi_ed,N [Modification factor for tensile strength based on proximity to edges]			ACI 17.4.2.5
Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =		16 inches	OK, <= 20*Dia.
Minimum edge distance, Ca_min =		6.125 inches	
psi_ed,N =		0.777	
psi_c,N [Modification factor for tensile strength based on presence or absence of cracks]			ACI 17.4.2.6
psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads) =		1.0	
psi_cp,N [Modification factor for post-installed anchors intended for use in uncracked concrete] psi_cp,N = Supplementary Reinforce	ment Included, Therefore =	1.0 for CIP anchors	ACI 17.4.2.7
Concrete Breakout Strength of a Single Anchor in Tension in Cracked Concrete, Nb =		97.15 kips	ACI 17.4.2.2
Nob -		10.00 kinc	
Ncb = phi_tc*Ncb =		10.90 kips 8.18 kips	
Determine Nominal Concrete Breakout Strength of an Anchor Group in Tension, Ncbg = A_nc * Nb / (9*he	f^2) *psi_ec,N* psi_ed	,N * psi_c,N * psi_cp,N:	ACI 17.4.2.1b
Psi Factors:	f^2) *psi_ec,N* psi_ed	,N * psi_c,N * psi_cp,N:	
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension]	f^2) *psi_ec,N* psi_ed		ACI 17.4.2.1b ACI 17.4.2.4
Psi Factors:	f^2) *psi_ec,N* psi_ed	N * psi_c,N * psi_cp,N: 0 1.00	
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N =	f^2) *psi_ec,N* psi_ed	0 inches	ACI 17.4.2.4
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges]	f^2) *psi_ec,N* psi_ed	0 1.00	ACI 17.4.2.4 ACI 17.4.2.5
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =	f^2) *psi_ec,N* psi_ed	0 1.00 16 inches	ACI 17.4.2.4
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges]	f^2) *psi_ec,N* psi_ed	0 1.00	ACI 17.4.2.4 ACI 17.4.2.5
<pre>Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N =</pre>	f^2) *psi_ec,N* psi_ed	0 1.00 16 inches 6.125 inches	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia.
<pre>Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N = psi_c,N [Modification factor for tensile strength based on presence or absence of cracks]</pre>	f^2) *psi_ec,N* psi_ed	0 1.00 1.00 inches 6.125 0.777	ACI 17.4.2.4 ACI 17.4.2.5
<pre>Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N =</pre>	f^2) *psi_ec,N* psi_ed	0 1.00 16 inches 6.125 inches	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia.
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N = psi_c,N [Modification factor for tensile strength based on presence or absence of cracks] psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads) = psi_cp,N [Modification factor for post-installed anchors intended for use in uncracked concrete]		0 inches 1.00 16 inches 6.125 inches 0.777 1.0	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia.
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N = psi_c,N [Modification factor for tensile strength based on presence or absence of cracks] psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads) = psi_cp,N [Modification factor for post-installed anchors intended for use in uncracked concrete]	<pre>f^2) *psi_ec,N* psi_ed ment Included, Therefore =</pre>	0 1.00 1.00 inches 6.125 0.777	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =	ment Included, Therefore =	0 1.00 1.00 1.05 1.05 1.0 1.0 1.00 for CIP anchors	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =		0 inches 1.00 16 inches 6.125 inches 0.777 1.0	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =	ment Included, Therefore =	0 inches 1.00 inches 6 inches 6.125 inches 0.777 inches 1.0 for CIP anchors 97.1 kips 21.22 kips	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =	ment Included, Therefore =	0 1.00 1.00 1.0 1.0 1.0 1.0 for CIP anchors 97.1 kips	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =	ment Included, Therefore =	0 inches 1.00 inches 6 inches 6.125 inches 0.777 inches 1.0 for CIP anchors 97.1 kips 21.22 kips	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N = psi_c,N [Modification factor for tensile strength based on presence or absence of cracks] psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads) = psi_cp,N [Modification factor for post-installed anchors intended for use in uncracked concrete] psi_cp,N = Basic Concrete Breakout Strength of a Single Anchor in Tension in Cracked Concrete, Nb = Ncbg = phi_tc*Ncbg =	ment Included, Therefore =	0 inches 1.00 1.00 1.00 1.0 1.0 1.0 1.0 1.0 1.0	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7 ACI 17.4.2.2
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N = psi_c,N [Modification factor for tensile strength based on presence or absence of cracks] psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads) = psi_cp,N [Modification factor for post-installed anchors intended for use in uncracked concrete] psi_cp,N = Basic Concrete Breakout Strength of a Single Anchor in Tension in Cracked Concrete, Nb = Ncbg = phi_tc*Ncbg = Determine Nominal Pullout Strength of a Single Anchor or Anchor Group in Tension, Npn = Np *psi_c,p:	ment Included, Therefore =	0 inches 1.00 inches 6 inches 6.125 inches 0.777 inches 1.0 for CIP anchors 97.1 kips 21.22 kips	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7 ACI 17.4.2.2
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N = psi_c,N [Modification factor for tensile strength based on presence or absence of cracks] psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads) = psi_cp,N [Modification factor for post-installed anchors intended for use in uncracked concrete] psi_cp,N = Basic Concrete Breakout Strength of a Single Anchor in Tension in Cracked Concrete, Nb = Ncbg = phi_tc*Ncbg = Determine Nominal Pullout Strength of a Single Anchor or Anchor Group in Tension, Npn = Np *psi_c,p: Psi Factors: psi_c,p [Modification factor for pull-out strength based on cracking]	ment included, Therefore = for normal weight concrete	0 inches 1.00 1.00 1.00 1.0 1.0 1.0 1.0 1.0 1.0	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7 ACI 17.4.2.2 ACI 17.4.2.2
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N = psi_c,N [Modification factor for tensile strength based on presence or absence of cracks] psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads) = psi_cp,N [Modification factor for post-installed anchors intended for use in uncracked concrete] psi_cp,N = Basic Concrete Breakout Strength of a Single Anchor in Tension in Cracked Concrete, Nb = Ncbg = phi_tc*Ncbg = Determine Nominal Pullout Strength of a Single Anchor or Anchor Group in Tension, Npn = Np *psi_c,p: Psi Factors: psi_c,p [Modification factor for pull-out strength based on cracking]	ment Included, Therefore =	0 inches 1.00 1.00 1.0 1.0 1.0 1.0 for CIP anchors 97.1 kips 21.22 kips 15.91 kips 1.9	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7 ACI 17.4.2.2 ACI 17.4.2.2
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =	ment included, Therefore = for normal weight concrete	0 1.00 1.00 1.00 1.0 1.0 1.0 for CIP anchors 97.1 kips 21.22 kips 15.91 kips 1.37.22 kips 1.9 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7 ACI 17.4.2.2 ACI 17.4.2.2
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =	ment included, Therefore = for normal weight concrete	0 inches 1.00 1.00 1.06 1.05 1.0 1.0 1.0 for CIP anchors 97.1 kips 21.22 kips 15.91 kips 1.9 1.9 1.9 1.9 1.9 1.9 1.9 1.9	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7 ACI 17.4.2.2 ACI 17.4.2.2
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =	ment included, Therefore = for normal weight concrete accounting for hooked ends	0 1.00 1.00 1.00 1.0 1.0 1.0 for CIP anchors 97.1 kips 21.22 kips 15.91 kips 1.37.22 kips 1.9 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7 ACI 17.4.2.2 ACI 17.4.2.2
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =	ment included, Therefore = for normal weight concrete accounting for hooked ends	0 1.00 1.00 1.00 1.0 1.0 1.0 for CIP anchors 97.1 kips 21.22 kips 15.91 kips 1.9 1.9 1.9 1.9 1.9 1.9 1.9 1.9	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7 ACI 17.4.2.2 ACI 17.4.3.1 ACI 17.4.3.6
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ec,N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =	ment included, Therefore = for normal weight concrete accounting for hooked ends	0 1.00 1.00 1.00 1.0 1.0 1.0 for CIP anchors 97.1 kips 21.22 kips 15.91 kips 1.9 1.9 1.9 1.9 1.9 1.9 1.9 1.9	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7 ACI 17.4.2.2 ACI 17.4.3.1 ACI 17.4.3.6
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ec,N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =	ment included, Therefore = for normal weight concrete accounting for hooked ends	0 1.00 1.00 1.00 1.0 1.0 1.0 for CIP anchors 97.1 kips 21.22 kips 15.91 kips 1.37.22 kips 15.91 kips 15.91 kips 15.91 kips 15.91 kips 15.91 kips 15.91 kips 15.91 kips 16 kips 17.91 kips 19 kips 10	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7 ACI 17.4.2.2 ACI 17.4.3.1 ACI 17.4.3.6
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ec,N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =	ment included, Therefore = for normal weight concrete accounting for hooked ends	0 1.00 1.00 1.00 1.0 1.0 1.0 for CIP anchors 97.1 kips 21.22 kips 15.91 kips 1.9 1.9 1.9 1.9 1.9 1.9 1.9 1.9	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7 ACI 17.4.2.2 ACI 17.4.3.1 ACI 17.4.3.6
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ec,N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =	ment included, Therefore = for normal weight concrete accounting for hooked ends	0 1.00 1.00 1.00 1.0 1.0 1.0 for CIP anchors 97.1 kips 21.22 kips 15.91 kips 1.37.22 kips 15.91 kips 15.91 kips 15.91 kips 15.91 kips 15.91 kips 15.91 kips 15.91 kips 16 kips 17.91 kips 19 kips 10	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7 ACI 17.4.2.2 ACI 17.4.3.1 ACI 17.4.3.6

Determine Concrete Side Face Blowout of Multiple Headed Anchors in Tension, Nsbg = (1+s/6/Ca1)*Nsb):		ACI 17.4.4.2
Check Applicability: Applicable if hef > 2.5*Ca1 and anchor spacing < 6*Ca1:			ACI 17.4.4.2
hef =		16 inches	
2.5*Ca1 =		15.3125 inches	
Spacing =		5.75 inches	
6*Ca1 =		36.75 inches	
Status of Applicability =		Not Applicable	
Side Face Blowout Strength for Multiple Achors, Nsbg = (1+2/6/Ca1)*Nsb = phi_tc_pullout*Nsbg for Multiple Anchors =		77.3 kips 57.97 kips	
Summary of Design Strengths for Tension:			
Steel Strength, phi*Nsa =		68.2 kips	
Concrete Breakout Strength, phi*Ncb =	Contro	s 15.9 kips	
Pullout Strength, phi*Npn =		55.8 kips	
Sideface Blowout Strength, phi*Nsb =		N/A kips	
Controlling Tension Capacity =		15.9 kips	
Check Tensile Capacity vs. Tensile Load			
Factored Tension Force, Nu =		13.2 kips	
Controlling Tension Capacity =		15.9 kips	
Selected Anchor has Sufficient Tensile Capacity			
CIP ANCHOR SHEAR RESISTANCE:			
Nominal Shear Resistance, Vr = phi_vs*0.6*Vsa <= phi_vc*Vcb <= phi_vp*Vcp Phi Factors:			
Steel Classification =		Ductile	ACI 2.3
Supplementary Reinforcement Included =		Yes	ACI 17.3.3
phi vs =		0.65	
phi_vc =		0.75	
phi_vp =		0.75	
Determine Nominal Steel Strength of Anchor in Shear, Vsa = Ase,V * f_uta: Effective Cross-Sectional Area of Anchor in Tension, A se,N:			ACI 17.5.1.2
Anchor Diameter =	override	1 inches	
Area, A se,V =	overnae	0.606 inches^2	
Tensile Strength of Anchor, futa <= 1.9*fy <= 125 ksi			
fy =		55 ksi	
fu =		75 ksi	
1.9*fy =	override	104.5 ksi	
Controlling Tensile Strenght, f_uta =		75 ksi	
Vsa =		27.3 kips	
phi_vs*Vsa =		17.7 kips	
Determine Nominal Concrete Breakout Strength in Shear for a Single Anchor, Vcb = A_vc * Vb / (4.5*Ca1	1^2) * psi_ed,V * psi_c,	V * psi_h,V * psi_p,V:	ACI 17.5.2.1a
Psi Factors:			
psi_ed,V [Modification factor for shear strength based on proximity to edges]			ACI 17.5.2.6
Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =	override	16 inches	OK, <= 20*Dia.
Minimum edge distance, Ca_min = Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear =	override	6.125 inches	
Ca2 = Distance from C/L anchor to edge of concrete in direction of applied shear =	6.125	6.125 inches	
Direction of Shear (perpendicular is conservative) =	0.125	Perpendicular	
psi_ed,V =		0.8	
psi c,V [Modification factor for shear strength based on presence or absence of cracks and supplementa	al reinforcement]		ACI 17.5.2.7
Where analysis shows no cracking at service loads, psi_c, V =	arrennerechneriej	1.4	/10/17/15/2//
Where analysis shows cracking at service loads and no supplemental rebar or edge rebar <#4, psi_c,	V =	1.0	
Where analysis shows cracking at service loads and a #4 bar or greater between anchor and edge, ps	ii_c, V =	1.2	
Where analysis shows cracking at service loads & >= #4 bar between edge & >=#4 stirrups spaced <=4", psi_c	c, V =	1.4	
	override		
psi_c,V =		1.2	
psi_h,V [Modification factor for shear strength of anchors located in members with ha < 1.5*Ca1]			ACI 17.5.2.8
Concrete member thickness, ha =		19 inches	
Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear =		13 inches	
psi_h,V = max(sqrt(1.5*Ca1/ha),1.0) =		1.0	
nci n.V. [Modification factor for chear strength baced on loading direction]			ACI 17.5
<pre>psi_p,V [Modification factor for shear strength based on loading direction] psi_p,V =</pre>		1.00	ACI 17.5
Projected Area of Concrete Failure Surface, Avc:			
H = min(member depth, 1.5*Ca1) =		19 inches	
		C 105 1	
S1 = min(Spacing/2,perpendicular edge distance(Ca2),1.5*edge distance(Ca1)) = S2 = min(Spacing/2,perpendicular edge distance,1.5*edge distance) =		6.125 inches 2.875 inches	

Avc = H(S1+S2) =

171.0 inches^2

Γ

Concrete Breakout Strength of a Single Anchor in Shear in Cracked Concrete, Vb:		ACI 17.5.2.2
le = hef < 8*dia. =	8 inches	
diameter = f'c =	1 inches 4000 psi	
Ca1 =	13 inches	
Vb = min[7*(le/dia)^0.2 * dia^0.5 * f'c^0.5 * Ca1^1.5 ,9 *f'c^0.5 * ca1^1.5]=	26.680 kips	
Vcb = phi_vc*Vcb =	5.79 kips 4.34 kips	
Determine Nominal Concrete Breakout Strength in Shear for an Anchor Group, Vcbg = A_vc * Vb / (4.5*Ca1^2) * psi_ec,V * psi_ed,V Psi Factors:	* psi_c,V * psi_h,V * psi_p,V:	ACI 17.5.2.1b
psi_ec,V [Modification factor for anchor group loaded eccentrically in shear]		ACI 17.5.2.5
Eccentricity, e'V = Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear =	0 inches 13 inches	
psi_ec,V =	1.00	
psi_ed,V [Modification factor for shear strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =	16 inches	ACI 17.5.2.6 Warning, Exceeds 20*Dia.
Minimum edge distance, Ca_min = override	6.125 inches	
Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear =	13 inches	
Ca2 = Distance from C/L anchor to edge of concrete in direction perpendicular to Ca1 = Direction of Shear (perpendicular is conservative) =	5.75 inches Perpendicular	
	reipendicalar	
psi_ed,V =	0.79	
psi_c,V [Modification factor for shear strength based on presence or absence of cracks and supplemental reinforcement]		ACI 17.5.2.7
Where analysis shows no cracking at service loads, psi_c, V =	1.4	ACI 17.5.2.7
Where analysis shows cracking at service loads and no supplemental rebar or edge rebar <#4, psi_c, V =	1.0	
Where analysis shows cracking at service loads and a #4 bar or greater between anchor and edge, psi_c, V =	1.2 1.4	
Where analysis shows cracking at service loads & >= #4 bar between edge & >=#4 stirrups spaced <=4", psi_c, V =	7	
psi_c,V =	1.2	
psi_h,V [Modification factor for shear strength of anchors located in members with ha < 1.5*Ca1]		ACI 17.5.2.8
Concrete member thickness, ha =	19 inches	ACI 17.5.2.0
Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear =	13 inches	
psi_h,V = max(sqrt(1.5*Ca1/ha),1.0) =	1.0	
psi,v = max(sqt(1.5 Cat/ma),1.0) =	1.0	
psi_p,V [Modification factor for shear strength based on loading direction]	1.00	ACI 17.5
psi_p,V =	1.00	
Projected Area of Concrete Failure Surface, Avc:		
Avc = H(S1+S2) =	342.0 inches^2	
Concrete Breakout Strength of a Single Anchor in Shear in Cracked Concrete, Vb:		ACI 17.5.2.2
le = hef < 8*dia. =	8 inches	
diameter = f'c =	1 inches 4000 psi	
Ca1 =	13 inches	
Vb = min[7*(le/dia)^0.2 * dia^0.5 * f'c^0.5 * Ca1^1.5 , 9 *f'c^0.5 * ca1^1.5]=	26.68 kips	
Vcb =	11.50 kips	
phi_vc*Vcb =	8.63 kips	
Determine Nominal Concrete Pryout Strength for a Single Anchor, Vcp = Kcp*Ncp:		ACI 17.5.3.1(a)
Kcp = 1.0 for hef < 2.5" and 2.0 for hef >= 2.5" =	2	
Nominal Concrete Pryout Strength, Ncp = Ncb for cast in place anchors =	10.90 kips	
Vcp =	21.81 kips	
phi_vp*Vcp =	16.36 kips	
Patarmina Naminal Canavata Devaut Strangth fay a Graum of Anabara Vana - Kan*Nena		40147524/4
Determine Nominal Concrete Pryout Strength for a Group of Anchors, Vcpg = Kcp*Ncpg: Kcp = 1.0 for hef < 2.5" and 2.0 for hef >= 2.5" =	2	ACI 17.5.3.1(b)
Nominal Concrete Pryout Strength, Ncpg = Ncbg for cast in place anchors =	21.22 kips	
Vcp =	42.43 kips	
phi_vp*Vcp =	31.83 kips	
	·	
Summary of Design Strengths for Shear: Steel Strength, phi*Vsa =	106.4 kips	
Steel Strength, phi*Vsa = Concrete Breakout Strength, phi*Vcb =	8.6 kips	
Pryout Strength, phi*Vcp =	31.8 kips	
Controlling Shaar Capacity -	0 6 king	
Controlling Shear Capacity =	8.6 kips	

0.59	kips
8.63	kips

0.07 0.83

ACI 17.6

Selected Anchor has Sufficient Shear Capacity

SHEAR & TENSION INTERACTION ANALYSIS Vu/(phi*Vn) = Nu/(phi*Nn) =

For Vu/(phi*Vn) <=0.2: Nu <= phi*Nn Interaction Capacity is Sufficient

For Nu/(phi*Nn) <=0.2: Vu <= phi * Vn Not Applicable

For Vu/(phi*Vn) > 0.2 and Nu/(phi*Nn) > 0.2: Nu/(phi*Nn) + Vu/(phi*Vn) <=1.2 Not Applicable Interaction Value = N/A

Task:: 1904 Mide CP Andrea Analysis - locality program devices to face of Analysis Date:: 2016 Devices To the Analysis - locality program devices to the Analysis -	Structure Number		Drojact #1. 22114	
Design By: WM Date: 2228/2024 Checked By: GOX Date: 1229/2024 CONCRETE MASONRY CIP ANCHOR DESIGN PROGRAM Reference of the set of th	Structure Number: B-16-38		Project #: ²²¹¹⁴	
CONCRETE MASONRY CIP ANCHOR DESIGN PROGRAM Concrete Masonney CiP Anchor Depart Conchor Sectore Concrete	Task: Light Pole CIP Anchor Analysis - loading per	rpendicular to face of Parapet		Engineering
NLADDS:	Design By: WAH	Date: 12/18/2024	Checked By: SKH	Date: 12/19/2024
seed She for force, Vu =		CONCRETE MASONRY	CIP ANCHOR DESIGN PROGRA	AM
seed She for force, Vu =	GN LOADS:			
osed Anchor Site = (a Single Anchor of Group = (by, # 6 Anchor Streame (by, # 6 Anchor Streame (b), # 6 Anchor Streame (c), Berow Limit of 20 th (c), Berow Limit of		п	noment is less perpendicular to parapet	
ive as Single Anchor or Group =	HOR PROPERTIES:			
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racked or lurracked at Service Loads =				
ampresis Strength =				
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thinkmum Spacing = ft Side: Edge or Anchor = Distance to Edge or Anchor Spacing = OK, Meets Minimum Edge Distance Requirement 133 Inches inche				
df: Sie:::::::::::::::::::::::::::::::::::				
Edge or Anchor = OK, Meets Minimum Edge Distance Requirement Edge or Anchor = Distance to Edge or Anchor Spacing = OK, Meets Minimum Edge Distance Requirement Anchor Distance to Edge or Anchor = OK, Meets Minimum Edge Distance Requirement Anchor Distance to Edge or Anchor = OK, Meets Minimum Edge Distance Requirement Anchor Distance to Edge or Anchor Spacing = OK, Meets Minimum Edge Distance Requirement Edger Distance to Edge or Anchor Spacing = OK, Meets Minimum Edge Distance Requirement Edger Distance to Edge or Anchor Spacing = OK, Meets Minimum Edge Distance Requirement Edger Distance to Edge or Anchor Spacing = OK, Meets Minimum Edge Distance Requirement Edger Distance to Edge or Anchor Spacing = OK, Meets Minimum Edge Distance Requirement Edger Distance to Edge or Anchor Spacing = OK, Meets Minimum Edge Distance Requirement Edger Distance to Edge of Anchor Spacing = OK, Meets Minimum Edge Distance Requirement Edger Distance to Edge of Anchor Spacing = OK, Meets Minimum Edge Distance Requirement Edger Distance to Edge of Anchor Spacing = OK, Meets Minimum Edge Distance Requirement Edger Distance to Edge of Anchor Spacing = OK, Meets Minimum Edge				4 inches
Distance to Edge or Anchor Spacing = OK, Meets Minimum Edge Distance Requirement 13 inches ght Side: Edge or Anchor = OK, Meets Minimum Spacing Requirement 5 inches act: Edge or Anchor Spacing = OK, Meets Minimum Edge Distance Requirement 6.125 inches act: Edge or Anchor = OK, Meets Minimum Edge Distance Requirement 6.125 inches Anchor = OK, Meets Minimum Edge Distance Requirement 6.125 inches Anchor = OK, Meets Minimum Edge Distance Requirement 6.125 inches Anchor = OK, Meets Minimum Edge Distance Requirement 6.125 inches HOR GEOMETRIC PROPERTIES: Traine Projected Concrete Breakout Area of a Single Anchor, A_NC: Distance to Edge of Anchor Spacing = OK, Meets Minimum Edge Distance Requirement 6.125 inches HOR GEOMETRIC PROPERTIES: Traine Projected Concrete Breakout Area of a Single Anchor, A_NC: Distance to Edge distance (cal) ff: S = 0.11875 inches act: S = 0.11875				Edgo
ghr Side: Edge or Anchor = Distance to Edge of Anchor Spacing = Distance to Edge of Anchor Group the f = Distance to Cli Spire 17.4.2.1 for Anchor Group Edge Distance to Edge of Concrete in direction of applied shear = Distance to Cli Spire 17.5.2.1b for Anchor Group Edge Distance to Edge of Concrete in direction of applied shear = Distance to Cli Spire 17.5.2.1b for Anchor Group Edge Distance to Edge of Concrete in direction of applied shear = Distance to Cli Spire 17.5.2.1b for Anchor Group Distance to Edge of Concrete in direction of applied shear = Distance to Cli Spire to Edge of Concrete in direction of applied shear = Distance to Cli Spire to Edge of Concrete in direction of applied shear = Distance to Cli Spire to Edge of Concrete in direction of applied shear = Distance to Cli Spire to Edge of Concrete in direction of applied shear = Distance to Cli Spire to Edge of Concrete in direction of applied shear	-		OK Meets Minimum Ed	
Edge or Anchor = OK, Meets Minimum Spacing Requirement Anchor Distance to Edge or Anchor Spacing = OK, Meets Minimum Spacing Requirement Sinches Edge or Anchor = Distance to Edge or Anchor Spacing = OK, Meets Minimum Edge Distance Requirement Edge Distance to Edge or Anchor Spacing = OK, Meets Minimum Edge Distance Requirement Edge ack: Edge or Anchor Spacing = OK, Meets Minimum Edge Distance Requirement Edge Distance to Edge or Anchor Spacing = OK, Meets Minimum Edge Distance Requirement Edge Distance to Edge or Anchor Spacing = OK, Meets Minimum Edge Distance Requirement Edge Distance to Edge or Anchor Spacing = OK, Meets Minimum Edge Distance Requirement Edge Distance to Edge or Anchor Spacing = OK, Meets Minimum Edge Distance Requirement Edge Distance to Edge or Anchor Spacing = OK, Meets Minimum Edge Distance Requirement Edge Distance to Edge or Anchor Spacing = OK, Meets Minimum Edge Distance Requirement Edge Distance to Edge or Anchor Spacing = OK, Meets Minimum Edge Distance Requirement Edge Distance to Edge or Anchor Spacing = OK, Meets Minimum Edge Distance Requirement Edge Distance to Edge or Anchor Spacing = OK, Meets Minimum Edge Distance Requirement Edge Distance to Edge or Anchor Group Inches Inches Inches Bits S = Information Spacing Inches Inches Inches Information = Inches Inches Inches Inches <t< td=""><td></td><td></td><td>OK, MEELS MINIMUM Ed</td><td>Se obtance requirement 10 merles</td></t<>			OK, MEELS MINIMUM Ed	Se obtance requirement 10 merles
Distance to Edge or Anchor Spacing = OK, Meets Minimum Spacing Requirement S inches ort: Edge or Anchor = Edge or Anchor Spacing = OK, Meets Minimum Spacing Requirement 11375 inches ack: Edge or Anchor = OK, Meets Minimum Edge Distance Requirement 6.129 inches HOR ECONCETRIC PROPERTIES: Timine Projected Concrete Breakout Area of a Single Anchor, A_NC: os 9 * hef? 2 2304.0 inches^2 in(L5*hef?, spacing/2, edge distance (ca)) eft: 5 = 13 inches ack: 5 = 13 inches ack: 5 = 279.0 inches^2 Uable A_Nc per ACI Figure 17.4.2.1 for Anchor Group hef = n of Group = ave. width accounting for sloped sides 20 inches to Group = ave. width accounting for sloped sides 20 inches to Group = 10 - 10				Anchor
indification of anchor spacing =	-		OK, Meets Minim	
Distance to Edge or Anchor Spacing = 0K, Meets Minimum Edge Distance Requirement 11875 inches ack: Edge or Anchor = 1879 inches Distance to Edge or Anchor Spacing = 0K, Meets Minimum Edge Distance Requirement 6.125 inches HOR GEOMETRIC PROPERTIES: Trmine Projected Concrete Breakout Area of a Single Anchor, A_NC: co = 9 * hef^2 = 23040 inches^2 xin(15*hef, spacing/2, edge distance (ca)) eff: S = 2.5 inches 11.875 inches ack: S = 2.5 inches co = 2 * 0.279.0 inches^2 ulate A_NC per ACI Figure 17.4.2.1 for Anchor Group Hef = 24 inches h of Group = ave. width accounting for sloped sides 20 inches ca = 2.201 inches ca = 2.				
ack: Edge or Anchor Spacing = CK, Meets Minimum Edge Distance Requirement 6.125 inches HOR GEOMETRIC PROPERTIES: HOR GEOMETRIC PROPERTIES: HOR GEOMETRIC PROPERTIES: Trainine Projected Concrete Breakout Area of a Single Anchor, A_NC: co = 9 * hef^2 = 2304.0 inches^2 inif1.5*hef, spacing/2, edge distance (ca)) eft: 5 = 133 inches inches inf1.5* 5 = 133 inches ack: 5 = 279.0 inches/2 Ualte A_Nc per ACI Figure 17.4.2.1 for Anchor Group hef = 120 inches th of Group = ave. width accounting for sloped sides 20 inches cc = 200 inches/2 Ualte A_Nc per ACI Figure 17.5.2.1b for Anchor Group = 0 istance from C/L anchor to edge of concrete in direction of applied shear = 6.13 inches acti = 9.19 inches 10+9.19*2 2.8.38 inches	Edge or Anchor =			Edge
Edge or Anchor = Distance to Edge or Anchor Spacing = Distance to Edge or Anchor Spacing = OK, Meets Minimum Edge Distance Requirement HOR GEOMETRIC PROPERTIES: Projected Concrete Breakout Area of a Single Anchor, A_NC: co = 9 * hef^2 = co = 9 * hef^2 = 11 2304.0 inches* 2300.0 inches* 2300.0			OK, Meets Minimum Ed	ge Distance Requirement 11.875 inches
Distance to Edge or Anchor Spacing = OK, Meets Minimum Edge Distance Requirement 6.125 Incluster ACR GEOMETRICS: entry Projected Concrete Breakout Area of a Single Anchor, A_NC: co = 9* hef^2 = 2304.0 incluster Acressing /2, edge distance (ca)) eft: 5 = incluster Acressing /2, edge distance (ca)) eft: 5 = incluster Acressing /2, edge distance (ca)) eft: 5 = incluster Acressing /2, edge distance (ca)) eft: 5 = incluster Acressing /2, edge distance (ca)) eft: 5 = incluster Acressing /2, edge distance (ca)) eft: 5 = incluster Acressing /2, edge distance (ca)) eft: 5 = incluster Acressing /2, edge distance (ca)) incluster Acressing /2, edge distance (ca)) eft: 5 = incluster Acressing /2, edge distance (ca)) incluster Acressing /2, edge distance (ca)				
HAR GEOMETRIC PROPERTIES: remine Projected Concrete Breakout Area of a Single Anchor, A_NC: co = 9 * hef*2 = 2304.0 inches*2 ini(1.5*hef, spacing/2, edge distance (ca)) eft: 5 = 2.5 inches ight: 5 = 2.5 inches inches ack: 5 = 2.5 inches inches c = 279.0 inches*2 ulate A_Nc per ACI Figure 17.4.2.1 for Anchor Group hef = 24 inches th of Group = ave. width accounting for sloped sides 20 inches c = 200 inches*2 ulate A_vc per ACI Figure 17.5.2.1b for Anchor Group = 0 istance from C/L anchor to edge of concrete in direction of applied shear = 0.19 inches ca1 = 0.19 inches th of Group = 10+9.19*2 28.38 inches				
rmine Projected Concrete Breakout Area of a Single Anchor, A_NC: co = 9 * hef^2 = 2304.0 inches^2 nin(1.5*hef, spacing/2, edge distance (ca)) eff: S = 2304.0 inches inches cont: S = 2.5 inches ack: S = 2.25 inches cc = 2.25 inches cc = 2.279.0 inches^2 ulate A_Nc per ACI Figure 17.4.2.1 for Anchor Group hef = 24 inches inches cc = 2.20 inches cc = 2.20 inch	Distance to Edge or Anchor Spacing =		OK, Meets Minimum Ed	ge Distance Requirement 6.125 inches
co = 9 * hef^2 = 2304.0 inches^2 nin(1.5*hef, spacing/2, edge distance (ca)) 13 eft: 5 = 2.5 ight: 5 = 2.5 control 5 = 2.5 ack: 5 = 2.1 c = 279.0 ulate A_Nc per ACI Figure 17.4.2.1 for Anchor Group hef = 24 inches 2.25 th of Group = 36 inches 20 c = 279.0 verride 6.12 c = 0xerride c = 0xerride c = 0xerride e Distance from C/L anchor to edge of concrete in direction of applied shear = 6.13 Ga1 = 9.19 hord Group = 10+9.19*2 th of Group = 10+9.19*2 th of Group = 10+9.19*2		chor, A Nc:		
aft: S = 13 ight: S = 2.5 inches 11.875 inches 6.125 inches 720 inches 20 inches 20 inches 720 inches 720 inches 9.19 inches 9.19 inches 9.19 inches 9.19 inches 9.19 inches 19.00 inches 19.00 inches 19.00 inches 19.00 in Group = 10+9.19*2 </td <td></td> <td>· _ ·</td> <td></td> <td>2304.0 inches^2</td>		· _ ·		2304.0 inches^2
ight: S = ront: S = ack: S = c = ulate A_Nc per ACI Figure 17.4.2.1 for Anchor Group hef = th of Group = th of Group = e = 24 inches 279.0 inches^2 279.0 inches^2 270 inches^2 272 inches^2 272 inches^2 272 inches 272 inches^2 272 inches				
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ack: S = 6.125 inches 279.0 ulate A_Nc per ACI Figure 17.4.2.1 for Anchor Group 24 hef = 24 inches 36 inches 20 inches 9.19 inches 9.19 inches 9.10 inches 19.00 inches 10.00 inches 10.00 inches 10.9.02 inches 10.9.02				
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ulate A_Nc per ACI Figure 17.4.2.1 for Anchor Group hef = 24 hof Group = 36 inches 20 inches c = 720 inches^2 ulate A_vc per ACI Figure 17.5.2.1b for Anchor Group override = Distance from C/L anchor to edge of concrete in direction of applied shear = 6.13 Ca1 = 9.19 hof Group = 10+9.19*2 28.38 inches				0.123 menes
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th of Group = ave. width accounting for sloped sides 20 inches c = 720 inches^2 ulate A_vc per ACI Figure 17.5.2.1b for Anchor Group override = Distance from C/L anchor to edge of concrete in direction of applied shear = 6.13 inches Ca1 = 9.19 inches th of Group = 10+9.19*2 28.38 inches				
h of Group = ave. width accounting for sloped sides 20 inches c = 720 inches^2 ulate A_vc per ACI Figure 17.5.2.1b for Anchor Group override = Distance from C/L anchor to edge of concrete in direction of applied shear = 6.13 inches Ca1 = 9.19 inches the of Group = 10+9.19*2 28.38 inches				
C = 720 inches^2 ulate A_vc per ACI Figure 17.5.2.1b for Anchor Group override = Distance from C/L anchor to edge of concrete in direction of applied shear = 6.13 inches Ca1 = 9.19 inches aber Depth, ha = 19.00 inches h of Group = 10+9.19*2	-			
Jate A_vc per ACI Figure 17.5.2.1b for Anchor Group override Distance from C/L anchor to edge of concrete in direction of applied shear = Ca1 = 6.13 inches Ider Depth, ha = 9.19 inches h of Group = 10+9.19*2 28.38 inches	n or Group = ave. width accounting for sloped s	ides 20 inc	nes	
= Distance from C/L anchor to edge of concrete in direction of applied shear = 6.13 inches Ca1 = 9.19 inches hober Depth, ha = 19.00 inches h of Group = 10+9.19*2 28.38 inches	:=			720 inches^2
= Distance from C/L anchor to edge of concrete in direction of applied shear = 6.13 Ca1 = 9.19 nber Depth, ha = 19.00 th of Group = 10+9.19*2 28.38 inches	ulate A vc per ACI Figure 17.5.2.1b for Anchor Group		override	
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ber Depth, ha = 19.00 h of Group = 10+9.19*2 28.38 inches				
h of Group = 10+9.19*2 28.38 inches				
h of Group = 9.19 inches				
	h of Group =			

CIP ANCHOR TENSILE RESISTANCE:		
Nominal Tensile Resistance, Nr = phi_ts*Nsa <= phi_tc*Ncb <= phi_tc*Na		
Phi Factors: Steel Classification =	Ductile	ACI 2.3
Supplementary Reinforcement Included =	Yes	ACI 2.3 ACI 17.3.3
phi_ts =	0.75	
phi_tc =	0.75	
phi_tc_pullout =	0.75	
Determine Nominal Steel Strength of Anchor in Tension, Nsa = Ase,N * f_uta:		ACI 17.4.1.2
Effective Cross-Sectional Area of Anchor in Tension, A_se,N:		ACI 17.4.1.2
Anchor Size =	override 1 inches	
Area, A_se,N =	0.61 inches	^2
Tensile Strength of Anchor, futa <= 1.9*fy <= 125 ksi	55 ksi	
fγ = fu =	75 ksi	
1.9*fy =	override 104.5 ksi	
Controlling Tensile Strenght, f_uta =	75 ksi	
Nsa = phi_ts*Nsa =	45.5 kips 34.1 kips	
hu-0 100 -	54.1 105	
Determine Nominal Concrete Breakout Strength of a Single Anchor in Tension, Ncb = A_nc * Nb / (9*hef^2) * psi_ed,N * psi_c,N * psi_cp,N:	ACI 17.4.2.1a
Psi Factors:		
psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =	16 inches	ACI 17.4.2.5 OK, <= 20*Dia.
Minimum edge distance, Ca min =	6.125 inches	
psi_ed,N =	0.777	
psi_c,N [Modification factor for tensile strength based on presence or absence of cracks]	10	ACI 17.4.2.6
<pre>psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads) =</pre>	1.0	
psi_cp,N [Modification factor for post-installed anchors intended for use in uncracked concrete]		ACI 17.4.2.7
psi_cp,N = Supplementary Reinforcer	nent Included, Therefore = 1.0 for CIP a	anchors
	07.65	
Concrete Breakout Strength of a Single Anchor in Tension in Cracked Concrete, Nb =	97.15 kips	ACI 17.4.2.2
Ncb =	9.14 kips	
phi_tc*Ncb =	6.85 kips	
	·····	
Determine Nominal Concrete Breakout Strength of an Anchor Group in Tension, Ncbg = A_nc * Nb / (9*het Psi Factors:	^2) *psi_ec,N* psi_ed,N * psi_c,N * psi_cp,N:	ACI 17.4.2.1b
Psi Factors:	^2) *psi_ec,N* psi_ed,N * psi_c,N * psi_cp,N:	
	^2) *psi_ec,N* psi_ed,N * psi_c,N * psi_cp,N:	ACI 17.4.2.4
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension]		ACI 17.4.2.4
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N =	0 inches	ACI 17.4.2.4
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N =	0 inches	ACI 17.4.2.4 ACI 17.4.2.5
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges]	0 1.00	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia.
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =	0 1.00 16.000 inches	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia.
<pre>Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N =</pre>	0 1.00 16.000 6.125 inches inches	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia.
<pre>Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N = psi_c,N [Modification factor for tensile strength based on presence or absence of cracks]</pre>	0 1.00 1.00 16.000 6.125 0.777	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia.
<pre>Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N =</pre>	0 1.00 16.000 6.125 inches inches	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia.
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N = psi_c,N [Modification factor for tensile strength based on presence or absence of cracks] psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads) = psi_cp,N [Modification factor for post-installed anchors intended for use in uncracked concrete]	0 inches 1.00 inches 6.125 inches 0.777 1.0	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7
<pre>Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N = psi_c,N [Modification factor for tensile strength based on presence or absence of cracks] psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads) =</pre>	0 inches 1.00 inches 6.125 inches 0.777 1.0	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =	0 1.00 16.000 inches 6.125 0.777 1.0 1.0 for CIP a	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =	0 1.00 16.000 inches 6.125 inches 0.777 1.0 1.0 for CIP a	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =	0 inches 1.00 inches 16.000 inches 6.125 inches 0.777 inches 1.0 inches 1.0 for CIP a 1.0 for CIP a 1.0 for CIP a 1.0 for CIP a 23.57 kips	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N = psi_c,N [Modification factor for tensile strength based on presence or absence of cracks] psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads) = psi_cp,N [Modification factor for post-installed anchors intended for use in uncracked concrete] psi_cp,N = Basic Concrete Breakout Strength of a Single Anchor in Tension in Cracked Concrete, Nb =	0 inches 1.00 inches 6.125 inches 0.777 inches 1.0 inches 1.0 inches 0.777 inches 1.0 inches 0.777 inches	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N = psi_c,N [Modification factor for tensile strength based on presence or absence of cracks] psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads) = psi_cp,N [Modification factor for post-installed anchors intended for use in uncracked concrete] psi_cp,N = Basic Concrete Breakout Strength of a Single Anchor in Tension in Cracked Concrete, Nb = Ncbg = phi_tc*Ncbg =	0 inches 1.00 inches 16.000 inches 6.125 inches 0.777 inches 1.0 inches 1.0 for CIP a 1.0 for CIP a 1.0 for CIP a 1.0 for CIP a 23.57 kips	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7 anchors ACI 17.4.2.2
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =	0 inches 1.00 inches 16.000 inches 6.125 inches 0.777 inches 1.0 inches 1.0 for CIP a 1.0 for CIP a 1.0 for CIP a 1.0 for CIP a 23.57 kips	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =	0 inches 1.00 inches 16.000 inches 6.125 inches 0.777 inches 1.0 inches 1.0 for CIP a 1.0 for CIP a 1.0 for CIP a 1.0 for CIP a 23.57 kips	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7 anchors ACI 17.4.2.2
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N = psi_c,N [Modification factor for tensile strength based on presence or absence of cracks] psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads) = psi_cp,N [Modification factor for post-installed anchors intended for use in uncracked concrete] psi_cp,N = Basic Concrete Breakout Strength of a Single Anchor in Tension in Cracked Concrete, Nb = Ncbg = phi_tc*Ncbg = Determine Nominal Pullout Strength of a Single Anchor or Anchor Group in Tension, Npn = Np *psi_c,p: Psi Factors: psi_c,p [Modification factor for pull-out strength based on cracking]	0 inches 1.00 16.000 inches 6.125 inches 0.777 1.0 1.0 or normal weight concrete 97.1 kips 23.57 kips 17.68 kips 1	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7 ACI 17.4.2.2 ACI 17.4.2.2
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =	0 inches 1.00 inches 6.125 inches 0.777 inches 1.0 inches 23.57 kips 17.68 kips 1 inches 1	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7 ACI 17.4.2.2 ACI 17.4.2.2
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N = psi_c,N [Modification factor for tensile strength based on presence or absence of cracks] psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads) = psi_cp,N [Modification factor for post-installed anchors intended for use in uncracked concrete] psi_cp,N = Basic Concrete Breakout Strength of a Single Anchor in Tension in Cracked Concrete, Nb = Ncbg = phi_tc*Ncbg = Determine Nominal Pullout Strength of a Single Anchor or Anchor Group in Tension, Npn = Np *psi_c,p: Psi Factors: psi_c,p [Modification factor for pull-out strength based on cracking]	0 inches 1.00 16.000 inches 6.125 inches 0.777 1.0 1.0 or normal weight concrete 97.1 kips 23.57 kips 17.68 kips 1	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7 ACI 17.4.2.2 ACI 17.4.2.2
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =	0 inches 1.00 inches 6.125 inches 0.777 inches 1.0 inches 23.57 kips 17.68 kips 1 inches 1	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7 ACI 17.4.2.2 ACI 17.4.2.2
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ec,N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =	0 inches 1.00 inches 6.125 inches 0.777 inches 1.0 inches 1.0 inches 0.777 inches 1.0 inches 1.0 inches 0.777 inches 1.0 inches 23.57 kips 17.68 kips 1 inches 27.91 kips 83.74 kips	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7 ACI 17.4.2.2 ACI 17.4.3.1 ACI 17.4.3.1
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =	0 inches 1.00 inches 6.125 inches 0.777 inches 1.0 inches 1.0 inches 0.777 inches 1.0 inches 1.0 inches 0.777 inches 1.0 inches 23.57 kips 17.68 kips 1 inches 27.91 kips 83.74 kips	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7 ACI 17.4.2.2 ACI 17.4.2.2
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ec,N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =	0 inches 1.00 inches 6.125 inches 0.777 inches 1.0 inches 0.777 inches 1.0 inches 0.777 inches 1.0 inches 0.777 inches 1.0 inches 1.0 inches 1.0 inches 1.0 inches	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7 ACI 17.4.2.2 ACI 17.4.3.1 ACI 17.4.3.1 ACI 17.4.3.6
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ec,N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =	0 inches 1.00 inches 1.00 inches 6.125 inches 0.777 inches 1.0 inches 0.777 inches 1.0 inches 0.777 inches 1.0 inches 0.777 inches 1.0 inches 1.0 inches 1.0 inches 1.0 inches	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7 ACI 17.4.2.2 ACI 17.4.3.1 ACI 17.4.3.1 ACI 17.4.3.6
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ec,N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =	0 inches 1.00 inches 6.125 inches 0.777 inches 1.0 inches 0.777 inches 1.0 inches 0.777 inches 1.0 inches 0.777 inches 1.0 inches 1.0 inches 1.0 inches 1.0 inches	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7 ACI 17.4.2.2 ACI 17.4.3.1 ACI 17.4.3.1 ACI 17.4.3.6
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ec,N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =	0 inches 1.00 inches 1.00 inches 6.125 inches 0.777 inches 1.0 inches 0.777 inches 1.0 inches 0.777 inches 1.0 inches 0.777 inches 1.0 inches 1.0 inches 1.0 inches 1.0 inches	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7 ACI 17.4.2.2 ACI 17.4.3.1 ACI 17.4.3.1 ACI 17.4.3.6
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N = psi_c,N [Modification factor for tensile strength based on presence or absence of cracks] psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads) = psi_cp,N [Modification factor for post-installed anchors intended for use in uncracked concrete] psi_cp,N = Supplementary Reinforcer Basic Concrete Breakout Strength of a Single Anchor in Tension in Cracked Concrete, Nb = nccg = phi_tc*Ncbg = Determine Nominal Pullout Strength of a Single Anchor or Anchor Group in Tension, Npn = Np *psi_c,p: Psi Factors: psi_cp [Modification factor for pull-out strength based on cracking] Pullout Strength for a Single Anchor, Np = 8*Abrg*fc = phi_tc_pullout*Nag for Single Anchor = phi_tc_pullout*Nag for Single Anchor Group = Determine Concrete Side Face Blowout of a Headed Single Anchor in Tension, Nsb = 160*Ca1*Abrg*0.5*Ia Check Applicability: Applicable if hef > 2.5*Ca1: hef = 2.5*Ca1 = Status of Applicability =	0 inches 1.00 inches 6.125 inches 0.777 inches 1.0 inches 1.0 inches 0.777 inches 1.0 inches 0.777 inches 1.0 inches 0.777 inches 1.0 inches 0.777 inches 1.0 inches 23.57 kips 17.68 kips 1 inches 27.91 kips 83.74 kips mbda_a*ffc^0.5: inches 16 inches Not Applicable inches	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7 ACI 17.4.2.2 ACI 17.4.3.1 ACI 17.4.3.1 ACI 17.4.3.6

ACI 17.4.4.2

Check Applicability: Applicable if hef > 2.5*Ca1 and anchor spacing < 6*Ca1: hef = 16 inches 2 5*Ca1 = 15.3 inches Spacing = inches 6*Ca1 = 36.75 inches Status of Applicability = Not Applicable Side Face Blowout Strength for Multiple Achors, Nsbg = (1+2/6/Ca1)*Nsb = 75.9 kips 56.95 kips phi_tc_pullout*Nsbg for Multiple Anchors = Summary of Design Strengths for Tension: Steel Strength, phi*Nsa = 102.3 kips Concrete Breakout Strength, phi*Ncb = Control 17.7 kips Pullout Strength, phi*Npn = 83.7 kips Sideface Blowout Strength, phi*Nsb = N/A kips 17.7 kips Controlling Tension Capacity = Check Tensile Capacity vs. Tensile Load Factored Tension Force, Nu = 17.3 kips Controlling Tension Capacity = 17.7 kips Selected Anchor has Sufficient Tensile Capacity CIP ANCHOR SHEAR RESISTANCE: Nominal Shear Resistance, Vr = phi_vs*0.6*Vsa <= phi_vc*Vcb <= phi_vp*Vcp Phi Factors: Steel Classification = ACI 2.3 Ductile Supplementary Reinforcement Included = Ye ACI 17.3.3 phi vs = 0.65 phi_vc = 0.75 phi_vp = 0.75 Determine Nominal Steel Strength of Anchor in Shear, Vsa = Ase,V * f_uta: ACI 17.5.1.2 Effective Cross-Sectional Area of Anchor in Tension, A se,N: Anchor Diameter = override 1 inches Area, A se,V = 0.606 inches^2 Tensile Strength of Anchor, futa <= 1.9*fy <= 125 ksi fy = ksi 55 fu = 75 ksi 1.9*fy = 104.5 override ksi Controlling Tensile Strenght, f_uta = ksi 75 27.3 kips Vsa = phi_vs*Vsa = 17.7 kips Determine Nominal Concrete Breakout Strength in Shear for a Single Anchor, Vcb = A_vc * Vb / (4.5*Ca1^2) * psi_ed, V * psi_e, V * psi_h, V * psi_p, V: ACI 17.5.2.1a Psi Factors: psi_ed,V [Modification factor for shear strength based on proximity to edges] ACI 17.5.2.6 Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = 16 inches OK, <= 20*Dia. 6.125 inches Minimum edge distance, Ca min = override Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear = 6.125 inches Ca2 = Distance from C/L anchor to edge of concrete in direction perpendicular to Ca1 = 6.125 6.125 inches Direction of Shear (perpendicular is conservative) = Perpendicula 0.9 psi ed,V = psi_c,V [Modification factor for shear strength based on presence or absence of cracks and supplemental reinforcement] ACI 17.5.2.7 Where analysis shows no cracking at service loads, psi_c, V = 1.4 Where analysis shows cracking at service loads and no supplemental rebar or edge rebar <#4, psi_c, V = 1.0 Where analysis shows cracking at service loads and a #4 bar or greater between anchor and edge, psi_c, V = 1.2 Where analysis shows cracking at service loads & >= #4 bar between edge & >=#4 stirrups spaced <=4", psi_c, V 1.4 override 1.2 psi_c,V = psi_h,V [Modification factor for shear strength of anchors located in members with ha < 1.5*Ca1] ACI 17.5.2.8 Concrete member thickness, ha = 19 inches Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear = 6.125 inches psi_h,V = max(sqrt(1.5*Ca1/ha),1.0) = 1.0 psi_p,V [Modification factor for shear strength based on loading direction] ACI 17.5 psi_p,V = 1.00 Projected Area of Concrete Failure Surface, Avc: H = min(member depth, 1.5*Ca1) = 9.1875 inches S1 = min(Spacing/2,perpendicular edge distance(Ca2),1.5*edge distance(Ca1)) = inches 9.1875 S2 = min(Spacing/2,perpendicular edge distance,1.5*edge distance) = 2.5 inches Avc = H(S1+S2) =107.4 inches^2

Determine Concrete Side Face Blowout of Multiple Headed Anchors in Tension, Nsbg = (1+s/6/Ca1)*Nsb:

Concrete Breakout Strength of a Single Anchor in Shear in Cracked Concrete, Vb: le = hef < 8*dia. = diameter =	8 inches	ACI 17.5.2.2
f'c = Ca1 =	4000 psi 6.125 inches	
Vb = min[7*(le/dia)^0.2 * dia^0.5 * f'c^0.5 * Ca1^1.5 , 9 *f'c^0.5 * ca1^1.5]=	8.628 kips	
Vcb = phi_vc*Vcb =	5.93 kips 4.45 kips	
Determine Nominal Concrete Breakout Strength in Shear for an Anchor Group, Vcbg = A_vc * Vb / (4.5*Ca1^2) * psi_ec,V * psi_ed, Psi Factors:	V * psi_c,V * psi_h,V * psi_p,V:	ACI 17.5.2.1b
psi_ec,V [Modification factor for anchor group loaded eccentrically in shear] Eccentricity, e'V = Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear = psi_ec,V =	0 inches 6.125 inches 1.00	ACI 17.5.2.5
psi_ed,V [Modification factor for shear strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =	16 inches 6.125 inches 6.125 inches 9 sinches 9 sinches 9 sinches	ACI 17.5.2.6 Warning, Exceeds 20*Dia.
psi_ed,V =	0.86	
psi_c,V [Modification factor for shear strength based on presence or absence of cracks and supplemental reinforcement] Where analysis shows no cracking at service loads, psi_c, V = Where analysis shows cracking at service loads and no supplemental rebar or edge rebar <#4, psi_c, V = Where analysis shows cracking at service loads and a #4 bar or greater between anchor and edge, psi_c, V = Where analysis shows cracking at service loads & >= #4 bar between edge & >=#4 stirrups spaced <=4", psi_c, V =	1.4 1.0 1.2 1.4	ACI 17.5.2.7
psi_c,V =	1.2	
psi_h,V [Modification factor for shear strength of anchors located in members with ha < 1.5*Ca1] Concrete member thickness, ha = Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear =	19 inches 6.125 inches	ACI 17.5.2.8
psi_h,V = max(sqrt(1.5*Ca1/ha),1.0) =	1.0	
psi_p,V [Modification factor for shear strength based on loading direction] psi_p,V =	1.00	ACI 17.5
Projected Area of Concrete Failure Surface, Avc: Avc = H(S1+S2) =	260.7 inches^2	
Concrete Breakout Strength of a Single Anchor in Shear in Cracked Concrete, Vb: le = hef < 8*dia. =	8 inches	ACI 17.5.2.2
diameter = fc =	1 inches 4000 psi	
	6.125 inches	
Vb = min[7*(le/dia)^0.2 * dia^0.5 * f'c^0.5 * Ca1^1.5 , 9 *f'c^0.5 * ca1^1.5]= Vcb =	8.63 kips	
phi_vc*Vcb =	13.81 kips 10.35 kips	
Determine Nominal Concrete Pryout Strength for a Single Anchor, Vcp = Kcp*Ncp: Kcp = 1.0 for hef < 2.5" and 2.0 for hef >= 2.5" = Nominal Concrete Pryout Strength, Ncp = Ncb for cast in place anchors =	2 9.14 kips	ACI 17.5.3.1(a)
Vcp = phi_vp*Vcp =	18.27 kips 13.70 kips	
Determine Nominal Concrete Pryout Strength for a Group of Anchors, Vcpg = Kcp*Ncpg: Kcp = 1.0 for hef < 2.5" and 2.0 for hef >= 2.5" = Nominal Concrete Pryout Strength, Ncpg = Ncbg for cast in place anchors =	2 23.57 kips	ACI 17.5.3.1(b)
Vcp = phi_vp*Vcp =	47.15 kips 35.36 kips	
Summary of Design Strengths for Shear: Steel Strength, phi*Vsa = Concrete Breakout Strength, phi*Vcb =	106.4 kips 10.4 kips	
Pryout Strength, phi*Vcp =	35.4 kips	
Controlling Shear Capacity =	10.4 kips	

0.52 kips 10.35 kips

0.05 0.98

Selected Anchor has Sufficient Shear Capacity

SHEAR & TENSION INTERACTION ANALYSIS Vu/(phi*Vn) = Nu/(phi*Nn) =

For Vu/(phi*Vn) <=0.2: Nu <= phi*Nn Interaction Capacity is Sufficient

For Nu/(phi*Nn) <=0.2: Vu <= phi * Vn Not Applicable

For Vu/(phi*Vn) > 0.2 and Nu/(phi*Nn) > 0.2: Nu/(phi*Nn) + Vu/(phi*Vn) <=1.2 Not Applicable Interaction Value = N/A

ACI 17.6

Structure Number: B-16-38 Task: Parapet Adhesive Anchor Analysis - Median Parapets		Project #: ²²¹¹⁴	 LKSS
Task: Parapet Adhesive Anchor Anal	ysis - Median Parapets		Engineering

	CONCRETE MASONRY ADHESIVE ANCHOR		
DESIGN LOADS:			Enter loads on single
Factored Tension Force, Nu =			
Continuous Factored Tension Force, Nus {from load	s that are always present} =		(
Factored Shear Force, Vu =			(
ANCHOR PROPERTIES:			
Proposed Bar Size =			4
Analyze as Single Anchor or Group =		Group Analysis Required	Grou
If Group, # of Anchors Effective in Tension =	10' width, all new anchors - accounts for one side	For force in rebar or bolt only (not concrete)	16
f Group, # of Anchors Effective in Shear =	10' width, all new anchors - accounts for two sides	For force in rebar or bolt only (not concrete)	33
Condition of Concrete =			1
Dry or Wet (Saturated) =			Saturated
Cracked or Uncracked at Service Loads =			Cracker
Compressive Strength =			400
Proposed Embedmen Depth =		OK, Below Limit of 20*Dia.	5.2
Depth of Member =			9.00
Single Anchor Edge Distance & Spacing:	Note: See ACI 17.4.2.3 when lo	cated near 3 or more edges	
Minimum Edge Distance = 6*dia. =			3.7
Minimum Spacing = 6*dia. =			3.7
Left Side:			
Edge or Anchor =			Ancho
Distance to Edge or Anchor Spacing =		OK, Meets Minimum Spacing Requirement	8.00
Right Side:			1
Edge or Anchor =			Ancho
Distance to Edge or Anchor Spacing =		OK, Meets Minimum Spacing Requirement	8.00
Front:			
Edge or Anchor =			Edg
Distance to Edge or Anchor Spacing =		OK, Meets Minimum Edge Distance Requirement	4.0
Back:			
Edge or Anchor =			Edg
Distance to Edge or Anchor Spacing =		OK, Meets Minimum Edge Distance Requirement	90.00

ANCHOR GEOMETRIC PROPERTIES: Determine Projected Concrete Breakout Area of a Single Adhesive Anchor, A_Nc: S = min(1.5*hef, spacing/2, edge distance {ca}) Left: S = 4 Right: S = 4 Front: S = 4 Back: S = 7.875 A_Nc = 95.0 Calculate A_Nc per ACI Figure 17.4.2.1 for Anchor Group 1.5*hef = 7.875 inches Width of Group = 135.75 inches Depth of Group = 11.88 inches A_Nc = 1612.0 Determine Projected Influence Area of a Single Adhesive Anchor, A_Na: S = min(C_Na, spacing/2, edge distance {ca}) 510 tau_uncr = C_Na = 10 * Dia. * (tau_uncr/1100)^0.5 = 4.26 Left: S = 4.00

Right: S = 4.00 Front: S = 4.00 Back: S = 4.26 A_Na = 66.0

Calculate A_Na per ACI Figure 17.4.5.1 for Anchor Group C_Na = 10 * Dia. * (tau_uncr/1100)^0.5 = Width of Group =	4.26 inches 128.51 inches	
Depth of Group =	8.26 inches	
A_Na =		1060.9
Calculate A_vc per ACI Figure 17.5.2.1b for Anchor Group Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear = 1.5*Ca1 = Member Depth, ha = Width of Group = Depth of Group =	<u>override</u> 4.00 inches 6.00 inches 9.00 inches 132.00 inches 4.00 inches	ACI Case 1, 1/2 load to
A_vc =		528.0
ADHESIVE ANCHOR TENSILE RESISTANCE:		
Nominal Tensile Resistance, Nr = phi_ts*Nsa <= phi_tc*Ncb <= phi_tc*Na Phi Factors:		
Steel Classification =		Ductile
Supplementary Reinforcement Included = phi ts =		<u>Yes</u> 0.75
phi_ts =		0.65
phi_tc_pullout =		0.65
Determine Nominal Steel Strength of Anchor in Tension, Nsa = Ase,N * f_uta:		
Effective Cross-Sectional Area of Anchor in Tension, A_se,N:		
Bar # =	override	# 5
Area, A_se,N = Tensile Strength of Anchor, futa <= 1.9*fy <= 125 ksi		0.31 inches^2
fy =		60 ksi
fu =		90 ksi
1.9*fy =	<u>override</u>	114 ksi
Controlling Tensile Strenght, f_uta =		90 ksi
Nsa = phi_ts*Nsa =		27.6 kips 20.7 kips
Determine Nominal Concrete Breakout Strength of a Single Anchor in Tension, Ncb = A_	nc * Nb / (9*hef^2) * psi ed.N * psi c.N * psi cp.N:	
Psi Factors:		
psi_ed,N [Modification factor for tensile strength based on proximity to edges]		
Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min =		5.25 inches 4 inches
psi_ed,N =		0.852
psi_c,N [Modification factor for tensile strength based on presence or absence of crack psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads	-	1.0
psi_cp,N [Modification factor for post-installed anchors intended for use in uncracked	concrete]	
Critical Edge Distance, Cac = 2*hef =	Supplementary Deinforcement Included Therefore -	10.5 inches 1.000
psi_cp,N =	Supplementary Reinforcement Included, Therefore =	1.000
Concrete Breakout Strength of a Single Anchor in Tension in Cracked Concrete, Nb =		12.93 kips
Ncb =		4.22 kips
phi_tc*Ncb =		2.74 kips
Determine Nominal Concrete Breakout Strength of an Anchor Group in Tension, Ncbg = Psi Factors:	A_nc * Nb / (9*het/2) *psi_ec,N* psi_ed,N * psi_c,N *	psi_cp,N:
psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension]		
Eccentricity, e'N =		0.00 inches
psi_ec,N =		1.00
psi_ed,N [Modification factor for tensile strength based on proximity to edges]		
Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =		5.25 inches
Minimum edge distance, Ca_min =		4 inches
psi_ed,N =		0.852
psi_c,N [Modification factor for tensile strength based on presence or absence of crack psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads		1.0
psi_cp,N [Modification factor for post-installed anchors intended for use in uncracked	concrete]	
Critical Edge Distance, Cac = 2*hef =	-	10.5 inches
psi_cp,N =	Supplementary Reinforcement Included, Therefore =	1.000
Basic Concrete Breakout Strength of a Single Anchor in Tension in Cracked Concrete, Nb =	for normal weight concrete	10.3 kips
		F _
Ncbg =		57.31 kips
phi_tc*Ncbg =		37.25 kips

Determine Nominal Bond Strength of a Single Anchor in Tension, Na = A_na * Nba / (4	!*C_na^2) * psi_ed,Na * psi_cp,Na:	
Psi Factors: psi ed,Na [Modification factor for tensile strength of adhesive anchors based on pro	vimity to edges]	
Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =	kinity to cugesj	5.25 inches
Minimum edge distance, Ca_min =		4 inches
C_Na = distance required to develop full bond strength =		4.26 inches
psi_ed,Na =		0.982
psi_cp,Na [Modification factor for pull-out strength of adhesive anchors]		
Critical Edge Distance, Cac = 2*hef =		10.5 inches
psi_cp,Na =	Supplementary Reinforcement Included, Therefore =	1.00
Bond Strength in Tension of a Single Adhesive Anchor, Nba = tau_cr * pi * dia. * hef:		
tau = Nba =		410 psi 4.2 kips
NDa -		4.2 Kips
Na =		3.78 kips
phi_tc_pullout*Na =		2.46 kips
	····	
Determine Nominal Bond Strength of an Anchor Group in Tension, Nag = A_na * Nba ,	/ (4*C_na^2) *psi_ec,Na* psi_ed,Na * psi_cp,Na:	
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension]		
Eccentricity, e'N =		0 inches
psi_ec,N =		1.00
psi_ed,Na [Modification factor for tensile strength of adhesive anchors based on pro	ximity to edges]	
Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =		5.25 inches
Minimum edge distance, Ca_min = C_Na = distance required to develop full bond strength =		4 inches 4.26 inches
psi_ed,Na =		0.982
psi_cp,Na [Modification factor for pull-out strength of adhesive anchors]		
Critical Edge Distance, Cac = 2*hef =		10.5 inches
psi_cp,Na =	Supplementary Reinforcement Included, Therefore =	1.00
Bond Strength in Tension of a Single Adhesive Anchor, Nba = tau cr * pi * dia. * hef:		
tau =		410 psi
Nba =		4.2 kips
Nag =		60.78 kips
phi_tc_pullout*Nag =		39.51 kips
Check Tensile Capacity vs. Tensile Load		
Factored Tension Force, Nu =		0 kips
Nominal Tensile Resistance, Nr = min(phi_ts*Nsa, phi_tc*Ncb, phi_tc*Na) =		37.25 kips
Selected Anchor has Sufficient Tensile Capacity		
Check Sustained Tensile Capacity vs. Sustained Tensile Load Factored Sustained Tension Force, Nus =		0.00 kips
Nominal Tensile Resistance, Nr = 0.50*phi_tc_pullout*Nba =		21.98 kips
		22100 1000
Selected Anchor has Sufficient Tensile Capacity		
ADHESIVE ANCHOR SHEAR RESISTANCE:		
Nominal Shear Resistance, Vr = phi_vs*0.6*Vsa <= phi_vc*Vcb <= phi_vp*Vcp Phi Factors:		
Steel Classification =		Ductile
Supplementary Reinforcement Included =		Yes
phi_vs =		0.65
phi_vc =		0.75
phi_vp =		0.75
Determine Nominal Steel Strength of Anchor in Shear, Vsa = Ase,V * f_uta:		
Effective Cross-Sectional Area of Anchor in Tension, A se,N:		
Bar # =	<u>override</u>	# 5
Area, A_se,V =		0.307 inches^2
Tensile Strength of Anchor, futa <= 1.9*fy <= 125 ksi		
fy =		60 ksi
fu =		90 ksi
1.9*fy = Controlling Tensile Strength f uta =	<u>override</u>	114 ksi
Controlling Tensile Strenght, f_uta =		90 ksi
Vsa =		16.6 kips
phi_vs*Vsa =		10.77 kips

Effective Embedment Depth of Anchor, hef << 20 * anchor dameter = 5.25 inche Minimum edge distance, Ca_min = 5.25 inche Cat = Distance from C/L anchor to edge of concrete in direction of applied shear = 5.25 inche Cat = Distance from C/L anchor to edge of concrete in direction perpendicular to Cat = 9 inche Direction of Shear (perpendicular is a service loads, psi_C, V = 1.00 psi_cV (Modification factor for shear strength based on presence or absence of cracks and supplemental reinforcement) 1.4 Where analysis shows cracking at service loads and a 4D aor greater between anchor and edge, psi_C, V = 1.2 Where analysis shows cracking at service loads and a 4D aor greater between anchor and edge, psi_C, V = 1.2 psi_CV = 1.4 psi_CV = 1.2 psi_CV = 1.2 psi_CV = 1.2 psi_CV = 1.2 psi_D, V (Modification factor for shear strength of anchors located in members with ha < 1.5*Call 0 verride psi_D, V (Modification factor for shear strength based on loading direction] 1.0 psi_D, V (Modification factor for shear strength based on loading direction] 1.0 psi_D, V = 1.00 1.0 psi_D, V = 1.00 1.00 psi_D, V =	psi ed,V [Modification factor for shear strength based on proximity to edges]		
$ \begin{array}{c} thermal region that the constraints of the constraints of a dependence of the constraints of t$		5.25 inc	ches
Cold - Detection of Starting At Section 2 origin of concrete in direction perpendicular to Call =			
Direction of Shear (perpendicular is conservative) = Perpendicular pil_cV (A = 1.00 pil_cV (Modification factor for these strength band on presence or absence of acads and supplemental minforcement] 1.4 Where analysis above cracking a service loads and as bur or greater between and/or and eta, pil_c V = 1.4 Where analysis above cracking a service loads a ab bur or greater between and/or and eta, pil_c V = 1.4 Where analysis above cracking a service loads a ab bur or greater between and/or and eta, pil_c V = 1.2 pil_cV = 1.2 pil_sV (Modification factor for shear strength of anchors located in members with ha < 1.5*Call	Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear =	4 inc	ches
pi _cV =			ches
<pre>virtual control of the start of the start of the start of presence or absence of cacks and supplemental reinforcement) Where analysis shows cacking at service loads, and a #A bar or greater between and/or and degs, psi_c, V = 10 Where analysis shows cacking at service loads and a #A bar or greater between and/or and degs, psi_c, V = 10 Where analysis shows cacking at service loads and a supplemental reinforcement) Where analysis shows cacking at service loads and a #A bar or greater between and/or and degs, psi_c, V = 10 Where analysis shows cacking at service loads and a #A bar or greater between and/or and degs, psi_c, V = 10 Where analysis shows cacking at service loads and a #A bar or greater between and/or and/or greater degree deal at the service medge bards the service and/or a</pre>	Direction of Shear (perpendicular is conservative) =	Perpendicular	
Where analysis tows nor carding at service loads, poil, c, V = 14 Where analysis tows carding at service loads and a NB are or greater between and/or and degs, pJ, c, V = 10 Where analysis tows carding at service loads and a NB are or greater between and/or and degs, pJ, c, V = 12 pi_LCV = 0 pi_LV (Modification factor for shear strength based on loading direction) 0 pi_LN = 10 pi_LN = 100 pi_LN = 100 pi_LN = 0 pi_LN = 0 <t< td=""><td>psi_ed,V =</td><td>1.00</td><td></td></t<>	psi_ed,V =	1.00	
Where analysis shows nor carking at service loads, psi_c, V = 14 Where analysis shows carking at service loads and a Sub par or greater between and/or and degs, pi_c, V = 10 Where analysis shows carking at service loads and a Sub par or greater between and/or and degs, pi_c, V = 12 Where analysis shows carking at service loads and a Sub par or greater between and/or and degs, pi_c, V = 12 pi_c, V = 12 pi_c, V = 0 pi_c, V = 10 pi_c, V = 10 pi_c, V = 10 pi_c, V = 10 pi_c, V = 100 pi_c, V = 10 pi_c, V = 0 <td>nsi c.V.[Modification factor for shear strength based on presence or absence of cracks and supplemental reinforcement]</td> <td></td> <td></td>	nsi c.V.[Modification factor for shear strength based on presence or absence of cracks and supplemental reinforcement]		
Where analysis flows: cracking at curve loads and a dap or petter betwoen and control and code, price, V = 1.2 10 Where analysis shows: cracking at curve loads and a dap or petter betwoen and code, price, V = 1.2 12 pil_s(V) = 1.2 pil_s(V) Holdification factor for shear strength of anchors located in members with ha < 1.5*Ca1		1.4	
Where analysis shows cacking at service loads &> #4 bur between edge &> #4 storups spaced <=4", pil_c,v" =		1.0	
pi_c,V 12 pi_c,V 12 pi_c,V 12 Concrete member thickes, b, = 1 Concrete member thickes, b, = 1 Concrete member thickes, b, = 1 Concrete member thickes, b, = 10 pi_c,V 10 pi_c,V 10 pi_c,V 100 pi_c,V	Where analysis shows cracking at service loads and a #4 bar or greater between anchor and edge, psi_c, V =	1.2	
$ pi_{L_{q}}V_{q} = 12 $ $ pi_{L_{q}}V_{q} = $	Where analysis shows cracking at service loads & >= #4 bar between edge & >=#4 stirrups spaced <=4", psi_c, V =	1.4	
<pre>i, by [Modification factor for shear strength of anchors located in members with ha < 15*Cal] Concrete member thickness, ha = 9 inche Cal = Distance from (C, anchor to edge of concrete in direction of applied shear = 4 inche pi_, hv = max(qrt(1.5*Cal/ha), 1.0) = 1.0 pi_, hv = 1.00 pi_, hv = max(qrt(1.5*Cal/ha), 1.0) = 1.0 pi_, hv = 1.00 pieted Area of Concrete Failure Surface, Ave: H = Infinemether distribution factor for shear strength based on loading direction] pi_, hv = 1.00 pieted Area of Concrete Failure Surface, Ave: H = Infinemether distribution factor for shear strength based on loading direction] pi_, hv = 0.00 pieted Area of Concrete Failure Surface, Ave: H = Infinemether distribution factor for shear strength based on loading direction] pi_, hv = 0.00 pieted Area of Concrete Failure Surface, Ave: H = Infinemether distribution factor for shear strength based on loading direction] pi_, av = 0.00 pi_, dv = 0.</pre>			
Concrete member thickness, ha = 9 indee Cat = Distance from (/L) anchor to edge of concrete in direction of applied shear = 4 indee pil_b,V = mask(qrt(1.5*Ca1/hb),1.0) = 1.0 pil_b,V = mask(qrt(1.5*Ca1/hb),1.0) = 1.00 pic_b,V = mask(qrt(1.5*Ca1/hb),1.0) = 6 indee S1 = min(pacing/2, perpendicular edge distance,1.5*edge distance(Ca1)) = 6 indee S1 = min(pacing/2, perpendicular edge distance,1.5*edge distance(Ca1)) = 4 indee S2 = min(pacing/2, perpendicular edge distance,1.5 *edge distance,1.5*edge distance,2.5*edge distance,1.5*edge distance,2.5*edge distance,2.5*e	psi_c,V =	1.2	
Concrete member thickness, ha = 9 indee Cat = Distance from (/L) anchor to edge of concrete in direction of applied shear = 4 indee pil_b,V = mask(qrt(1.5*Ca1/hb),1.0) = 1.0 pil_b,V = mask(qrt(1.5*Ca1/hb),1.0) = 1.00 pic_b,V = mask(qrt(1.5*Ca1/hb),1.0) = 6 indee S1 = min(pacing/2, perpendicular edge distance,1.5*edge distance(Ca1)) = 6 indee S1 = min(pacing/2, perpendicular edge distance,1.5*edge distance(Ca1)) = 4 indee S2 = min(pacing/2, perpendicular edge distance,1.5 *edge distance,1.5*edge distance,2.5*edge distance,1.5*edge distance,2.5*edge distance,2.5*e	psi h.V [Modification factor for shear strength of anchors located in members with ha < 1.5 *Ca1]		
$p_{1}^{1}h_{i}^{1} = ma(s(qr(1.5^{c}a1/h_{i}).0) = 1 0$ $p_{1}^{1}h_{i}^{1}V = ma(s(qr(1.5^{c}a1/h_{i}).10) = 1$		9 inc	ches
$p_{1,p}(V) = 0$ p_{1	Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear =	4 inc	ches
$ p_{1} [V] Modification factor for shear strength based on loading direction] pi_2_NV = 1.00 optexted Area of Concrete Failure Surface, Ave: H = min(member depth, 15*Ca1, 2) = 6 inche S1 = min[Spacing/2, perpendicular edge distance, 1.5*edge distance] = 4 inche S2 = min[Spacing/2, perpendicular edge distance, 1.5*edge distance] = 4 inche Ave: = H(S1+S2) = 6 inche S1 = min[Spacing/2, perpendicular edge distance, 1.5*edge distance] = 4 inche Ave: = H(S1+S2) = 6 inche S1 = min[Spacing/2, perpendicular edge distance, 1.5*edge distance] = 6 inche fe = 6 * dia. = 6 inche fe = 6 * dia. = 6 inche fe = 6 * dia. = 6 * dia$			
pi_p_V * 1.00 picted Area of Concrete Failure Surface, Are: 6 F = min(member depth, 1.5*c1); 6 S1 = min(Spacing/2, perpendicular edge distance, 1.5*edge distance) = 4 Are = M(51+52) = 48.0 Are = M(51+52) = 48.0 Are = M(51+52) = 5 Cal = 0.025 Cal = 0.025 Vb = min(7*(le/dia)^0.0.2* dia^0.5* fc^0.0.5* cal^1.1.5, 9 *fc^0.5* cal^1.5] = 4.244 Vb = 2.55 Jue = 0.000 pi_u_cvV (Modification factor for anchor group loaded eccentrically in shear) 0.000 Concrete Breakout Strength in Shear for an Anchor Group, Vdag = A_uvc* Vb / (4.5*Cal^0.2)* pi_u_cvV * pi_u_cvV * pi_u_vV * pi_u_pv. Jue = V (Modification factor for shear strength based on proximity to edge.1 0.000 Di edv (Modification fa	psi_h,V = max(sqrt(1.5*Ca1/ha),1.0) =	1.0	
<pre>structure failure Surface, Ave: H = min(member depth, 15°cal) = 6 inche S1 = min(Spacing/2, perpendicular edge distance(Ca2), 1.5°edge distance(Ca1)) = 3 A inche S2 = min(Spacing/2, perpendicular edge distance, 1.5°edge distance) = 4 inche Ave = H(S1+S2) = 4.8.0 inche nerete Breakout Strength of a Single Anchor in Shear in Cracked Concrete, Vb: le = hef < 4° dia, = 0.6.25 inche fC = 0.000 i</pre>			
i = min(member dept, 1.5*Ca1) = 6 inche S1 = min(Scan(p2) Apprepriational edge distance(2a), 1.5*edge distance(Ca1)) = 4 inche S2 = min(Spacing/2, perpendicular edge distance(1.2*), 1.5*edge distance(Ca1)) = 48.0 inche S1 = min(S 4*dia, = 0.625 inche Avc = M(S1+S2) = 48.0 inche ncrete Breakout Strength of a Single Anchor in Shear in Cracked Concrete, Vb: 5 inche Ie = hef 4*dia, = 0.625 inche Ca1 = 0.625 inche Vb = min(7*(ie/dia)^0.2 * dia^0.5 * Fc^0.5 * Ca1^1.5 , 9 *fc^0.5 * ca1^1.5) = 4.244 kips b = 3.40 kips i_vc*Vcb = 3.40 kips Ip = cv/ Modification factor for anchor group loaded eccentrically in shear! 0.000 inche p = cv/ Modification factor for shear strength based on proximity to edge.] Ffcettve: Ffcettve: Embedment Depth of Anchor, hef <= 20 anchor diameter =	psi_p,V =	1.00	
if a min(member depth, 15*Cal) = 6 indhe 51 min(Spacing/2, perpendicular edge distance(2a), 1.5*edge distance(Cal)) = 4 inche 52 = min(Spacing/2, perpendicular edge distance), 1.5*edge distance) = 4 inche 52 = min(Spacing/2, perpendicular edge distance), 1.5*edge distance) = 48.0 inche norrete Breakout Strength of a Single Anchor in Shear in Cracked Concrete, Vb: le = hef 48*dia. = 5 inche diameter = 0.6252 inche f° = 0.625 inche f° = 0.625 inche f° = 0.625 inche diameter = 0.600 jinche b = injr*(le/dia)*0.2 * dia*0.5 * f°c*0.5 * Cal^1.5 , 9 * f°c*0.5 * cal^1.5)= 4.244 kips i yc* Vcb = 2.55 kips termine Nomhal Concrete Breakout Strength in Shear for an Anchor Group, Vcbg = A, yc * Vb / (A.5*Cal^2) * psi_ec, V* psi_ed, V* = 0.000 jinche diameter = 0.000 jinche	nierted Area of Concrete Failure Surface, Avc.		
22 = min(5pacing/2, perpendicular edge distance, 1.5 *edge distance) = 4 inclusion Arc = H(51+52) = 4.244 inche fe = 10, 525 inche fe = 1, 2, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,	•	6 inc	ches
Avc = H(S1+S2) = 48.0 inche increte Breakout Strength of a Single Anchor in Shear in Cracked Concrete, Vb: le = hef < 8 ³ (ab. + diameter = fc = 4.0000 psi Ca1 = 4.1 inche b = i_vc*Vcb = 4.244 kips b = 1.0000 inche Ca1 = 0.0000 inche Ca1 = 0.00000 inche Ca1 = 0.0000 inche Ca1 = 0.00000 inche Ca1 = 0.00000 inche Ca1 = 0.0000000000000000000000000000000000	S1 = min(Spacing/2,perpendicular edge distance(Ca2),1.5*edge distance(Ca1)) =	4 inc	ches
nervete Breakout Strength of a Single Anchor in Shear in Cracked Concrete, Vb: $le = hef < 8^*dia. = 0.625 inche0.625 inche0.626 inche0.625 inche0.626 inche$	S2 = min(Spacing/2,perpendicular edge distance,1.5*edge distance) =	4 inc	ches
le = bef < \$*dia. = since since in the set of the set	Avc = H(S1+S2) =	48.0 inc	ches
le = bef < \$*dia. = since since in the set of the set	ancrate Braskout Strength of a Single Anchor in Shear in Cracked Concrete Mb.		
diameter = 1 0.625 inche fr = 0.000 jnche i _0^* (Vc) = 0.255 kips termine Nominal Concrete Breakout Strength in Shear for an Anchor Group, Vcbg = A_vc * Vb / (4.5*Ca1*2) * psi_ec,V* psi_ed,V* psi_b,V* psi_p,V* i _0.000 jnche Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear = 0.000 psi_ed,V [Modification factor for shear strength based on proximity to edges] Effective Embedment Depth of Anchor, hef < 20 * anchor diameter = 0.000 Direction of Shear (perpendicular is conservative) = 0.000 psi_ed,V [Modification factor for shear strength based on proximity to edges] psi_ed,V = 0.000 psi_ed,V [Modification factor for shear strength based on proximity to edges] psi_ed,V = 0.000 psi_ed,V [Modification factor for shear strength based on proximity to edges] psi_ed,V = 0.000 psi_ed,V [Modification factor for shear strength based on proximity to edges] psi_ed,V = 0.000 psi_ed,V [Modification factor for shear strength based on presence or absence of cracks and supplemental reinforcement] Where analysis shows cracking at service loads, psi_c,V = 0.000 Where analysis shows cracking at service loads, and at bar or greater between anchor and edge, psi_c,V = 0.000 psi_c,V [Modification factor for shear strength of anchors located in members with ha < 1.5*Ca1] psi_h,V [Modification factor for shear strength of anchors located in members with ha < 1.5*Ca1] psi_h,V = 0.000 psi_h,V = 0		5 inc	che
Ca1 = 4 inche Vb = min[7*(ie/dia)^0.2 * dia^0.5 * fc^0.5 * Ca1^1.5 , 9 * fc^0.5 * ca1^1.5]= 4.244 kips b = 3.40 kips i_vc*Vcb = 3.40 kips i_vc*Vcb = 3.40 kips i_vc*Vcb = 3.40 kips i_vc*Vcb = 3.40 kips termine Nominal Concrete Breakout Strength in Shear for an Anchor Group, Vcbg = A_vc * Vb / (A.5*Ca1^2) * psi_ec,V* psi_ed,V* psi_e,V* psi_b,V* psi_p,V: IFactors: psi_ec,V [Modification factor for anchor group loaded eccentrically in shear] Eccentricity, e^V = 0.000 inche Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear = 0.000 psi_ed,V [Modification factor for shear strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <20 * anchor diameter = 0.000 psi_ed,V [Modification factor for shear strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <20 * anchor diameter = 0.000 psi_cd,V [Modification factor for shear strength based on presence or absence of cracks and supplemental reinforcement] Where analysis shows or cracking at service loads, psi_c, V = 1.00 Where analysis shows or cracking at service loads, psi_c, V = 1.4 Where analysis shows or cracking at service loads, psi_c, V = 1.2 psi_cV,V [Modification factor for shear strength of anchors located in members with ha < 1.5*Ca1] Concrete member thickness, ha = 0 psi_b,V,V [Modification factor for shear strength of anchors located in members with ha < 1.5*Ca1] Concrete member thickness, ha = 0 psi_b,V,V [Modification factor for shear strength of anchors located in members with ha < 1.5*Ca1] Concrete member thickness, ha = 0 psi_b,V,V [Modification factor for shear strength of anchors located in members with ha < 1.5*Ca1] psi_b,V,V [Modification factor for shear strength of anchors located in members with ha < 1.5*Ca1] concrete member thickness, ha = 0 psi_b,V,V [Modification factor for shear strength based on loading direction]	diameter =	0.625 inc	ches
$Vb = min[7*(le/dia)^0.2* dia^0.5* fc^0.5* cal^1.5, 9* fc^0.5* cal^1.5]= 4.244 kps$ $b = 3.40 kps$ $a = 3.40 k$	f'c =	4000 ps	si
b = 3.40 kgs ij_vc^Vvb = 3.40 kgs ij_vc^Vvb = 2.55 kgs termine Nonial Concrete Breakout Strength in Shear for an Anchor Group, Vcbg = A_vc * Vb / (4.5*Ca1^2) * psi_ec,V * psi_e,V * psi_h,V * psi_p,V * psi_p,V * psi_e,V * ps	Ca1 =	4 inc	ches
$i_{i}vc^{4}vcb =$ 2.55 kps termine Nominal Concrete Breakout Strength in Shear for an Anchor Group, Vcbg = A_vc * Vb / (4.5*Ca1^2) * psi_ec, V * psi_eh, V * psi_p, V: psi_p, V: psi_p, V; V = (0.00) inche Eccentricity, e'V = (0.00) inche Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear = (0.00) inche psi_pet, V = (0.00) inche (0.00)	Vb = min[7*(le/dia)^0.2 * dia^0.5 * f'c^0.5 * Ca1^1.5 , 9 *f'c^0.5 * ca1^1.5]=	4.244 kip	ps
<pre>iFactors: psi_ec,V [Modification factor for anchor group loaded eccentrically in shear] Eccentricity, eV = Cat = Distance from C/L anchor to edge of concrete in direction of applied shear = psi_ec,V = 1.00 psi_ed,V [Modification factor for shear strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = Cat = Distance from C/L anchor to edge of concrete in direction of applied shear = Cat = Distance from C/L anchor to edge of concrete in direction of applied shear = Cat = Distance from C/L anchor to edge of concrete in direction perpendicular to Cat = Direction of Shear (perpendicular is conservative) = psi_ed,V = 1.00 psi_c,V [Modification factor for shear strength based on presence or absence of cracks and supplemental reinforcement] Where analysis shows or cracking at service loads, psi_c, V = 1.0 Where analysis shows cracking at service loads and no supplemental rebar or edge rebar <#4, psi_c, V = 1.2 Where analysis shows cracking at service loads and a #4 bar or greater between anchor and edge, psi_c, V = 1.2 Where analysis shows cracking at service loads as >= #4 bar between edge &>=#4 stirrups spaced <=4*, psi_c, V = 1.2 psi_c,V [Modification factor for shear strength of anchors located in members with ha < 1.5*Ca1] Concrete member thickness, ha = Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear = 9 inche Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear = 9 inche 1.0 psi_b,V [Modification factor for shear strength based on loading direction]</pre>	cb = hi_vc*Vcb =		•
psi_ec,V [Modification factor for anchor group loaded eccentrically in shear] Eccentricity, e'V = 000 inche Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear = 4 inche psi_ec,V = 100 psi_ed,V [Modification factor for shear strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = 5.25 inche Minimum edge distance, Ca_min = 00 Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear = 00 Ca1 = Distance from C/L anchor to edge of concrete in direction pappied shear = 00 Direction of Shear (perpendicular is conservative) = 00 psi_ed,V = 100 psi_ed,V = 100 psi_ed,V = 100 psi_ed,V = 100 psi_ed,V = 100 Psi_ed,V = 100 Where analysis shows cracking at service loads, psi_c, V = 1.4 Where analysis shows cracking at service loads and no supplemental rebar or edge rebar <#4, psi_c, V = 1.4 Where analysis shows cracking at service loads and a #4 bar or greater between anchor and edge, psi_c, V = 1.4 Where analysis shows cracking at service loads and a #4 bar or greater between anchor and edge, psi_c, V = 1.4 psi_c,V [Modification factor for shear strength of anchors located in members with ha < 1.5*Ca1] Concrete member thickness, ha = 9 inche Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear = 4 inche psi_h,V [Modification factor for shear strength of anchors located in members with ha < 1.5*Ca1] Concrete member thickness, ha = 9 inche Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear = 9 inche Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear = 1.0 psi_h,V [Modification factor for shear strength based on loading direction]	etermine Nominal Concrete Breakout Strength in Shear for an Anchor Group, Vcbg = A_vc * Vb / (4.5*Ca1^2) * psi_ec,V * psi_ed,V	* psi_c,V * psi_h,V * psi_p,V:	
Eccentricity, e ¹ V = 0.00 inche Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear = 4 inche psi_ec,V = 1.00 psi_ed,V [Modification factor for shear strength based on proximity to edges] 5.25 inche Effective Embedment Depth of Anchor, hef <= 20* anchor diameter =	i Factors:		
Cal = Distance from C/L anchor to edge of concrete in direction of applied shear = 4 inche psi_ed,V [Modification factor for shear strength based on proximity to edges] 5.25 inche Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =		0.00 inc	choc
psi_ec,V =1.00psi_ed,V [Modification factor for shear strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =			
Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =		1.00	
Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =			
Minimum edge distance, Ca_min = Querride 4 inche Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear = Ca2 = Distance from C/L anchor to edge of concrete in direction perpendicular to Ca1 = Direction of Shear (perpendicular is conservative) = Perpendicular psi_ed,V = 1.00 psi_ed,V = Querride Perpendicular Mere analysis shows no cracking at service loads, psi_c, V = Where analysis shows cracking at service loads and no supplemental rebar or edge rebar <#4, psi_c, V = Querride		5.25 inc	choo
Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear = 4 inche Ca2 = Distance from C/L anchor to edge of concrete in direction perpendicular to Ca1 = 8 inche Direction of Shear (perpendicular is conservative) = Perpendicular psi_ed,V = 1.00 psi_c,V [Modification factor for shear strength based on presence or absence of cracks and supplemental reinforcement] 1.00 Where analysis shows no cracking at service loads, psi_c, V = 1.4 Where analysis shows cracking at service loads and no supplemental rebar or edge rebar <#4, psi_c, V =			
Ca2 = Distance from C/L anchor to edge of concrete in direction perpendicular to Ca1 = 8 inche Direction of Shear (perpendicular is conservative) = Perpendicular psi_ed,V = 1.00 psi_c,V [Modification factor for shear strength based on presence or absence of cracks and supplemental reinforcement] 1.00 Where analysis shows no cracking at service loads, psi_c, V = 1.4 Where analysis shows cracking at service loads and no supplemental rebar or edge rebar <#4, psi_c, V =		4 inc	ches
psi_cd,V = 1.00 psi_c,V [Modification factor for shear strength based on presence or absence of cracks and supplemental reinforcement] 1.4 Where analysis shows no cracking at service loads, psi_c, V = 1.4 Where analysis shows cracking at service loads and no supplemental rebar or edge rebar <#4, psi_c, V =		8 inc	ches
psi_c,V [Modification factor for shear strength based on presence or absence of cracks and supplemental reinforcement] where analysis shows no cracking at service loads, psi_c, V = 1.4 Where analysis shows cracking at service loads and no supplemental rebar or edge rebar <#4, psi_c, V =	Direction of Shear (perpendicular is conservative) =	Perpendicular	
Where analysis shows no cracking at service loads, psi_c, V = 1.4 Where analysis shows cracking at service loads and no supplemental rebar or edge rebar <#4, psi_c, V =	psi_ed,V =	1.00	
Where analysis shows no cracking at service loads, psi_c, V = 1.4 Where analysis shows cracking at service loads and no supplemental rebar or edge rebar <#4, psi_c, V =	nsi c.V. [Modification factor for shear strength based on presence or absence of cracks and supplemental minforcement]		
Where analysis shows cracking at service loads and no supplemental rebar or edge rebar <#4, psi_c, V =		1.4	
Where analysis shows cracking at service loads & >= #4 bar between edge & >=#4 stirrups spaced <=4", psi_c, V =			
psi_c,V = 1.2 psi_h,V [Modification factor for shear strength of anchors located in members with ha < 1.5*Ca1]	Where analysis shows cracking at service loads and a #4 bar or greater between anchor and edge, psi_c, V =	1.2	
psi_c,V = 1.2 psi_h,V [Modification factor for shear strength of anchors located in members with ha < 1.5*Ca1]		1.4	
Concrete member thickness, ha =9 incheCa1 = Distance from C/L anchor to edge of concrete in direction of applied shear =4 inchepsi_h,V = max(sqrt(1.5*Ca1/ha),1.0) =1.0psi_p,V [Modification factor for shear strength based on loading direction]		1.2	
Concrete member thickness, ha =9 incheCa1 = Distance from C/L anchor to edge of concrete in direction of applied shear =4 inchepsi_h,V = max(sqrt(1.5*Ca1/ha),1.0) =1.0psi_p,V [Modification factor for shear strength based on loading direction]		—	
Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear = 4 inche psi_h,V = max(sqrt(1.5*Ca1/ha),1.0) = 1.0 psi_p,V [Modification factor for shear strength based on loading direction] 1.0		0 :	cha
psi_p,V = max(sqrt(1.5*Ca1/ha),1.0) = 1.0 psi_p,V [Modification factor for shear strength based on loading direction]	,		
psi_p,V [Modification factor for shear strength based on loading direction]		4 110	
	psi_h,V = max(sqrt(1.5*Ca1/ha),1.0) =	1.0	
	psi_p,V [Modification factor for shear strength based on loading direction]		
		1.00	

Projected Area of Concrete Failure Surface, Avc:		
Avc = H(S1+S2) =		528.0 inches^2
Concrete Breakout Strength of a Single Anchor in Shear in Cracked Con	porete V/h:	
le = hef < 8*dia. =	lorete, vo.	5 inches
diameter =		0.625 inches
f'c =		4000 psi
Ca1 =		4 inches
Vb = min[7*(le/dia)^0.2 * dia^0.5 * f'c^0.5 * Ca1^1.5 , 9 *f'c^0.5 *	ca1^1.5]=	4.24 kips
Vcb =		37.35 kips
phi vc*Vcb =	ACI Case 1, 1/2 load to front anchors - Capacity is double this	28.01 kips
Determine Nominal Concrete Pryout Strength for a Single Anchor, Vc	p = Kcp*Ncp:	
Kcp = 1.0 for hef < 2.5" and 2.0 for hef >= 2.5" =		2
Nominal Concrete Pryout Strength, Ncp = min(Na,Ncb)		
Na (from ACI Eq. 17.4.5.1a) =		3.78 kips
Ncb (from ACI Eq. 17.4.2.1a) =		4.22 kips
Nominal Concrete Pryout Strength, Ncp =		3.78 kips
Vcp =		7.57 kips
phi_vp*Vcp =		5.68 kips
Determine Nominal Concrete Pryout Strength for a Group of Anchors	s, Vcpg = Kcp*Ncpg:	
Kcp = 1.0 for hef < 2.5" and 2.0 for hef >= 2.5" =		2
Nominal Concrete Pryout Strength, Ncpg = min(Nag,Ncbg)		
Nag (from ACI Eq. 17.4.5.1b) =		60.78 kips
Ncbg (from ACI Eq. 17.4.2.1b) =		57.31 kips
Nominal Concrete Pryout Strength, Ncpg =		57.31 kips
Vcp =		114.63 kips
phi_vp*Vcp =		85.97 kips
Check Shear Capacity vs. Shear Load		
Factored Shear Force, Vu =		0 kips
Nominal Shear Resistance, Vr = min(phi_vs*0.6*Vsa , phi_vc*Vcb, phi_		28.01 kips
Selected Anchor has Sufficient Shear Capacity	ACI Case 1, 1/2 load to front anchors - Total capacity	is double this
Selected Anchor has sufficient shear capacity		
SHEAR & TENSION INTERACTION ANALYSIS		
Vu/(phi*Vn) =		
Nu/(phi*Nn) =		
For Vu/(phi*Vn) <=0.2: Nu <= phi*Nn		
Interaction Capacity is Sufficient		
For Nu/(phi*Nn) <=0.2: Vu <= phi * Vn		
Interaction Capacity is Sufficient		
interaction cupucity is sufficient		
For Vu/(phi*Vn) > 0.2 and Nu/(phi*Nn) > 0.2: Nu/(phi*Nn) + Vu/(phi*V	Vn) <=1.2	
Not Applicable		

N/A

0.00 0.00

Not Applicable Interaction Value =

Structure Number: B-16-38	1	Project #: 22114	/	$K \leq L$
Task: Parapet CIP Anchor Analysis - Me			(_ 	ngineering
Design By: WAH	Date: 12/17/2024	Checked By: sкн	Date: 12/	/18/2024
	CONCRETE MASONRY CIP	ANCHOR DESIGN PROGRA	AM	
SN LOADS:			Ent	er loads on single anchor or on a
red Tension Force, Nu = red Shear Force, Vu =				1.00 kips 1.00 kips
IOR PROPERTIES:				
sed Anchor Size = ze as Single Anchor or Group = up, # of Anchors Effective in Tension = up, # of Anchors Effective in Shear = Strength of Anchor, fy = le Strength of Anchor, fut = titon of Concrete =	10' width, all existing anchors - accounts I 10' width, all existing anchors - accounts fo	for one side For force in rebar of	or bolt only (not concrete)	0.75 inches Group 16 anchors 32 anchors 60 ksi 90 ksi
y or Wet (Saturated) = acked or Uncracked at Service Loads = impressive Strength = osed Embedmen Depth = n of Member =		c	JK, Below Limit of 20*Dia.	Saturated Cracked 4000 psi 5 inches 9 inches
e Anchor Edge Distance & Spacing: inimum Edge Distance = 6*dia. = inimum Spacing = 6*dia. = ft Side:	Note: See A	ACI 17.4.2.3 when located near 3 or more ACI 17.7.2, if anchor will be ACI 17.7.2, if anchor will be torqu	e torqued (ACI 20.6 if not)	4.5 inches 4.5 inches
Edge or Anchor = Distance to Edge or Anchor Spacing = ght Side:		OK, Meets Minim	num Spacing Requirement	Anchor 8 inches
Edge or Anchor = Distance to Edge or Anchor Spacing = ont:		OK, Meets Minim	num Spacing Requirement	Anchor 8 inches
Edge or Anchor = Distance to Edge or Anchor Spacing = ck:		Warning, Minimu	m Edge Distance Not Met	Edge 3 inches
Edge or Anchor = Distance to Edge or Anchor Spacing =		OK, Meets Minimum Ec	lge Distance Requirement	Edge 90 inches
HOR GEOMETRIC PROPERTIES: mine Projected Concrete Breakout Area of a o = 9 * hef^2 =	Single Anchor, A_Nc:			225.0 inches^2
in(1.5*hef, spacing/2, edge distance {ca}) ft: S = ght: S = ont: S = ck: S =				4 inches 4 inches 3 inches 7.5 inches
=				84.0 inches^2
late A_Nc per ACI Figure 17.4.2.1 for Anchor lef = n of Group = n of Group =	Group 7.5 inches 135 inches 10.5 inches			
=				1417.5 inches^2
late A_vc per ACI Figure 17.5.2.1b for Anchor Distance from C/L anchor to edge of concrete a1 = ber Depth, ha = n of Group = n of Group =		4.50 9.00 129	inches inches inches inches inches	
· - · - · - • • • •		4.50		

CIP ANCHOR TENSILE RESISTANCE: Nominal Tensile Resistance, Nr = phi ts*Nsa <= phi tc*Ncb <= phi tc*Na			
Phi Factors:			
Steel Classification =		Ductile	ACI 2.3
Supplementary Reinforcement Included =		Yes	ACI 17.3.3
phi_ts =		0.75	
phi_tc =		0.75	
phi_tc_pullout =		0.75	
Determine Nominal Steel Strength of Anchor in Tension, Nsa = Ase,N * f_uta: Effective Cross-Sectional Area of Anchor in Tension, A_se,N:			ACI 17.4.1.2
Anchor Size =	override	0.75 inches	
Area, A_se,N =	0.44	0.44 inches^2	
Tensile Strength of Anchor, futa <= 1.9*fy <= 125 ksi fy =		60 ksi	
fu =		90 ksi	
1.9*fy =	override	114 ksi	
Controlling Tensile Strenght, f_uta =		90 ksi	
Nra –		20 6 kins	
Nsa = phi_ts*Nsa =		39.6 kips 29.7 kips	
Determine Nominal Concrete Breakout Strength of a Single Anchor in Tension, Ncb = A_nc * Nb / (9*h Psi Factors:	nef^2) * psi_ed,N * psi_c,N *	' psi_cp,N:	ACI 17.4.2.1a
psi_ed,N [Modification factor for tensile strength based on proximity to edges]			ACI 17.4.2.5
Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =		5 inches	OK, <= 20*Dia.
Minimum edge distance, Ca_min =		3 inches	
psi_ed,N =		0.820	
psi_c,N [Modification factor for tensile strength based on presence or absence of cracks]			ACI 17.4.2.6
psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads) =		1.0	
			40147437
psi_cp,N [Modification factor for post-installed anchors intended for use in uncracked concrete] psi_cp,N = Supplementary Rein	forcement Included, Therefore =	1.0 for CIP anchors	ACI 17.4.2.7
Concrete Breakout Strength of a Single Anchor in Tension in Cracked Concrete, Nb =		16.97 kips	ACI 17.4.2.2
		5.20 kins	
Ncb = phi_tc*Ncb =		5.20 kips 3.90 kips	
Determine Nominal Concrete Breakout Strength of an Anchor Group in Tension, Ncbg = A_nc * Nb / (!	9*hef^2) *nsi ec.N* nsi ed.	N * nci c N * nci cn N·	
	, her 2, psco, pscu,	ia bai_c'ia bai_ch'ia:	ACI 17.4.2.1b
	, <u>portection</u>	14 psi_c,14 psi_cp,14.	
psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension]	г, ро_со, ро_со,		ACI 17.4.2.1b ACI 17.4.2.4
psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N =	[0 inches	
psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension]	[
<pre>psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges]</pre>	, 1, p	0 inches 1.00	ACI 17.4.2.4 ACI 17.4.2.5
psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =	[0 inches 1.00 5 inches	ACI 17.4.2.4
psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min =	[0 inches 1.00 5 inches 3 inches	ACI 17.4.2.4 ACI 17.4.2.5
psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =	[0 inches 1.00 5 inches	ACI 17.4.2.4 ACI 17.4.2.5
<pre>psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min =</pre>	[0 inches 1.00 5 inches 3 inches	ACI 17.4.2.4 ACI 17.4.2.5
<pre>psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N =</pre>	[0 inches 1.00 5 inches 3 inches	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia.
<pre>psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N = psi_ec,N [Modification factor for tensile strength based on presence or absence of cracks] psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads) =</pre>	[0 inches 1.00 5 inches 3 inches 0.820	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6
<pre>psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N = psi_ed,N = psi_c,N [Modification factor for tensile strength based on presence or absence of cracks] psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads) = psi_cp,N [Modification factor for post-installed anchors intended for use in uncracked concrete]</pre>	[0 inches 1.00 5 inches 3 inches 0.820 1.0	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia.
<pre>psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N = psi_ed,N = psi_c,N [Modification factor for tensile strength based on presence or absence of cracks] psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads) = psi_cp,N [Modification factor for post-installed anchors intended for use in uncracked concrete]</pre>	forcement Included, Therefore =	0 inches 1.00 5 inches 3 inches 0.820	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6
psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N = psi_c,N [Modification factor for tensile strength based on presence or absence of cracks] psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads) = psi_cp,N [Modification factor for post-installed anchors intended for use in uncracked concrete] psi_cp,N = Supplementary Rein	[0 inches 1.00 5 inches 3 inches 0.820 1.0	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6
psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N = psi_ed,N = psi_c,N [Modification factor for tensile strength based on presence or absence of cracks] psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads) = psi_cp,N [Modification factor for post-installed anchors intended for use in uncracked concrete] psi_cp,N = Supplementary Rein Basic Concrete Breakout Strength of a Single Anchor in Tension in Cracked Concrete, Nb =	forcement Included, Therefore =	0 inches 1.00 5 inches 3 inches 0.820 1.0 1.0 for CIP anchors 17.0 kips	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7
psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N = psi_ed,N = psi_c,N [Modification factor for tensile strength based on presence or absence of cracks] psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads) = psi_cp,N [Modification factor for post-installed anchors intended for use in uncracked concrete] psi_cp,N = Basic Concrete Breakout Strength of a Single Anchor in Tension in Cracked Concrete, Nb = Ncbg =	forcement Included, Therefore =	0 inches 1.00 5 inches 3 inches 0.820 1.0 1.0 for CIP anchors	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7
psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N = psi_ed,N = psi_c,N [Modification factor for tensile strength based on presence or absence of cracks] psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads) = psi_cp,N [Modification factor for post-installed anchors intended for use in uncracked concrete] psi_cp,N = Basic Concrete Breakout Strength of a Single Anchor in Tension in Cracked Concrete, Nb = Ncbg =	forcement Included, Therefore =	0 inches 1.00 5 inches 3 inches 0.820 1.0 1.0 for CIP anchors 17.0 kips 87.67 kips	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7
psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N = psi_ed,N = psi_c,N [Modification factor for tensile strength based on presence or absence of cracks] psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads) = psi_cp,N [Modification factor for post-installed anchors intended for use in uncracked concrete] psi_cp,N = Supplementary Rein Basic Concrete Breakout Strength of a Single Anchor in Tension in Cracked Concrete, Nb = Ncbg = phi_tc*Ncbg = Determine Nominal Pullout Strength of a Single Anchor or Anchor Group in Tension, Npn = Np *psi_c,	forcement Included, Therefore = for normal weight concrete	0 inches 1.00 5 inches 3 inches 0.820 1.0 1.0 for CIP anchors 17.0 kips 87.67 kips	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7
psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N = psi_ed,N = psi_c,N [Modification factor for tensile strength based on presence or absence of cracks] psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads) = psi_cp,N [Modification factor for post-installed anchors intended for use in uncracked concrete] psi_cp,N = Supplementary Rein Basic Concrete Breakout Strength of a Single Anchor in Tension in Cracked Concrete, Nb = Ncbg = ohi_tc*Ncbg = Determine Nominal Pullout Strength of a Single Anchor or Anchor Group in Tension, Npn = Np *psi_c, Psi Factors:	forcement Included, Therefore = for normal weight concrete	0 inches 1.00 5 inches 3 inches 0.820 1.0 1.0 for CIP anchors 17.0 kips 87.67 kips 65.75 kips	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7 ACI 17.4.2.2 ACI 17.4.2.2
psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N = psi_ed,N = psi_c,N [Modification factor for tensile strength based on presence or absence of cracks] psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads) = psi_cp,N [Modification factor for post-installed anchors intended for use in uncracked concrete] psi_cp,N = Supplementary Rein Basic Concrete Breakout Strength of a Single Anchor in Tension in Cracked Concrete, Nb = Ncbg = phi_tc*Ncbg = Determine Nominal Pullout Strength of a Single Anchor or Anchor Group in Tension, Npn = Np *psi_c,	forcement Included, Therefore = for normal weight concrete	0 inches 1.00 5 inches 3 inches 0.820 1.0 1.0 for CIP anchors 17.0 kips 87.67 kips	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7 ACI 17.4.2.2
psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N = psi_ed,N = psi_c,N [Modification factor for tensile strength based on presence or absence of cracks] psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads) = psi_cp,N [Modification factor for post-installed anchors intended for use in uncracked concrete] psi_cp,N = Supplementary Rein Basic Concrete Breakout Strength of a Single Anchor in Tension in Cracked Concrete, Nb = Ncbg = phi_tc*Ncbg = Determine Nominal Pullout Strength of a Single Anchor or Anchor Group in Tension, Npn = Np *psi_c, Psi Factors: psi_c,p [Modification factor for pull-out strength based on cracking]	forcement Included, Therefore = for normal weight concrete	0 inches 1.00 5 inches 3 inches 0.820 1.0 1.0 for CIP anchors 17.0 kips 87.67 kips 65.75 kips	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7 ACI 17.4.2.2 ACI 17.4.2.2
psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N = psi_ed,N = psi_c,N [Modification factor for tensile strength based on presence or absence of cracks] psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads) = psi_cp,N [Modification factor for post-installed anchors intended for use in uncracked concrete] psi_cp,N = Supplementary Rein Basic Concrete Breakout Strength of a Single Anchor in Tension in Cracked Concrete, Nb = Ncbg = ohi_ct*Ncbg = Determine Nominal Pullout Strength of a Single Anchor or Anchor Group in Tension, Npn = Np *psi_c, psi_c,p [Modification factor for pull-out strength based on cracking] Pullout Strength for a Single Anchor, Np = 8*Abg*fc = conservative,	forcement included, Therefore = for normal weight concrete	 inches inches inches inches inches inches 0.820 1.0 for CIP anchors 17.0 kips 87.67 kips 65.75 kips 	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7 ACI 17.4.2.2 ACI 17.4.2.2
psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N = psi_ed,N = psi_c,N [Modification factor for tensile strength based on presence or absence of cracks] psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads) = psi_cp,N [Modification factor for post-installed anchors intended for use in uncracked concrete] psi_cp,N = Supplementary Rein Basic Concrete Breakout Strength of a Single Anchor in Tension in Cracked Concrete, Nb = Ncbg = ohi_tc*Ncbg = Determine Nominal Pullout Strength of a Single Anchor or Anchor Group in Tension, Npn = Np *psi_c, psi_c,p [Modification factor for pull-out strength based on cracking] Pullout Strength for a Single Anchor, Np = 8*Abrg*f'c = phi_tc_pullout*Nag for Single Anchor =	forcement included, Therefore = for normal weight concrete	0 inches 1.00 5 inches 3 inches 0.820 1.0 1.0 for CIP anchors 17.0 kips 87.67 kips 65.75 kips 1 1 20.93 kips	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7 ACI 17.4.2.2 ACI 17.4.2.2
psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N = psi_ed,N = psi_c,N [Modification factor for tensile strength based on presence or absence of cracks] psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads) = psi_cp,N [Modification factor for post-installed anchors intended for use in uncracked concrete] psi_cp,N = Supplementary Rein Basic Concrete Breakout Strength of a Single Anchor in Tension in Cracked Concrete, Nb = Ncbg = phi_tc*Ncbg = Determine Nominal Pullout Strength of a Single Anchor or Anchor Group in Tension, Npn = Np *psi_c, Psi factors: psi_c,p [Modification factor for pull-out strength based on cracking] Pullout Strength for a Single Anchor, Np = 8*Abrg*fc = phi_tc_pullout*Nag for Single Anchor = phi_tc_pullout*Nag for Anchor Group =	forcement Included, Therefore = for normal weight concrete , p : .not accounting for hooked ends	0 inches 1.00 5 inches 3 inches 0.820 1.0 1.0 for CIP anchors 17.0 kips 87.67 kips 65.75 kips 1 1 20.93 kips 15.70 kips	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7 ACI 17.4.2.2 ACI 17.4.2.2
psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N = psi_ed,N = psi_c,N [Modification factor for tensile strength based on presence or absence of cracks] psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads) = psi_cp,N [Modification factor for post-installed anchors intended for use in uncracked concrete] psi_cp,N = Supplementary Rein Basic Concrete Breakout Strength of a Single Anchor in Tension in Cracked Concrete, Nb = Ncbg = psi_ct, P [Modification factor for pull-out strength based on cracking] Pullout Strength for a Single Anchor, Np = 8*Abrg*f'c = psi_c_p, [Modification factor for pull-out strength based on cracking] Pullout Strength for a Single Anchor = phi_tc_pullout*Nag for Anchor Group = Determine Concrete Side Face Blowout of a Headed Single Anchor in Tension, Nbs = 160*Ca1*Abrg^0	forcement Included, Therefore = for normal weight concrete , p : .not accounting for hooked ends	0 inches 1.00 5 inches 3 inches 0.820 1.0 1.0 for CIP anchors 17.0 kips 87.67 kips 65.75 kips 1 1 20.93 kips 15.70 kips	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7 ACI 17.4.2.2 ACI 17.4.3.1 ACI 17.4.3.6
psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N = psi_ed,N = psi_c,N [Modification factor for tensile strength based on presence or absence of cracks] psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads) = psi_cp,N = [1.0 when cracking at service loads, 1.4 when no cracking at service loads] = psi_cp,N = Supplementary Rein Basic Concrete Breakout Strength of a Single Anchor in Tension in Cracked Concrete, Nb = Ncbg = phi_tc*Ncbg = Determine Nominal Pullout Strength of a Single Anchor or Anchor Group in Tension, Npn = Np *psi_c, psi_c,p [Modification factor for pull-out strength based on cracking] Pullout Strength for a Single Anchor, Np = 8*Abrg*f'c = phi_tc_pullout*Nag for Single Anchor = phi_tc_pullout*Nag for Anchor Group = Determine Concrete Side Face Blowout of a Headed Single Anchor in Tension, Nsb = 160*Ca1*Abrg^O Check Applicability: Applicable if hef > 2.5*Ca1: hef =	forcement Included, Therefore = for normal weight concrete , p : .not accounting for hooked ends	0 inches 1.00 5 inches 3 inches 0.820 1.0 1.0 for CIP anchors 17.0 kips 87.67 kips 65.75 kips 1 20.93 kips 15.70 kips 251.14 kips 5 inches	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7 ACI 17.4.2.2 ACI 17.4.3.1 ACI 17.4.3.6
psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N = psi_ed,N = psi_c,N [Modification factor for tensile strength based on presence or absence of cracks] psi_c,N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads) = psi_cp,N [Modification factor for post-installed anchors intended for use in uncracked concrete] psi_cp,N = Supplementary Rein Basic Concrete Breakout Strength of a Single Anchor in Tension in Cracked Concrete, Nb = Ncbg = bhi_tc*Ncbg = Determine Nominal Pullout Strength of a Single Anchor or Anchor Group in Tension, Npn = Np *psi_c, Psi Factors: psi_c,p [Modification factor for pull-out strength based on cracking] Pullout Strength for a Single Anchor, Np = 8*Abrg*f'c = conservative, bhi_tc_pullout*Nag for Single Anchor = bhi_tc_pullout*Nag for Anchor Group = Determine Concrete Side Face Blowout of a Headed Single Anchor in Tension, Nsb = 160*Ca1*Abrg^O Check Applicability: Applicable if hef > 2.5*Ca1: hef = 2.5*Ca1 =	forcement Included, Therefore = for normal weight concrete , p : .not accounting for hooked ends	0 inches 1.00 5 inches 3 inches 0.820 1.0 1.0 for CIP anchors 17.0 kips 87.67 kips 65.75 kips 1 1 20.93 kips 15.70 kips 251.14 kips 5 inches 3 inches 3 inches	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.6 ACI 17.4.2.7 ACI 17.4.2.2 ACI 17.4.3.1 ACI 17.4.3.6
psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ec,N = psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N = psi_ed,N = psi_c,N [Modification factor for tensile strength based on presence or absence of cracks] psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads) = psi_cp,N [Modification factor for post-installed anchors intended for use in uncracked concrete] psi_cp,N = Supplementary Rein Basic Concrete Breakout Strength of a Single Anchor in Tension in Cracked Concrete, Nb = Ncbg = ohi_tc*Ncbg = Determine Nominal Pullout Strength of a Single Anchor or Anchor Group in Tension, Npn = Np *psi_c, Psi Factors: psi_c,p [Modification factor for pull-out strength based on cracking] Pullout Strength for a Single Anchor, Np = 8*Abrg*fc = conservative, ohi_tc_pullout*Nag for Single Anchor = ohi_tc_pullout*Nag for Single Anchor Group = Determine Concrete Side Face Blowout of a Headed Single Anchor in Tension, Nsb = 160*Ca1*Abrg^O Check Applicability: Applicable if hef > 2.5*Ca1: hef =	forcement Included, Therefore = for normal weight concrete , p : .not accounting for hooked ends	0 inches 1.00 5 inches 3 inches 0.820 1.0 1.0 for CIP anchors 17.0 kips 87.67 kips 65.75 kips 1 20.93 kips 15.70 kips 251.14 kips 5 inches	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.7 ACI 17.4.2.2 ACI 17.4.2.2 ACI 17.4.3.1 ACI 17.4.3.6
psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension] Eccentricity, e'N = psi_ec,N = psi_ec,N = psi_ec,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N = psi_ed,N = psi_ed,N = psi_c,N [Modification factor for tensile strength based on presence or absence of cracks] psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads) = psi_cp,N [Modification factor for post-installed anchors intended for use in uncracked concrete] psi_cp,N = Supplementary Rein Basic Concrete Breakout Strength of a Single Anchor in Tension in Cracked Concrete, Nb = Ncbg = phi_tc*Ncbg = Determine Nominal Pullout Strength of a Single Anchor or Anchor Group in Tension, Npn = Np *psi_c, Psi Factors: psi_c,p [Modification factor for pull-out strength based on cracking] Pullout Strength for a Single Anchor, Np = 8*Abrg*f'c = phi_tc_pullout*Nag for Single Anchor = phi_tc_pullout*Nag for Anchor Group = Determine Concrete Side Face Blowout of a Headed Single Anchor in Tension, Nsb = 160*Ca1*Abrg^O Check Applicability: Applicable if hef > 2.5*Ca1: hef = 2.5*Ca1 = Status of Applicability =	forcement Included, Therefore = for normal weight concrete , p : .not accounting for hooked ends	<pre> inches 1.00 inches 1.00 5 inches 3 inches 0.820 1.0 1.0 for CIP anchors 17.0 kips 87.67 kips 65.75 kips 1 20.93 kips 15.70 kips 251.14 kips S inches 3 inches 3 inches Not Applicable </pre>	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.7 ACI 17.4.2.2 ACI 17.4.2.2 ACI 17.4.3.1 ACI 17.4.3.6
Eccentricity, e'N = psi_ec,N = psi_ec,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = psi_ed,N = psi_c,N [Modification factor for tensile strength based on presence or absence of cracks] psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads) = psi_cp,N [Modification factor for post-installed anchors intended for use in uncracked concrete] psi_cp,N = Supplementary Rein Basic Concrete Breakout Strength of a Single Anchor in Tension in Cracked Concrete, Nb = Ncbg = phi_tc *Ncbg = Determine Nominal Pullout Strength of a Single Anchor or Anchor Group in Tension, Npn = Np *psi_c, Psi Factors: psi_c,p [Modification factor for pull-out strength based on cracking] Pullout Strength for a Single Anchor, Np = 8*Abrg*f'c = phi_tc_pullout*Nag for Single Anchor re phi_tc_pullout*Nag for Anchor Group = Determine Concrete Side Face Blowout of a Headed Single Anchor in Tension, Nsb = 160*Ca1*Abrg^O Check Applicability: Applicable if hef > 2.5*Ca1: hef = 2.5*Ca1 =	forcement Included, Therefore = for normal weight concrete , p : .not accounting for hooked ends	0 inches 1.00 5 inches 3 inches 0.820 1.0 1.0 for CIP anchors 17.0 kips 87.67 kips 65.75 kips 1 1 20.93 kips 15.70 kips 251.14 kips 5 inches 3 inches 3 inches	ACI 17.4.2.4 ACI 17.4.2.5 OK, <= 20*Dia. ACI 17.4.2.7 ACI 17.4.2.2 ACI 17.4.2.2 ACI 17.4.3.1 ACI 17.4.3.6

Determine Concrete Side Face Blowout of Multiple Headed Anchors in Tension, Nsbg = (1+s/6/Ca1)*Nsb:			ACI 17.4.4.2
Check Applicability: Applicable if hef > 2.5*Ca1 and anchor spacing < 6*Ca1:			
hef =		5 inches	
2.5*Ca1 =		7.5 inches	
Spacing = 6*Ca1 =		8 inches 18 inches	
Status of Applicability =		Applicable	
Side Face Blowout Strength for Multiple Achors, Nsbg = (1+2/6/Ca1)*Nsb =		35.5 kips	
phi_tc_pullout*Nsbg for Multiple Anchors =		26.60 kips	
Summary of Design Strengths for Tension:			
Steel Strength, phi*Nsa =		475.2 kips	
Concrete Breakout Strength, phi*Ncb =	Controls	65.8 kips	
Pullout Strength, phi*Npn = Sideface Blowout Strength, phi*Nsb =		251.1 kips 26.6 kips	
Controlling Tension Capacity =		26.6 kips	
Check Tensile Capacity vs. Tensile Load			
Factored Tension Force, Nu =		1.0 kips	
Controlling Tension Capacity =		26.6 kips	
Selected Anchor has Sufficient Tensile Capacity			
CIP ANCHOR SHEAR RESISTANCE:			
Nominal Shear Resistance, Vr = phi_vs*0.6*Vsa <= phi_vc*Vcb <= phi_vp*Vcp			
Phi Factors:		D	
Steel Classification =		Ductile	ACI 2.3
Supplementary Reinforcement Included =		Yes 0.65	ACI 17.3.3
phi_vs = phi_vc =		0.65	
phi_vp =		0.75	
Determine Nominal Steel Strength of Anchor in Shear, Vsa = Ase,V * f_uta:			ACI 17.5.1.2
Effective Cross-Sectional Area of Anchor in Tension, A_se,N:			ACI 17.5.1.2
Anchor Diameter =	override	0.75 inches	
Area, A_se,V =		0.334 inches^2	
Tensile Strength of Anchor, futa <= 1.9*fy <= 125 ksi			
fy =		60 ksi	
fu =		90 ksi	
1.9*fy = Controlling Tensile Strenght, f_uta =	<u>override</u>	114 ksi 90 ksi	
		10.0 1/	
Vsa = phi_vs*Vsa =		18.0 kips 11.7 kips	
Determine Nominal Concrete Breakout Strength in Shear for a Single Anchor, Vcb = A_vc * Vb / (4.5*Ca1/	^2) * psi_ed,V * psi_c,V * psi	_h,V * psi_p,V:	ACI 17.5.2.1a
Psi Factors:			10117526
psi_ed,V [Modification factor for shear strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =		5 inches	ACI 17.5.2.6 OK, <= 20*Dia.
Minimum edge distance, Ca_min =	override	3 inches	OK, <= 20 Dia.
Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear =		3 inches	
Ca2 = Distance from C/L anchor to edge of concrete in direction perpendicular to Ca1 =		8 inches	
Direction of Shear (perpendicular is conservative) =	·	Perpendicular	
psi_ed,V =	1.0		
psi_c,V [Modification factor for shear strength based on presence or absence of cracks and supplementa	reinforcement]		ACI 17.5.2.7
Where analysis shows no cracking at service loads, psi_c, V =	iorecinentj	1.4	ACI 17.3.2.7
Where analysis shows cracking at service loads and no supplemental rebar or edge rebar <#4, psi_c, V	'=	1.0	
Where analysis shows cracking at service loads and a #4 bar or greater between anchor and edge, psi		1.2	
Where analysis shows cracking at service loads & >= #4 bar between edge & >=#4 stirrups spaced <=4", psi_c,	V =	1.4	
psi_c,V =	override	1.2	
psi_h,V [Modification factor for shear strength of anchors located in members with ha < 1.5*Ca1]		0 :!	ACI 17.5.2.8
Concrete member thickness, ha = Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear =		9 inches 3 inches	
psi_h,V = max(sqrt(1.5*Ca1/ha),1.0) =		1.0	
psi_p,V [Modification factor for shear strength based on loading direction] psi_p,V =		1.00	ACI 17.5
Projected Area of Concrete Failure Surface, Avc:		4.5 inches	
H = min(member depth, 1.5*Ca1) = S1 = min(Spacing/2,perpendicular edge distance(Ca2),1.5*edge distance(Ca1)) =		4.5 inches	
S1 = min(Spacing/2,perpendicular edge distance(Ca2),1.5 edge distance(Ca1)) = S2 = min(Spacing/2,perpendicular edge distance,1.5*edge distance) =		4 inches	
Avc = H(S1+S2) =		36.0 inches^2	

Concrete Breakout Strength of a Single Anchor in Shear in Cracked Concrete, Vb:		ACI 17.5.2.2
le = hef < 8*dia. =	5 inches	ACI 17.3.2.2
diameter =	0.75 inches	
f'c =	4000 psi	
Ca1 =	3 inches	
Vb = min[7*(le/dia)^0.2 * dia^0.5 * fc^0.5 * Ca1^1.5 , 9 *f'c^0.5 * ca1^1.5]=	2.912 kips	
Vcb =	3.11 kips	
phi_vc*Vcb =	2.33 kips	
Determine Nominal Concrete Breakout Strength in Shear for an Anchor Group, Vcbg = A_vc * Vb / (4.5*Ca1^2) * psi_ec,V * psi_ed,V * psi_	c.V*nsi h.V*nsi n.V∙	ACI 17.5.2.1b
Psi Factors:	c,• psi_ii,• psi_p;•.	ACT 17.5.2.10
psi_ec,V [Modification factor for anchor group loaded eccentrically in shear]		ACI 17.5.2.5
Eccentricity, e'V =	0 inches	
Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear = psi ec,V =	3 inches 1.00	
p5 <u>-</u> cc, v =	1.00	
psi_ed,V [Modification factor for shear strength based on proximity to edges]		ACI 17.5.2.6
Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =	5 inches	Warning, Exceeds 20*Dia.
Minimum edge distance, Ca_min =	3 inches	
Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear =	3 inches	
Ca2 = Distance from C/L anchor to edge of concrete in direction perpendicular to Ca1 = Direction of Shear (perpendicular is conservative) =	8 inches Perpendicular	
birection of shear (perpendicular is conservative) -	Perpendicular	
psi_ed,V =	1.00	
psi_c,V [Modification factor for shear strength based on presence or absence of cracks and supplemental reinforcement]	1.4	ACI 17.5.2.7
Where analysis shows no cracking at service loads, psi_c, V = Where analysis shows cracking at service loads and no supplemental rebar or edge rebar <#4, psi c, V =	1.4	
Where analysis shows cracking at service loads and a #4 bar or greater between anchor and edge, psi_c, v =	1.2	
Where analysis shows cracking at service loads & >= #4 bar between edge & >=#4 stirrups spaced <=4", psi_c, V =	1.4	
override		
psi_c,V =	1.2	
psi_h,V [Modification factor for shear strength of anchors located in members with ha < 1.5*Ca1]		ACI 17.5.2.8
Concrete member thickness, ha =	9 inches	ACI 17.5.2.8
Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear =	3 inches	
psi_h,V = max(sqrt(1.5*Ca1/ha),1.0) =	1.0	
psi_p,V [Modification factor for shear strength based on loading direction]		ACI 17.5
psi_p,V =	1.00	
Projected Area of Concrete Failure Surface, Avc: Avc = H(S1+S2) =	580.5 inches^2	
AVC - 11(51752) -	Source and	
Concrete Breakout Strength of a Single Anchor in Shear in Cracked Concrete, Vb:		ACI 17.5.2.2
le = hef < 8*dia. =	5 inches	
diameter =	0.75 inches	
f'c=	4000 psi	
Ca1 =	3 inches	
Vb = min[7*(le/dia)^0.2 * dia^0.5 * f'c^0.5 * Ca1^1.5 , 9 *f'c^0.5 * ca1^1.5]=	2.91 kips	
Vcb =	50.08 kips	
phi_vc*Vcb =	37.56 kips	
Determine Nominal Concrete Pryout Strength for a Single Anchor, Vcp = Kcp*Ncp:		ACI 17.5.3.1(a)
Kcp = 1.0 for hef < 2.5" and 2.0 for hef >= 2.5" =	2	
Nominal Concrete Pryout Strength, Ncp = Ncb for cast in place anchors =	5.20 kips	
Vcp =	10.39 kips	
vcp = phi vp*Vcp =	7.79 kips	
Determine Nominal Concrete Pryout Strength for a Group of Anchors, Vcpg - Kcp*Ncpg:	2	ACI 17.5.3.1(b)
Kcp = 1.0 for hef < 2.5" and 2.0 for hef >= 2.5" = Nominal Concrete Pryout Strength, Ncpg = Ncbg for cast in place anchors =	2 87.67 kips	
noniniai constata i i you oriangui, mpp - mog ior cost in piece an tinos -	07.07 mps	
Vcp =	175.34 kips	
phi_vp*Vcp=	131.50 kips	
Summary of Davian Strongthe for Shoar		
Summary of Design Strengths for Shear: Steel Strength, phi*Vsa =	375.1 kips	
Concrete Breakout Strength, phi*Vcb =	37.6 kips	
Pryout Strength, phi*Vcp =	131.5 kips	
Controlling Shoar Capacity -	27 E kins	
Controlling Shear Capacity =	37.6 kips	

Selected Anchor has Sufficient Shear Capacity

SHEAR & TENSION INTERACTION ANALYSIS Vu/(phi*Vn) = Nu/(phi*Nn) =

For Vu/(phi*Vn) <=0.2: Nu <= phi*Nn Interaction Capacity is Sufficient

For Nu/(phi*Nn) <=0.2: Vu <= phi * Vn Interaction Capacity is Sufficient

For Vu/(phi*Vn) > 0.2 and Nu/(phi*Nn) > 0.2: Nu/(phi*Nn) + Vu/(phi*Vn) <=1.2 Not Applicable Interaction Value = N/A

1.00 kips 37.56 kips

> 0.03 0.04

ACI 17.6

Project:	USH 2	over St.	Louis Rive
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Structure Number: B-16-38

Project #: 22114



Task: Median Parapet Analysis

Design By: WAH

Date: 12/17/2024 Checked By: SKH

Date: 12/18/2024

PARAPET ANALYSIS

Parapet Parameters: Railing Design Level Designation Height of Parapet = Width of Parapet at Base = Transverse Load on Barrier, Ft (LRFD T.A13.2.1) = Longitudinal Length of distribution of impact force, Lt (LI	RFD T. A13.2.1) =		1.58 54.0	inches feet kips feet
<u>Material Parameters:</u> Compressive Strength of Moment Slab, f'c =			3,500	nci
Yield Strength of Steel, fy =			60,000	
WIND LOADING				
From AASHTO LRFD 9th Edition:				
Equation 3.8.1.2.1-1: Pz = 0.00256*V^2*Kz*G*Cd				
Service I: Design 3-second gust wind speed, V =		Table 3.8.1.1.2-1		mph mph
Strength III: Design 3-second gust wind speed, V = Strength V: Design 3-second gust wind speed, V =		Table 3.8.1.1.2-1 Figure 3.8.1.1.2-1		mph
Exposure Category =		3.8.1.1.5	D	mpn
Pressure exposure and elevation coefficient,Kz =	150' above grade, conservative	Table C3.8.1.2.1-1	1.52	
Gust effect factor,G =		Table 3.8.1.2.1-1	1.00	
Drag Coefficient, Cd =		Table 3.8.1.2.1-2	1.00	
Service I: Pz = 0.00256*V^2*Kz*G*Cd =			19.1	psf
Strength III: Pz = 0.00256*V^2*Kz*G*Cd =			51.5	psf
Strength V: Pz = 0.00256*V^2*Kz*G*Cd =			24.9	psf
From AASHTO LRFD Specifications for Structural Supports for	or Highway Signs, Luminaires, and Traffic Sig	nals		
Equation 3.8.1-1: Pz = 0.00256*Kz*Kd*G*V^2*Cd			100	
1700-Year MRI Basic Wind Speed, V =	150 ¹ above grade concernative	Fig. 3.8-2b Table C3.8.4-1	120 1.37	mpn
Pressure exposure and elevation coefficient,Kz = Directionality Factor, Kd =	150' above grade, conservative	Table C3.8.5-1	0.95	
Gust effect factor,G =		3.8.6	1.14	
Drag Coefficient, Cd =		Table 3.8.7-1	0.50	
Pz = 0.00256KzKdG*V^2*Cd =			27.3	psf
Loading on Parapet				
Light Pole Diameter =	average equivalent width to account for a	rms & pole taper	0.57	feet
Light Pole Height =				feet
Parapet Height =			2.67	feet
Parapet Width at Base =			1.58	feet
Horizontal Load on Light Pole =				
Service I =			0.406	
Strength III =				kips
Strength V =				kips
Per LRFD Signs, Luminaires, and Traffic Signals Spec =			0.582	kips
Horizontal Load on Parapet =				
Service I =				kips/foot
Strength III =				kips/foot kips/foot
Strength V = Per LRFD Signs, Luminaires, and Traffic Signals Spec =				kips/foot
		(0.075	
Distribution of Light Pole Load to Base of Parapet			0.00	6 t
Width of Anchor Bolts = 45 degree distribution to base of parapet =			0.83 6.166	
45 degree distribution to base of parapet =		(0.100	1001
Horizontal Load at Base of Parapet =				
Service I =				kips/foot
Strength III =				kips/foot kips/foot
Strength V = Per LRFD Signs, Luminaires, and Traffic Signals Spec =	Strength III pressure on parapet, Guid	le Spec on Light Pole		kips/foot kips/foot
· · · · · · · · · · · · · · · · · · ·			0.010	

Moment at Base of Parapet =			
Service I =		1.47	kips/foot
Strength III =		3.97	kips/foot
Strength V =		1.92	kips/foot
Per LRFD Signs, Luminaires, and Traffic Signals Spec =	Strength III pressure on parapet, Guide Spec on Light Pole	2.20	kips/foot
Reinforcement			
Adhesive Anchor Tensile Capacity in Cracked Con	crete =		kips/foot
Adhesive Anchor Tensile Capacity in Uncracked Co	oncrete =		kips/foot
CIP Anchor Tensile Capacity in Cracked Concrete	existing reinforcement) =		kips/foot
CIP Anchor Tensile Capacity in Uncracked Concret	e (existing reinforcement) =	9.21	kips/foot
Percentage of Adhesive Anchor Tensile Capacity i	n Cracked Concrete =	25%	
Percentage of Adhesive Anchor Tensile Capacity i	n Uncracked Concrete =	25%	
Percentage of CIP Anchor Tensile Capacity in Crac	ked Concrete (existing reinforcement) =	25%	
Percentage of CIP Anchor Tensile Capacity in Unc	racked Concrete (existing reinforcement) =	25%	
Average Tensile Capacity of Anchors =		6.11	kips/foot
Bar Size =		#	5
Bar Spacing =	modified to provide a tension equal to the anchor capacity		inches
Total Area of Steel =	override		inches^2/foot
'd' = thickness of design section - 2.0" cover - bar			inches
Check Moment Capacity:			
$C = T = as^* fy =$	set equal to average tensile capacity of anchors	6.11	kips/foot
B1 = 0.85-0.05(f'c - 4000)/1000 < 0.85 =		0.85	
a = C/bB1f'c =			inches
c = a / β ₁ =		0.201	inches
$\varepsilon_{bot} = 0.003 [(d_s / c) - 1)]$		0.235	inches/inch
$\Phi_{\rm f} =$	Tension Controlled	0.900	
	Tension Controlled		foot-kips/foot
Mr = (phi)Mn = (phi)T(d-a/2)			foot-kips/foot
Mu = OK, Section Capacity is Sufficient		5.57	1001-кips/1001
Check Reinforcement Limit per AASHTO 5.6.2.1-1 c/de =		0.01	
Limit (to ensure steel yield before concrete crushi	ing) =	0.60	
OK, Section is Not Over-Reinforced			
Minimum reinforcement check (AASHTO 5.6.3.3):			
phi(Mn) > 1.072 Mcr			
Determine Mcr			
Modulus of Rupture, fr = .24 (f'c)^0.5 =		0.449	ksi
Section Modulus, Sc =		721.70	inches ³
Mcr = Sc*fr =		27.00	foot-kips
Mstrength1 =		3.97	foot-kips
1.072Mcr =			foot-kips
1.33*Mstrength1			foot-kips
Mr			foot-kips
min(1.072Mcr,1.33Mstrength1) Min. Reinforcement Criteria is Satisfied		5.28	foot-kips
Check Shear Capacity (LRFD 5.8.3.3): Determine dv:			
dv1 = d - a/2 =		15.91	inches
dv2 = 0.9*d =			inches
dv3 = 0.72 * member height =		13.68	inches
dv = max(dv1, dv2, dv3) =		15.91	inches
Nominal Shear Resistance:			
Vn1 = Vc = 0.0316*β*γ*f'c^0.5*bv*dv =		22.58	kips
Vn2 = 0.25*f'c*b*dv =		167.10	
Vn = min(Vn1, Vn2) =		22.58	
		0.90	
φv =			I day a
φv = Vr = (phi)Vn =		20.32	kips
-		20.32	

DETERMINE BARRIER CAPACITY FOR EXTREME EVENT LOAD (LRFD A13.3.1):

min. width at base de 0.47 inches^2/ 0 16.00 inches 0.75 de 3.75 kips/foot 16.00 inches 0.85 0.11 inches 0.85 0.11 inches 3.74 foot-kips/ # 4 5 bars
de 0.47 inches^2/ 0 16.00 inches 0.75 0.75 inches de 3.75 kips/foot inchers only 16.00 inches 0.11 inches 0.11 3.74 foot-kips/ 4
0 16.00 0.75 de 3.75 kips/foot 16.00 inches 0.85 0.11 inches 0.11 inches 3.74 foot-kips/ 4
0.75 de 3.75 kips/foot inchors only 0.85 0.11 inches 3.74 foot-kips/ # 4
de 3.75 kips/foot inchors only 0.85 0.11 inches 3.74 foot-kips/ # 4
3.75 kips/foot inchors only 0.85 0.11 inches 3.74 foot-kips/
16.00 inches 0.85 0.11 0.74 foot-kips/
0.85 0.11 inches 3.74 foot-kips/ # 4
0.11 3.74 foot-kips/ # 4
3.74 foot-kips/
4
19.0 inches
0.98 inches^2/
16.12 inches
1.0
58.90 kips/foot
16.12 inches
0.85
1.65 inches
75.08 foot-kips/
are for impacts w/in segment, not at ends
0.0 foot-kips
3.5 feet
2.67 feet
22.53 feet
63.14 kips
54.0 kips
31

Structure Number: B-16-38		Project #: ²²¹¹⁴	 كككا
Task: Parapet Adhesive Anchor Anal	ysis - Exterior Parapets		Engineering

DESIGN LOADS:			Enter loads on single
Factored Tension Force, Nu =			
Continuous Factored Tension Force, Nus {from loa	ds that are always present} =		
Factored Shear Force, Vu =			(
ANCHOR PROPERTIES:			
Proposed Bar Size =			4
Analyze as Single Anchor or Group =		Group Analysis Required	Group
If Group, # of Anchors Effective in Tension =	10' width, all new anchors - accounts for one side	For force in rebar or bolt only (not concrete	
If Group, # of Anchors Effective in Shear =	10' width, all new anchors - accounts for two sides	For force in rebar or bolt only (not concrete	28
Condition of Concrete =			
Dry or Wet (Saturated) =			Saturated
Cracked or Uncracked at Service Loads =			Cracked
Compressive Strength =			4000
Proposed Embedmen Depth =		OK, Below Limit of 20*Dia	. 5.25
Depth of Member =			9.00
Single Anchor Edge Distance & Spacing:	Note: See ACI 17.4.2.3 when lo	ocated near 3 or more edges	
Minimum Edge Distance = 6*dia. =			3.75
Minimum Spacing = 6*dia. =			3.75
Left Side:			
Edge or Anchor =			Ancho
Distance to Edge or Anchor Spacing =		OK, Meets Minimum Spacing Requiremen	t 9.00
Right Side:			
Edge or Anchor =			Ancho
Distance to Edge or Anchor Spacing =		OK, Meets Minimum Spacing Requiremen	t 9.00
Front:			
Edge or Anchor =			Edge
Distance to Edge or Anchor Spacing =	back anchor only in tension	OK, Meets Minimum Edge Distance Requirement	t 11.00
Back:			
Edge or Anchor =			Edge
Distance to Edge or Anchor Spacing =		OK, Meets Minimum Edge Distance Requirement	90.0

 Determine Projected Concrete Breakout Area of a Single Adhesive Anchor, A_Nc:

 S = min(1.5*hef, spacing/2, edge distance {ca})

 Left: S =
 4.5

 Right: S =
 4.5

 Front: S =
 7.875

 Back: S =
 7.875

 A_Nc =
 141.8

 Calculate A_Nc per ACI Figure 17.4.2.1 for Anchor Group

7.875 inches

132.75 inches

18.88 inches Depth of Group = A_Nc = 2505.7 Determine Projected Influence Area of a Single Adhesive Anchor, A_Na: S = min(C_Na, spacing/2, edge distance {ca}) 510 tau_uncr = ______C_Na = 10 * Dia. * (tau_uncr/1100)^0.5 = 4.26 Left: S = 4.26 Right: S = 4.26 Front: S = 4.26 Back: S = 4.26

72.4

A_Na =

1.5*hef =

Width of Group =

Calculate A_Na per ACl Figure 17.4.5.1 for Anchor Group C_Na = 10 * Dia. * (tau_uncr/1100)^0.5 = Width of Group =	4.26 inches	
Depth of Group =	15.26 inches	
A_Na =		1914.8
Calculate A_vc per ACI Figure 17.5.2.1b for Anchor Group Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear = 1.5*Ca1 = Member Depth, ha = Width of Group = Depth of Group =	<u>override</u> 4.00 4.00 inches 6.00 inches 9.00 inches 129.00 inches 4.00 inches	ACI Case 1, 1/2 load to
A_vc =		516.0
ADHESIVE ANCHOR TENSILE RESISTANCE:		
Nominal Tensile Resistance, Nr = phi_ts*Nsa <= phi_tc*Ncb <= phi_tc*Na Phi Factors:		
Steel Classification =		Ductile
Supplementary Reinforcement Included = phi_ts =		<u>Yes</u> 0.75
phi_tc =		0.65
phi_tc_pullout =		0.65
Determine Nominal Steel Strength of Anchor in Tension, Nsa = Ase, N * f_uta:		
Effective Cross-Sectional Area of Anchor in Tension, A_se,N: Bar # =	override	# 5
Area, A_se,N = Tensile Strength of Anchor, futa <= 1.9*fy <= 125 ksi		0.31 inches^2
fy = 125 ks		60 ksi
fu =		90 ksi
1.9*fy = Controlling Tensile Strenght, f_uta =	<u>override</u>	114 ksi 90 ksi
Nee		
Nsa = phi_ts*Nsa =		27.6 kips 20.7 kips
Determine Nominal Concrete Breakout Strength of a Single Anchor in Tension, Ncb = A_	nc * Nh / (0*hof/2) * nci od N * nci c N * nci cn N;	
Psi Factors:		
psi_ed,N [Modification factor for tensile strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =		5.25 inches
Minimum edge distance, Ca_min =		11 inches
psi_ed,N =		1.000
psi_c,N [Modification factor for tensile strength based on presence or absence of crack psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads)		1.0
psi_cp,N [Modification factor for post-installed anchors intended for use in uncracked	concrete]	
Critical Edge Distance, Cac = 2*hef = psi cp,N =	Supplementary Reinforcement Included, Therefore =	10.5 inches 1.000
	Supplementary neuroscenter included, meterosc	
Concrete Breakout Strength of a Single Anchor in Tension in Cracked Concrete, Nb =		12.93 kips
Ncb =		7.39 kips
phi_tc*Ncb =		4.80 kips
Determine Nominal Concrete Breakout Strength of an Anchor Group in Tension, Ncbg =	A_nc * Nb / (9*hef^2) *psi_ec,N* psi_ed,N * psi_c,N *	* psi_cp,N:
Psi Factors: psi_ec,N [Modification factor for anchor groups loaded eccentrically in tension]		
Eccentricity, e'N =		0.00 inches
psi_ec,N =		1.00
psi_ed,N [Modification factor for tensile strength based on proximity to edges]		
Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min =		5.25 inches 11 inches
psi_ed,N =		1.000
psi_c,N [Modification factor for tensile strength based on presence or absence of crack	sl	
psi_c, N = (1.0 when cracking at service loads, 1.4 when no cracking at service loads)		1.0
psi_cp,N [Modification factor for post-installed anchors intended for use in uncracked	concrete]	
Critical Edge Distance, Cac = 2*hef =		10.5 inches
psi_cp,N =	Supplementary Reinforcement Included, Therefore =	1.000
Basic Concrete Breakout Strength of a Single Anchor in Tension in Cracked Concrete, Nb =	for normal weight concrete	10.3 kips
Ncbg =		104.51 kips
phi_tc*Ncbg =		67.93 kips

pi.g.d.k.k.k.k.k.k.k.k.k.k.k.k.k.k.k.k.k.k	Determine Nominal Bond Strength of a Single Anchor in Tension, Na = A_na * Nba / (4	*C_na^2) * psi_ed,Na * psi_cp,Na:	
Effective Embeddment Depth of Achor, hefe "as " andra dummes " 6.15 inches Minimum adje distance, c., mi 4.26 inches pill, ex.Na " 4.26 inches pill, ex.Na " 100 pill ma s 4.2 kpip Na " 4.2 kpip Na " 4.2 kpip pill, ex.Na " 2.75 kpip pill, ex.Na " 2.75 kpip pill, ex.Na " 2.75 kpip pill ex.Na " 2.75 kpip pill ex.Na " 0 inches pill ex.Na " 2.55 inches pill ex.Na " 0 inches pill ex.Na " 0 inches pill ex.Na " 0 inches pill ex.Na " 2.5 inches pill ex.Na " 1.00 inches	Psi Factors:	vimity to edges]	
Minimum edge distance, 2, units 4.2 for index C_Na = distance required divelop full bond strength = 4.2 for index pic_ep.ka Modification factor for pull-out strength of adhesive anchors) 100 pic_ep.ka Modification factor for pull-out strength of adhesive anchors) 100 Strength in fraction of 3 Single Adhesive Anchor, Nos = tau, or * pi * dia. * het 100 Na = 4.2 logs Pic_ep.ka Modification factor for anchor groups toaded eccentrically in tension 2.25 londs Pic_ep.ka Modification factor for anchor groups toaded eccentrically in tension 2.25 londs Pic_ep.ka Modification factor for pull-out strength of adhesive anchors based on proximity to edges 0 inches Pic_ep.ka Modification factor for pull-out strength of adhesive anchors based on proximity to edges 100 Pic_ep.ka Modification factor for pull-out strength of adhesive anchors 100 Pic_ep.ka Modification factor for pull-out strength of adhesive anchors 100 Pic_ep.ka Modification factor for pull-out strength of adhesive anchors 100 Pic_ep.ka Modification factor for pull-out strength of adhesive anchors 100 Pic_ep.ka Modification factor for pull-out strength of adhesive anchors 100 Pic_ep.ka Modification factor for pull-out		anity to edges	5.25 inches
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Just Section Just Section Just Section Just Section Just Section Just Section Just Section Just Section Just Section Just Section Just Section Just Section Just Section Just Section Just Section	C_Na = distance required to develop full bond strength =		4.26 inches
Critical Signe Distance, Care - 2'hef =	psi_ed,Na =		1.000
Critical Signe Distance, Care - 2'hef =	nsi on Na [Modification factor for null-out strength of adhesive anchors]		
pi (c) Na ⁺ 1.00 Bond Strength in Tension of a Single Adhesive Anchor, Na = tau_or * pi * dia.* bef: 4.2 kpp Na = 4.2 kpp Pi (c, Ni * *) 0 inches Pi (c, Ni * *) 1.00			10.5 inches
tot = 410 pi MN = 423 kpc NN = 423 kpc 423 kpc NN = 423 kpc 275 kpc Pil.tr, pullout*Ms = 275 kpc 275 kpc Determine Nominal Bood Strongh of an Anchor Group in Tension, Nag = A, na * Nbs / (4*C, na*2) * pil_ec, Na* 0 inches pil_ec, K = 0 inches 100 100 pil_ec, K = 100 100 100 100 pil_ec, K = 100 100 1000		Supplementary Reinforcement Included, Therefore =	1.00
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Determine Nominal Bond Strength of an Anchor Group in Tension, Nag = A, na * Nba / (4*C, na*2) *psi_ec, Na * psi_ed, Na * psi_ec, Na * psi	Na =		4.23 kips
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pi factor: 0 pi : ec.N Modification factor for anchor groups loaded eccentrically in tension] 0 pi : ec.N : 0 pi : ec.N : 100 pi : ec.N : 110 Holman edge distance, C, an inn : 120 pi : ec.N : 100 stantage : 100 pi : ec.N : 100 stantage : 100 pi : ec.N : 100 stantage : 100 <td>Determine Nominal Bond Strength of an Anchor Group in Tension Nag = A na * Nha</td> <td>(4*C na^2) *nsi ec Na* nsi ed Na * nsi cn Na:</td> <td></td>	Determine Nominal Bond Strength of an Anchor Group in Tension Nag = A na * Nha	(4*C na^2) *nsi ec Na* nsi ed Na * nsi cn Na:	
cccccccccccccccccccccccccccccccccccc	Psi Factors:	(+ c_na z) psi_cc,na psi_ca,na psi_cp,na.	
psi_cr.N =			
pi			
if Effective Embedment Depth of Anchor, hF = 20 * anchor dameter = 5.25 inches Minitum edge distance, Ca, an, n = 11 inches c, Na = distance required to develop full bond strength = 4.26 inches pil, ed, Na = 1.000 gi, cy, Ni (Modification factor for pull-out strength of adhesive anchors) 1.000 gi, cy, Na = 1.00 Bond Strength in Tension of a Single Adhesive Anchor, Nb = tau, cr * pi * dia. * hef: 410 ppi tau = 4.28 kips Nag = 1.11.71 kips Pil_C_pullout*Nag = 2.28 kips Check Tensile Capacity vs. Tensile Load 2.28 kips Factored Tensile Capacity vs. Tensile Load 0 kips Factored Tensile Capacity vs. Tensile Load 0.00 kips Selected Anchor has Sufficient Tensile Capacity 0.00 kips Selected Anchor has Sufficient Tensile Capacity vs. Sustained Tensile Tensile Capacity vs. Sustained Tensile Force, Nus = 0.00 kips Nominal Tensile Resistance, Vr = phi_vs*0.6*Vas <= phi_vs*Vcb <= phi_vs*Vcb	psi_ec,N =		1.00
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Minimum deg distance, Ca_min = 11 inches pi.g.d,Na = 4.25 inches pi.g.d,Na = 1.000 pi.g.d,Na = 1.000 pi.g.d,Na = 1.000 sond Strength in Tension of a Single Adhesive Anchor, Na = tau_cr* pi*dia.* hef: 1.00 tau = 4.2 kips Nag = 1.11.71 kips pi.g.d,Na = 4.2 kips Nag = 1.11.71 kips pi.g.d,Na = 4.2 kips Nag = 1.11.71 kips pi.g.d,Na = 0 kips Sorder Tensile Capacity vs. Tensile Load 6.7.93 kips Sected Anchor has Sufficient Tensile Capacity vs. Sustained Tensile Load 6.7.93 kips Sected Anchor has Sufficient Tensile Capacity vs. Sustained Tensino force. Nu = 0.000 kips		and to coBes1	5.25 inches
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bit op Nit Modification factor for pull-out strength of adhesive anchors] 105 inches pit op Nit Modification factor for pull-out strength of adhesive anchors] 100 pit op Nit adhesite adhesive anchors, Nba = tau_cr* pit dia.* hef: 410 psi Na = 42 kips Nag = 111.71 kips Phit_c_pullout*Nag = 0 kips Check Tensile Capacity vs. Tensile Load 0 kips Factored Tension Facce, Nu = 0 kips Selected Anchor has Sufficient Tensile Capacity 0 kips Nominal Tensile Resistance, Nr = min(phi_ts*Nsa, phi_tc*Na) = 0.000 kips Selected Anchor has Sufficient Tensile Capacity 0.000 kips Nominal Tensile Resistance, Nr = 50° phi_tc_pullout*Nba = 19.23 kips Selected Anchor has Sufficient Tensile Capacity 0.000 kips Nominal Tensile Resistance, Nr = 50° phi_tc_pullout*Nba = 19.23 kips Selected Anchor has Sufficient Tensile Capacity 0.000 kips Nominal Tensile Resistance, Nr = phi_vc*Vcb <= phi_vv*vcp			
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Nominal Shear Resistance, Vr = phi_vs*0.6*Vsa <= phi_vc*Vcb <= phi_vp*Vcp	ADHESIVE ANCHOR SHEAR RESISTANCE:		
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$\begin{array}{c} \text{phi_vp} = & 0.75 \\ \hline \textbf{Determine Nominal Steel Strength of Anchor in Shear, Vsa = Ase, V * f_uta:} \\ \text{Effective Cross-Sectional Area of Anchor in Tension, A_se, N:} \\ Bar \# = & & \underline{override} & \# 5 \\ Area, A_se, V = & 0.307 \text{ inches}^2 \\ \hline \textbf{Tensile Strength of Anchor, futa <= 1.9*fy <= 125 \text{ ksi}} \\ fy = & & 60 \text{ ksi} \\ fu = & & 90 \text{ ksi} \\ 1.9*fy = & & 0.456 \text{ ksi} \\ \hline \textbf{Controlling Tensile Strength, f_uta =} & 0 \text{ ksi} \\ \hline \textbf{Vsa} = & & 16.6 \text{ kjps} \end{array}$			
Determine Nominal Steel Strength of Anchor in Shear, Vsa = Ase, V * f_uta: Effective Cross-Sectional Area of Anchor in Tension, A_se,N: Bar # = override Area, A_se,V = Tensile Strength of Anchor, futa <= 1.9*fy <= 125 ksi			
Effective Cross-Sectional Area of Anchor in Tension, A_se,N:Bar # = $override$ # 5Area, A_se,V = 0.307 inches^2Tensile Strength of Anchor, futa <= $1.9*$ fy <= 125 ksi	r <u> </u>		
Bar # =override# 5Area, A_se, V = 0.307 inches^2Tensile Strength of Anchor, futa <= $1.9*$ fy <= 125 ksi	Determine Nominal Steel Strength of Anchor in Shear, Vsa = Ase,V * f_uta:		
Area, A_se, V = 0.307 inches^2 Tensile Strength of Anchor, futa <= 1.9*fy <= 125 ksi	Effective Cross-Sectional Area of Anchor in Tension, A_se,N:		
Tensile Strength of Anchor, futa <= 1.9*fy <= 125 ksi		<u>override</u>	
fy = 60 ksi fu = 90 ksi 1.9*fy = override Controlling Tensile Strenght, f_uta = 90 ksi			0.307 Incnes ²
fu = 90 ksi 1.9*fy = override Controlling Tensile Strenght, f_uta = 90 ksi			60 ksi
1.9*fy = override 114 ksi Controlling Tensile Strenght, f_uta = 90 ksi Vsa = 16.6 kips	-		
Vsa = 16.6 kips		override	114 ksi
	Controlling Tensile Strenght, f_uta =		90 ksi
			1001
			•
	P10 100		10.77 Kips

Concrete member thickness, ha = 9 inche Call = Distance from (C) anchor to edge of concrete in direction of applied shear = 10 pis_hV = max(sqrt(1.5*Cal/ha).0) = 10 pis_hV = max(sqrt(1.5*Cal/ha).10) = 100 gist_hV = max(sqrt(1	psi_ed,V [Modification factor for shear strength based on proximity to edges]			
cl.1 = Details from C(L) and/or to degin of concret in direction of applied blaser = 4.00 4 inche cl.2 = Details of thom C(L) and/or to degin of concret in direction prepriodicular to C(L) = 1.00 pd(.dV) = 1.00 pd(.dV) = 1.00 pd(.dV) = 1.00 pd(.dV) = 1.00 Where analysis thors cracking at service loads, pd(.2 V = 1.0 Where analysis thors cracking at service loads, pd(.2 V = 1.0 Where analysis thors cracking at service loads, pd(.2 V = 1.0 Where analysis thors cracking at service loads, pd(.2 V = 1.0 Where analysis thors cracking at service loads and as barre greater between endor and end, pd(., V = 1.0 pd(.dV) = 1.0 1.0 pd(.dV) = 1.0 <th>Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =</th> <th></th> <th>5.25</th> <th>inches</th>	Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =		5.25	inches
Q2 Detainer form (2) under to degin of concrete in direction perpendicular to Cal = 9 9 pic_del (4) 100 Where marked in theory cracking at service loads and a superment in chart or edge mater at 40, pic_L (2) = 10 Where marked in theory cracking at service loads and a bit are granter between and edge, pic_V = 12 Where marked in theory cracking at service loads and a bit are granter between and edge, pic_V = 12 pic_V = 12 10 pic_V = 10 10 pic_V = 100 10 10 pic_V = 100 10 10 pic_V =				
$ pi_{k} dV = 1 $ $ pi_{k} dV$	Ca2 = Distance from C/L anchor to edge of concrete in direction perpendicular to Ca1 =	4.00	9	
$ \begin{aligned} $	Direction of Shear (perpendicular is conservative) =		Perpendicular	
Where analysis chow on caching at service loads and on supplemental relation or edge relations, pic, V = 1.0 Where analysis chow caching at service loads and on supplemental relation or edge relations, pic, V = 1.2 Where analysis chow caching at service loads and on supplemental relation or edge relations, pic, V = 1.2 pic, CV = 0 pic, CV = <	psi_ed,V =		1.00	
Where analysis chow on caching at service loads and on supplemental relation or edge relations, pic, V = 1.0 Where analysis chow caching at service loads and on supplemental relation or edge relations, pic, V = 1.2 Where analysis chow caching at service loads and on supplemental relation or edge relations, pic, V = 1.2 pic, CV = 0 pic, CV = <	psi c.V [Modification factor for shear strength based on presence or absence of cracks and supplemental rei	nforcementl		
Where analysis shows cracking at service back an 44 bar or greater between and/or and edge, pc, v = 1.2 where analysis shows cracking at service back a > 44 bar between edge & >=44 strups spaced <=x ⁺ , pd_v, v = 000000000000000000000000000000000			1.4	
where analysis shows cracking at service loads &>=# bar between edge & >=# strings spaced <=*, gil_, v_1^*	Where analysis shows cracking at service loads and no supplemental rebar or edge rebar <#4, psi_c, V =		1.0	
$p_{1,k} V = 1 $ $p_{1,k} V (Modification factor for shear strength of anchors located in members with ha < 1.5^{Ca1} Call Call Contact for G have strength of anchors located in members with ha < 1.5^{Ca1} Call Call Call Call Call Call Call Cal$	Where analysis shows cracking at service loads and a #4 bar or greater between anchor and edge, psi_c, V	=	1.2	
$ pi_{L} V_{l} = $ $ pi_{L} V_{l} (Modification factor for shear strength of anchors located in members with ha < 1.5* (Cal) Concrete member takines, ha = 0 inche Cal = Distance from (A, anchor to edge of concrete in direction of applied shear = 4 inche pi_{L} V_{l} max(sqr(11.5* Cal/ha).1.0) = 1.0 pi_{L} V_{l} (Modification factor for shear strength based on loading direction] pi_{L} V_{l} (Modification factor for shear strength based on loading direction] pi_{L} V_{l} (Modification factor for shear strength based on loading direction] pi_{L} V_{l} (Modification factor for shear strength based on loading direction] pi_{L} V_{l} (Modification factor for shear strength based on loading direction] pi_{L} V_{l} (Modification factor for shear strength based on loading direction] pi_{L} V_{l} (Modification factor for shear strength based on loading direction] pi_{L} V_{l} (Modification factor for shear strength based on loading direction] pi_{L} V_{l} (Modification factor for shear strength of a Single Anchor in Shear in Cracked Concrete, Vic: t = the (13.5* Cal/ha). (Modification factor for shear strength based on cracked Concrete, Vic: t = the (13.5* Cal/ha). (Modification factor for anchor group loaded eccentrically in shear) [Cal = 0.000 pi_{L} v_{L} (V_{L} (V_{L} + U_{L} + V_{L} + V_{L}$	Where analysis shows cracking at service loads & >= #4 bar between edge & >=#4 stirrups spaced <=4", psi_c, V =		1.4	
<pre>i</pre>	nsi r V =	override	1.2	
Concrete member thickness, ha = 9 inche Call = Distance from (C) anchor to edge of concrete in direction of applied shear = 10 pis_hV = max(sqrt(1.5*Cal/ha).0) = 10 pis_hV = max(sqrt(1.5*Cal/ha).10) = 100 gist_hV = max(sqrt(1	ps_,, v =		1.2	
CA1 = Distance from C/L anchor to edge of concrete in direction of applied shear = 4 inche pihV = max(sqrt(1.5*Ca1/ha).1.0) = 1.0 pibV = 1.00 pibV = 6 1 = min(panety action factor for shear strength based on loading direction) 1.00 pibV = 6 2 = min(Spacing/2, perpondicular edge distance(1.2), 1.5* edge distance(1.2)) = 6.1 2 = min(Spacing/2, perpondicular edge distance(1.2), 1.5* edge distance(1.2)) = 5.0 2 = min(Tr(ic/dia).0.2 * dia^0.5 * fc^0.5 * Ca1^1.5 , 9 * fc^0.5 * ca1^1.5] = 5.2 2 = min(Tr(ic/dia).0.2 * dia^0.5 * fc^0.5 * Ca1^1.5 , 9 * fc^0.5 * ca1^1.5] = 4.244 kips p =	psi_h,V [Modification factor for shear strength of anchors located in members with ha < 1.5*Ca1]		٥	inche
$p_{ij} (Midfitcation factor for shear strength based on loading direction] p_{ij}, V = 1.00 jested Area of Concrete Failure Surface, Ave: H = min(member dept), 15*Ca12, 15*edge distance(Ca1)) = 4.5 inche S1 = min(Spacing/2, perpendicular edge distance, 1.5*edge distance) = 4.5 inche S2 = min(Spacing/2, perpendicular edge distance, 1.5*edge distance) = 4.5 inche S2 = min(Spacing/2, perpendicular edge distance, 1.5*edge distance) = 4.5 inche S2 = min(Spacing/2, perpendicular edge distance, 1.5*edge distance) = 4.5 inche S2 = min(Spacing/2, perpendicular edge distance, 1.5*edge distance) = 4.5 inche Ave: = H(S1:S2) = 5.4 inche F1 = 4.5 d'dia, = 5.5 inche f1 = 4.5 d'dia, = 5.5 inche f1 = 4.5 d'dia, = $				
$p_{ij} (Midfitcation factor for shear strength based on loading direction] p_{ij}, V = 1.00 jested Area of Concrete Failure Surface, Ave: H = min(member dept), 15*Ca12, 15*edge distance(Ca1)) = 4.5 inche S1 = min(Spacing/2, perpendicular edge distance, 1.5*edge distance) = 4.5 inche S2 = min(Spacing/2, perpendicular edge distance, 1.5*edge distance) = 4.5 inche S2 = min(Spacing/2, perpendicular edge distance, 1.5*edge distance) = 4.5 inche S2 = min(Spacing/2, perpendicular edge distance, 1.5*edge distance) = 4.5 inche S2 = min(Spacing/2, perpendicular edge distance, 1.5*edge distance) = 4.5 inche Ave: = H(S1:S2) = 5.4 inche F1 = 4.5 d'dia, = 5.5 inche f1 = 4.5 d'dia, = 5.5 inche f1 = 4.5 d'dia, = $				
$p_{1}p_{2}p_{1}V = 100$ $p_{1}p_{2}p_{1}V = 100$ $p_{1}p_{2}p_{1}v_{1}V = 100$ $p_{1}p_{2}p_{2}p_{2}p_{2}p_{2}p_{2}p_{2}p_{2$	psi_h,V = max(sqrt(1.5*Ca1/ha),1.0) =		1.0	
<pre>vertex Area of Concrete Failure Surface, Ave: H = min(prember depth, 15*Call = 6 inche S1 = min(Spacing/2, perpendicular edge distance(Cal), 15*edge distance(Cal)) = 4 5 inche S1 = min(Spacing/2, perpendicular edge distance, 12*edge distance) Ave = H(S1+S2) = 54.0 inche hreete Breakout Strength of a Single Anchor in Shear in Cracked Concrete, Vb: le = hef < 8*dia. = 0.62.5 inche fe = 0.62.5 inche</pre>	psi_p,V [Modification factor for shear strength based on loading direction]			
is miniformer and existing a service loads, pair_existing a se	psi_p,V =		1.00	
 S1 = min(Spacing/2, perpendicular edge distance(Ca2), 15*edge distance(Ca1)) = S2 = min(Spacing/2, perpendicular edge distance, 1.5*edge distance) = Atc = h(5+52) = Atc = h(5+52) = S4.0 inche Exterte Breakout Strength of a Single Anchor in Shear in Cracked Concrete, Vb: Exterte Breakout Strength of a Single Anchor in Shear in Cracked Concrete, Vb: Exterte Breakout Strength of a Single Anchor in Shear in Cracked Concrete, Vb: Exterte Breakout Strength of a Single Anchor in Shear in Cracked Concrete, Vb: Exterte Breakout Strength of a Single Anchor in Shear in Cracked Concrete, Vb: Exterte Breakout Strength of an Anchor Group, vbg = A, vc * Vb / (4.5*Ca1*2) * psi_ec, V* psi_ed, V* psi_eb, V* psi_	vjected Area of Concrete Failure Surface, Avc:			
$S2 = \min\{Spacing/2, perpendicular edge distance, 1.5*edge distance) = 4.5 inche Avc = h(51+52) = 5.4.0 inche increte Breakout Strength of a Single Anchor in Shear in Cracked Concrete, Vb: l = hef < k^2 dia_{l} = \frac{5}{0.6.25} inche Pc = 0.6.25 inche Pc = 0.000 jinche Pc = $				
Avc = H(3+2) = 54.0 inche harrete Breakout Strength of a Single Anchor in Shear in Cracked Concrete, Vb: le = hef < 8° dia = diameter = C				
Note the transformer to the set of the set	sz = min(spacing/z,perpendicular edge distance,1.5 'edge distance) =		4.5	inche
le = hef < s*dia. = s inche diameter = heft < s*dia. = 0.625 inche Cal = 4000 psi Cal = 4 inche vb = min[7*(le/dia)^0.2 * dia^0.5 * fc^0.5 * Cal^1.5 , 9 *fc^0.5 * cal^1.5]= 4.244 kips 2 = 3.82 kips 2 wc*Vcb = 3.82 kips 2 wc*Vcb = 3.82 kips vc*Vcb = 0.000 jnche Factors: psi _ec/ V modification factor for anchor group loaded eccentrically in shear] Cccentricity, eV = 0.000 jnche Cal = Distance from C/L anchor to edge of concrete in direction of applied shear = 4 inche psi _ec/V = 1000 psi _ed/V modification factor for shear strength based on proximity to edges] Effective Emotion for C/L anchor to edge of concrete in direction of applied shear = 4.000 4 inche Cal = Distance from C/L anchor to edge of concrete in direction of applied shear = 4.000 4 inche Cal = Distance from C/L anchor to edge of concrete in direction of applied shear = 4.000 4 inche Direction of Shear (perpendicular is conservative) = 0.000 jnche cal = Distance from C/L anchor to edge of concrete in direction of applied shear = 4.000 4 inche psi _ed/V = 1.0000 psi _ed/V = 1.000000 psi _ed/V = 1.00000000000000000000000000000000000	Avc = H(S1+S2) =		54.0	inche
diameter = 0.625 inche fr = 0.625 inche fr = 0.621 = 4.000 psi 	ncrete Breakout Strength of a Single Anchor in Shear in Cracked Concrete, Vb:			
$fc = \frac{4000 \text{ pis}}{Ca1 =} \frac{4000 \text{ pis}}{4 \text{ inche}}$ $vb = \min[7^*(le/da)^0.2^* da^0.5^* fc^0.5^* Ca1^1.5] = 4.244 \text{ kips}$ $s = \frac{3.82 \text{ kips}}{2^* v^* vb =} \frac{3.82 \text{ kips}}{2.86 \text{ kips}}$ $ve^* vb = \sqrt{4.5^* Ca1^2.5^* fc^0.5^* ca1^1.5]} = 4.244 \text{ kips}$ $s = \frac{3.82 \text{ kips}}{2.86 \text{ kips}}$ $ve^* vb = \sqrt{4.5^* Ca1^2.5^* ps} edv * ps = ev * ev$	le = hef < 8*dia. =			
Ca1 = 4 inche Ca1 = 4 inche Vb = min[7*(le/dia)^0.2 * dia^0.5 * fc^0.5 * ca1^1.5 , 9 * fc^0.5 * ca1^1.5] = 4.244 kips p = 3.82 kips Lvc^Vcb = 3.82 kips termine Nominal Concrete Breakout Strength in Shear for an Anchor Group, Vcbg = A_vc * Vb / (4.5*Ca1^2) * psi_ec,V* psi_ed,V* psi_c,V* psi_b,V* psi_p,V* Factors: Factors: Discev.[Modification factor for anchor group loaded eccentrically in shear] Eccentricity, e'V = 0 0.00 inche Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear = 0.00 psi_ed,V [Modification factor for shear strength based on proximity to edges] Effective Embedment Depth of Anchor, hef ~ 20 * anchor diameter = 0.00 Minimum edge distance, Ca_min = 0.00 psi_ed,V [Modification factor for shear strength based on presence or absence of cracks and supplemental reinforcement] Where analysis shows cracking at service loads, psi_c,V = 1.00 Where analysis shows cracking at service loads, psi_c,V = 0.00 Where analysis shows cracking at service loads and an 4b aro or greater between anchor and edge, psi_c,V = 0.20 mine analysis shows cracking at service loads and an 4b aro or greater between anchor and edge, psi_c,V = 0.20 psi_c,V [Modification factor for shear strength of anchors located in members with ha < 1.5*Ca1] Concrete member thickness, ha = 0 psi_c,V = 0.20 psi_c,V = 0.20 psi_h,V = max(sqrt(1.5*Ca1/ha).10) = 1.00 psi_h,V = max(sqrt(1.5*Ca1/ha).10) = 1.00 psi_h,V = Modification factor for shear strength based on loading direction]				
$Vb = min[7*(le/dia)^0.2* dia^0.5* fc^0.5* cal^1.5, 9*fc^0.5* cal^1.5] = 4.244 kips$ $p = 3.32 kips$ $p = 3.32 kips$ $2.86 kips$ termine Nominal Concrete Breakout Strength in Shear for an Anchor Group, Vcbg = A_vc* Vb / (4.5* cal^2)* psi_ec,V* psi_ed,V* psi_c,V* psi_h,V* psi_p,V: Factors: $psi_ec,V [Modification factor for anchor group loaded eccentrically in shear]$ Eccentricity, eV = 0.000 inche cal = 0.000 inche for psi_ec,V = 1.00 $psi_ec,V = 1.00 $ Effective Embedment Depth of Anchor, hef <= 20* anchor diameter = 0.000 inche cal = Distance from C/L anchor to edge of concrete in direction of applied shear = 4.00 4.00 4 inche cal = Distance from C/L anchor to edge of concrete in direction of applied shear = 4.00 4.00 4 inche cal = Distance from C/L anchor to edge of concrete in direction of applied shear = 4.00 4.00 4 inche cal = Distance from C/L anchor to edge of concrete in direction perpendicular to Cal = 0.000 psi_ed,V [Modification factor for shear strength based on presence or absence of cracks and supplemental reinforcement] Where analysis shows cracking at service loads and a number or grater between anchor and edge, psi_c, V = 1.2 Where analysis shows cracking at service loads and a supplemental rebar or edge rebar <44, psi_c, V = 1.2 Where analysis shows cracking at service loads and a number or grater between anchor and edge, psi_c, V = 1.2 Where analysis shows cracking at service loads and a number and repared set <44, psi_c, V = 1.2 Where analysis shows cracking at service loads and a supplemental rebar or edge rebar <44, psi_c, V = 1.2 Where analysis shows cracking at service loads and a flat bar or grater between anchora and edge, psi_c, V = 1.2 Where analysis shows cracking at service loads and a supplemental rebar or edge rebar <44, psi_c, V = 1.2 Where analysis shows cracking at service loads and a flat bar or grater between each or and edge, psi_c, V = 1.2 Where analysis shows cracking at service loads and a flat bar or gratere between each or and edge, psi_c, V = 1.2 Where analysis show	f'c = Ca1 =			•
$ \begin{array}{c} 3.82 \text{ kps} \\ ye^{\text{w}}\text{Cb} = & 3.82 \text{ kps} \\ 2.86 k$	Vh - min[7*/la/dia)40 2 * dia40 5 * fi-40 5 * Ca141 5 0 *fi-40 5 * ca141 5]-		1 211	kins
$ vert ve b = 286 \text{ kps} $ termine Nominal Concrete Breakout Strength in Shear for an Anchor Group, Vcbg = A_vc * Vb / (4.5*Ca1^2) * psi_ec, V * psi_ed, V * psi_e, V * psi_h, V * psi_p, V: psi_ec, V * psi_ed, V * psi_ec, V * psi_ec, V * psi_ed, V * psi_ec, V * psi_ed, V * psi_ec, V * psi_ed, V * psi_ec,			4.244	кірз
Factors: psi_ec, V [Modification factor for anchor group loaded eccentrically in shear] Eccentricity, $e^{V} =$ Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear = psi_ed, V [Modification factor for shear strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear = Ca2 = Distance from C/L anchor to edge of concrete in direction perpendicular to Ca1 = Direction of Shear (perpendicular is conservative) = psi_ed,V = psi_ed,V = 1.00 psi_cV [Modification factor for shear strength based on presence or absence of cracks and supplemental reinforcement] Where analysis shows no cracking at service loads, psi_c, V = Where analysis shows cracking at service loads and at #4 bar or greater between anchor and edge, psi_c, V = 1.2 Where analysis shows cracking at service loads & >= #4 bar between edge & >=#4 stirrups spaced <=4", psi_c, V = 1.2 where analysis shows cracking at service loads & >= #4 bar between edge & >=#4 stirrups spaced <=4", psi_c, V = 1.2 psi_c,V = 1.4 More thickness, ha = Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear = 4 inche 2.2 psi_h,V [Modification factor for shear strength of anchors located in members with ha <1.5*Ca1] Concrete member thickness, ha = Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear = psi_h,V = max(sqrt(1.5*Ca1/ha),1.0) = psi_b,V = max(sqrt(1.5*Ca1/ha),1.0) = 1.0 psi_b,V [Modification factor for shear strength based on loading direction]	:b = ii_vc*Vcb =			•
Factors: psi_ec, V [Modification factor for anchor group loaded eccentrically in shear] Eccentricity, $e^{V} =$ Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear = psi_ed, V [Modification factor for shear strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter = Minimum edge distance, Ca_min = Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear = Ca2 = Distance from C/L anchor to edge of concrete in direction perpendicular to Ca1 = Direction of Shear (perpendicular is conservative) = psi_ed,V = psi_ed,V = 1.00 psi_cV [Modification factor for shear strength based on presence or absence of cracks and supplemental reinforcement] Where analysis shows no cracking at service loads, psi_c, V = Where analysis shows cracking at service loads and at #4 bar or greater between anchor and edge, psi_c, V = 1.2 Where analysis shows cracking at service loads & >= #4 bar between edge & >=#4 stirrups spaced <=4", psi_c, V = 1.2 where analysis shows cracking at service loads & >= #4 bar between edge & >=#4 stirrups spaced <=4", psi_c, V = 1.2 psi_c,V = 1.4 More thickness, ha = Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear = 4 inche 2.2 psi_h,V [Modification factor for shear strength of anchors located in members with ha <1.5*Ca1] Concrete member thickness, ha = Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear = psi_h,V = max(sqrt(1.5*Ca1/ha),1.0) = psi_b,V = max(sqrt(1.5*Ca1/ha),1.0) = 1.0 psi_b,V [Modification factor for shear strength based on loading direction]	etermine Nominal Concrete Breakout Strength in Shear for an Anchor Group. Vcbg = A vc * Vb / (4.5*Ca1^2) * g	osiec.V*psied.V*psic.V*	* psi h.V * psi p.V:	
Eccentricity, e'V = 0.00 inche Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear = 4 inche psi_ed, V [Modification factor for shear strength based on proximity to edges] Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =	i Factors:	co,o poco,o poo,o	po) • pop) • ·	
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Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =				
Effective Embedment Depth of Anchor, hef <= 20 * anchor diameter =	nsi ed V [Modification factor for shear strength based on provimity to edges]			
Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear = 4.00 4 inche Ca2 = Distance from C/L anchor to edge of concrete in direction perpendicular to Ca1 = 9 inche Direction of Shear (perpendicular is conservative) = Perpendicular psi_ed,V = 1.00 psi_c,V [Modification factor for shear strength based on presence or absence of cracks and supplemental reinforcement] 1.00 Where analysis shows no cracking at service loads, psi_c, V = 1.4 Where analysis shows cracking at service loads and no supplemental rebar or edge rebar <#4, psi_c, V =		override	5.25	inche
Ca2 = Distance from C/L anchor to edge of concrete in direction perpendicular to Ca1 = 9 inche Direction of Shear (perpendicular is conservative) = Perpendicular psi_ed,V = 1.00 psi_c,V [Modification factor for shear strength based on presence or absence of cracks and supplemental reinforcement] 1.00 Where analysis shows no cracking at service loads, psi_c, V = 1.4 Where analysis shows cracking at service loads and no supplemental rebar or edge rebar <#4, psi_c, V =	Minimum edge distance, Ca_min =	4.00	4	inche
Direction of Shear (perpendicular is conservative) = Perpendicular psi_ed,V = 1.00 psi_c,V [Modification factor for shear strength based on presence or absence of cracks and supplemental reinforcement] Where analysis shows no cracking at service loads, psi_c, V = Where analysis shows cracking at service loads and no supplemental rebar or edge rebar <#4, psi_c, V =	Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear =	4.00	4	inche
psi_ed,V = 1.00 psi_c,V [Modification factor for shear strength based on presence or absence of cracks and supplemental reinforcement] Where analysis shows no cracking at service loads, psi_c, V = 1.4 Where analysis shows cracking at service loads and no supplemental rebar or edge rebar <#4, psi_c, V =				inche
psi_c,V [Modification factor for shear strength based on presence or absence of cracks and supplemental reinforcement] Where analysis shows no cracking at service loads, psi_c, V = 1.4 Where analysis shows cracking at service loads and no supplemental rebar or edge rebar <#4, psi_c, V = 1.0 Where analysis shows cracking at service loads and a #4 bar or greater between anchor and edge, psi_c, V = 1.2 Where analysis shows cracking at service loads & >= #4 bar between edge & >=#4 stirrups spaced <=4", psi_c, V = 1.4 psi_c,V = 1.2 psi_c,V = 1.2 psi_h,V [Modification factor for shear strength of anchors located in members with ha < 1.5*Ca1] Concrete member thickness, ha = 9 inche Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear = 4 inche psi_h,V = max(sqrt(1.5*Ca1/ha),1.0) = 1.0 psi_p,V [Modification factor for shear strength based on loading direction]	Direction of Shear (perpendicular is conservative) =		Perpendicular	
Where analysis shows no cracking at service loads, psi_c, V = 1.4 Where analysis shows cracking at service loads and no supplemental rebar or edge rebar <#4, psi_c, V =	psi_ed,V =		1.00	
Where analysis shows cracking at service loads and no supplemental rebar or edge rebar <#4, psi_c, V =	psi_c,V [Modification factor for shear strength based on presence or absence of cracks and supplemental rein	nforcement]		
Where analysis shows cracking at service loads and a #4 bar or greater between anchor and edge, psi_c, V = 1.2 Where analysis shows cracking at service loads & >= #4 bar between edge & >=#4 stirrups spaced <=4", psi_c, V =				
Where analysis shows cracking at service loads & >= #4 bar between edge & >=#4 stirrups spaced <=4", psi_c, V =				
psi_c,V = 0verride psi_h,V [Modification factor for shear strength of anchors located in members with ha < 1.5*Ca1]		' =		
psi_c,V = 1.2 psi_h,V [Modification factor for shear strength of anchors located in members with ha < 1.5*Ca1]	where analysis shows cracking at service loads & >= #4 bar between edge & >=#4 stirrups spaced <=4", psi_c, V =	override	1.4	
Concrete member thickness, ha = 9 inche Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear = 4 inche psi_h,V = max(sqrt(1.5*Ca1/ha),1.0) = 1.0 psi_p,V [Modification factor for shear strength based on loading direction]	psi_c,V =		1.2	
Concrete member thickness, ha = 9 inche Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear = 4 inche psi_h,V = max(sqrt(1.5*Ca1/ha),1.0) = 1.0 psi_p,V [Modification factor for shear strength based on loading direction]	psi h.V. [Modification factor for shear strength of anchors located in members with ha < $1.5*Ca1$]			
Ca1 = Distance from C/L anchor to edge of concrete in direction of applied shear = 4 inche psi_h,V = max(sqrt(1.5*Ca1/ha),1.0) = 1.0 psi_p,V [Modification factor for shear strength based on loading direction] 1.0			9	inche
psi_p,V [Modification factor for shear strength based on loading direction]				
psi_p,V [Modification factor for shear strength based on loading direction]	psi h,V = max(sqrt(1.5*Ca1/ha),1.0) =		1.0	
			2.0	
	psi_p,V [Modification factor for shear strength based on loading direction] psi_p,V =		1.00	

Projected Area of Concrete Failure Surface, Avc:		
Avc = H(S1+S2) =		516.0 inches^2
Concrete Breakout Strength of a Single Anchor in Shear in Cracked Co	ncrete. Vb:	
le = hef < 8*dia. =	,	5 inches
diameter =		0.625 inches
f'c =		4000 psi
Ca1 =		4 inches
Vb = min[7*(le/dia)^0.2 * dia^0.5 * f'c^0.5 * Ca1^1.5 , 9 *f'c^0.5 *	* ca1^1.5]=	4.24 kips
Vcb =		36.50 kips
phi_vc*Vcb =	ACI Case 1, 1/2 load to front anchors - Capacity is double this	27.37 kips
Determine Nominal Concrete Pryout Strength for a Single Anchor, V Kcp = 1.0 for hef < 2.5" and 2.0 for hef >= 2.5" =	/cp = Kcp*Ncp:	2
Nominal Concrete Pryout Strength, Ncp = min(Na,Ncb)		2
Na (from ACI Eq. 17.4.5.1a) =		4.23 kips
Ncb (from ACI Eq. 17.4.2.1a) =		7.39 kips
NCD (110111 ACI EQ. 17.4.2.12) -		7.55 Kips
Nominal Concrete Pryout Strength, Ncp =		4.23 kips
Vcp =		8.45 kips
phi_vp*Vcp =		6.34 kips
Determine Neminal Concrete Drugut Strength for a Crown of Angles	re Vong - Kon*Nong	
Determine Nominal Concrete Pryout Strength for a Group of Anchor Kcp = 1.0 for hef < 2.5" and 2.0 for hef >= 2.5" =	rs, vcpg = kcp ncpg:	2
Nominal Concrete Pryout Strength, Ncpg = min(Nag,Ncbg)		2
Nag (from ACI Eq. 17.4.5.1b) =		111.71 kips
Ncbg (from ACI Eq. 17.4.2.1b) =		104.51 kips
Nominal Concrete Pryout Strength, Ncpg =		104.51 kips
Nominal concrete riyout strength, hepg -		104.51 Kips
Vcp =		209.02 kips
phi_vp*Vcp =		156.77 kips
Check Shear Capacity vs. Shear Load		
Factored Shear Force, Vu =		0 kips
Nominal Shear Resistance, Vr = min(phi vs*0.6*Vsa , phi vc*Vcb, phi	i vp*Vcp) =	27.37 kips
	ACI Case 1, 1/2 load to front anchors - Total capacity	•
Selected Anchor has Sufficient Shear Capacity		
SHEAR & TENSION INTERACTION ANALYSIS		
Vu/(phi*Vn) =		
Nu/(phi*Nn) =		
For Vu/(phi*Vn) <=0.2: Nu <= phi*Nn		
Interaction Capacity is Sufficient		
For Nu/(phi*Nn) <=0.2: Vu <= phi * Vn		
Interaction Capacity is Sufficient		
For Vu/(phi*Vn) > 0.2 and Nu/(phi*Nn) > 0.2: Nu/(phi*Nn) + Vu/(phi*	*Vn) <=1.2	
Not Applicable		

0.00 0.00

For Vu/(pni*Vn) > 0.2 and Nu/(pni*Nn) > 0.2: Nu/(pni*Nn) + Vu/(pni*Vn) <=1. Not Applicable Interaction Value = N/A

With of Parapet at Base =1.25 feetTransverse Load on Barrier, FI (LRFD T.A13.2.1) =3.5 leetbeing Parapet at Base =3.5 leetScongruduinal Length of distribution of impact force, Lt (LRFD T. A13.2.1) =3.5 leetbeing Parapet at Base =3.5 leetStringth of Steel, fy =3.500 piStringth of Moment Slab, fc =Wield Strength of Steel, fy =Stringth of Additional Events to assign =Average parapet thickness =min. width at baseStringth of Additional Events to assign =Average parapet thickness =OverrideCoverride <th>Structure Number: B-16-38</th> <th></th> <th>Project #: 22114</th> <th></th>	Structure Number: B-16-38		Project #: 22114	
PARAPET ANALYSIS Sister PARAMETERS: apad: Parameters: The Parameters: Aling Design Level Designation (reght of Parapet at Base = (Parameters: Compressive Strength of Moment Slab, fc = (Parameters: Compressive Strength of Strength o	Task: Exterior Parapet Analysis			Engineering
SSIGN PARAMETERS: aget Parameters: Bailing Design Level Designation Height of Parapet at Base = Transverse Load on Barrier, Pt (LRFD T.A13.2.1) = Statistic of distribution of impact force, Lt (LRFD T. A13.2.1) = Statistic of distribution of impact force, Lt (LRFD T. A13.2.1) = Statistic of cantilevered parapet about an axis parallel to the longitudinal axis of the bridge, Mc: Vertical reinforcement bar size = Num	Design By: WAH	Date: 12/17/2024	Checked By: SKH	Date: 12/18/2024
appl Parameters: tailing Design Level Designation teight of Parapet = teight of Parapet = transverse Load on Barrier, Pt (LRED T.A13.2.1) = ongitudinal Length of distribution of impact force, Lt (LRED T. A13.2.1) = teight of Parapet = call Parameters: Compressive Strength of Moment Slab, for = teid Strength of Steel, fy = TERMINE BARRIER CAPACITY FOR EXTREME EVENT LOAD (LRFD A13.3.1): Termine bars paralet about an axis parallel to the longitudinal axis of the bridge, Mc: verage parapet thickness = override (and are of Steel = override teiction Capacity, Mn = T(d-a/2) override (and resistance of cantilevered parapet about envice) axis, Mw: teiction Capacity, Mn = T(d-a/2) override (and resistance of cantilevered parapet about envice) axis, Mw: torical axis, Mw: Cort		PARAPE		
laing Design Level Design Level Design to the level Design Level Design to the level of granget = 125 feet 32 (inche level of granget at Base = 125 feet 32 (inche level of granget at Base = 125 feet 35 (feet distribution of impact force, Lt (LRPD T. A13.2.1) = 35 feet 35 (feet distribution of steel, fv = 3500 psi field Strength of distribution of Impact force, Lt (LRPD T. A13.2.1) = 35 (feet distribution of steel, fv = 3500 psi field Strength of Steel = 3000 psi field Strength of Steel = 900 psi field Steel = 1200 psi	SIGN PARAMETERS:			
Height of Parapet = 32 inche Width of Parapet = 32 inche Width of Parapet = 322 foet Transverse Load on Barrier, Ft (LRFD T.A13.2.1) = 325 feet Large transverse Load on Barrier, Ft (LRFD T.A13.2.1) = 325 feet Large transverse Load on Barrier, Ft (LRFD T.A13.2.1) = 325 feet Large transverse Load on Barrier, Ft (LRFD T.A13.2.1) = 325 feet Large transverse Load on Barrier, Ft (LRFD T.A13.2.1) = 325 feet Large transverse Load on Barrier, Ft (LRFD T.A13.2.1) = 325 feet Large transverse Load on Barrier, Ft (LRFD T.A13.2.1) = 325 feet Large transverse Load on Barrier, Ft (LRFD T.A13.2.1) = 325 feet Large transverse Load on Barrier, Ft (LRFD T.A13.2.1) = 325 feet Large transverse Load on Cover - bar size / 16 = 3200 for H Large transverse Load on Cover - bar size / 16 = 3200 for H Large transverse Load on Size = 1200 for H Large transverse Load Size = 1200 for H Large transverse Load Size = 1200 for H Large transverse Load Fiel = 1200 for H Large transverse Load feet = 1200 for H Large transverse Load feet = 1200 for H Large transverse Load Size = 1200 for H Large transv	apet Parameters:			
With of Parapet at Base = Transverse Load on Barrier, Fl (LRFD T. A13.2.1) = 1.25 [setincinguturial Length of distribution of impact force, Lt (LRFD T. A13.2.1) = 3.5 [setincinguturial Length of distribution of impact force, Lt (LRFD T. A13.2.1) = 3.5 [setincinguturial Length of distribution of impact force, Lt (LRFD T. A13.2.1) = 3.5 [setincinguturial Length of distribution of impact force, Lt (LRFD T. A13.2.1) = 3.5 [setincinguturial Length of distribution of impact force, Lt (LRFD T. A13.2.1) = 3.5 [setincinguturial Length of distribution of impact force, Lt (LRFD T. A13.2.1) = 3.5 [setincinguturial Length of distribution of impact force, Lt (LRFD T. A13.2.1) = 3.5 [setincinguturial Length of distribution of impact force, Lt (LRFD T. A13.2.1) = 3.5 [setincinguturial Length of distribution of impact force, Lt (LRFD T. A13.2.1) = 3.5 [setincinguturial Length of distribution of impact force, Lt (LRFD T. A13.2.1) = 3.5 [setincinguturial Length of distribution of impact force, Lt (LRFD T. A13.2.1) = 3.5 [setincinguturial Length of distribution of impact force, Lt (LRFD T. A13.2.1) = 3.5 [setincinguturial Length of distribution of length of distributio	Railing Design Level Designation			
Transverse Load on Barrier, Ft (LRFD T. A13.2.1) = 33 [set arial Parameters: Compressive Strongth of Moment Slab, fc = $35,00$ psi rield Strongth of Steel, fy = $35,00$ psi TERMINE BARRIER CAPACITY FOR EXTREME EVENT LOAD (LRFD A13.3.1): TRANSVERSE Transverse load, fix: vertical reinforcement bar size = 4 for 4 = thickness of design section - cover - bar size/16 = 0 verride 12,00 inche 12,00 inche 12				32 inches
Longitudinal Length of distribution of impact force, Lt (LRFD T. A13.2.1) = 35 feet arial Parameters: Compressive Strength of Moment Slab, fc = 35,000 psi field Strength of Steel, fy = 50,000 psi TERMINE BARRIER CAPACITY FOR EXTREME EVENT LOAD (LRFD A13.3.1): trural resistance of cantilevered parapet about an axis parallel to the longitudinal axis of the bridge, Mc: Vertical reinforcement bar spacing = 9 inche Vertical reinforcement bar spacing = 0,000 psi TOTAL Area of Steel = 0,000 psi d = thickness of design section - cover - bar size/16 = 0,000 psi a c (Pba17c = 10,000 psi b) B = 0,850,000 (rc + 4000)/1000 <0.85 = 0,000 psi b) a = c (Pba17c = 10,000 psi b) Average parapet thickness = 0 override 0,000 psi b) C = T = ast fv = 10,000 psi b) Average parapet thickness = 0 override 0,000 psi b) B = 0,850,000 (rc + 4000)/1000 <0.85 = 0,000 psi b) Average parapet thickness = 0 override 0,000 psi b) B = 0,850,000 (rc + 4000)/1000 <0.85 = 0,000 psi b) B = 0,850,000 (rc + 4000)/1000 <0.85 = 0,000 psi b) B = 0,850,000 (rc + 4000)/1000 <0.85 = 0,000 psi b) B = 0,850,000 (rc + 4000)/1000 <0.85 = 0,000 psi b) Average parapet thickness = 0 over - bar size/16 = 0,000 psi b) B = 0,850,000 (rc + 4000)/1000 <0.85 = 0,000 psi b) Average parapet thickness = 0 over - bar size/16 = 0,000 psi b) B = 0,850,000 (rc + 4000)/1000 <0.85 = 0,000 psi b) B = 0,850,000 (rc + 4000)/1000 <0.85 = 0,000 psi b) B = 0,850,000 (rc + 4000)/1000 <0.85 = 0,000 psi b) B = 0,850,000 (rc + 4000)/1000 <0.85 = 0,000 psi b) B = 0,850,000 (rc + 4000)/1000 <0.85 = 0,000 psi b) B = 0,850,000 (rc + 4000)/1000 <0.85		2 2 4) -		
Compressive Strength of Moment Slab, fc = 3.500 psi rield Strength of Steel, fy = 0.0000 psi TERMINE BARRIER CAPACITY FOR EXTREME EVENT LOAD (LRFD A13.3.1): train resistance of cantilevered parapet about an axis parallel to the longitudinal axis of the bridge, Mc: vertical reinforcement bar space 41 Average parapet thickness = override 0000 inche Override 0000 inche 0000 inche </td <td></td> <td>,</td> <td></td> <td></td>		,		
Wield Strength of Steel, fy = 60,000 psi ETERMINE BARRIER CAPACITY FOR EXTREME EVENT LOAD (LRFD A13.3.1): # Kural resistance of cantilevered parapet about an axis parallel to the longitudinal axis of the bridge, Mc: # Vertical reinforcement bar spacing = 9 Average parapet thickness = 9 Total Area of Steel = 0.000 0' = thickness of design section - cover - bar size/16 = 12.00 Resistance Factor, phi (AASHTO 5.5.4.2) = 6.79 Section Capacity, Mn = T(d-a/2) override C = T = as ⁴ fy = 6.79 b1 = 0.85 - 0.05(fc - 4000)/1000 < 0.85 =	terial Parameters:			
ETERMINE BARRIER CAPACITY FOR EXTREME EVENT LOAD (LRFD A13.3.1): Working resistance of cantilevered parapet about an axis parallel to the longitudinal axis of the bridge, Mc: Vertical reinforcement bar spacing = Average parapet thickness = Total Area of Steel = (In the transforment bar spacing = Average parapet thickness = Total Area of Steel = (In the transforment bar space") (In the transforment bar space") Resistance of design section - cover - bar size/16 = Resistance of cantilevered parapet about vertical axis, Mw: Horizontal reinforcement bar space = Mumber of bars at front or back face = Average parapet thickness = Total Area of Steel = Override Overrid	Compressive Strength of Moment Slab, f'c =	=		
varial resistance of cantilevered parapet about an axis parallel to the longitudinal axis of the bridge, Mc:Vertical reinforcement bar size =#Vertical reinforcement bar spacing =9Average parapet thickness =0ortal Area of Steel =0(' = thickness of design section - cover - bar size/16 =12.00C = T = ast ⁴ y =6.79h = 'd' =6.79based on #5 anchors only12.00B1 = 0.85-0.05(fc - 4000)/1000 <0.85 =	/ield Strength of Steel, fy =			60,000 psi
Vertical reinforcement bar spacing = Average parapet thickness = Total Area of Steel =min. width at base 3 inche 15.00 inche(d' = thickness of design section - cover - bar size/16 = Resistance Factor, phi (AASHTO 5.5.4.2) = 0 verride 0.41 inche 12.00 Section Capacity, Mn = T(d-a/2) C = T = as *fy = M = dr = (h = 1) 0 verride 0.75 Section Capacity, Mn = T(d-a/2) 0.85 0 verride 0.75 Section Capacity, Mn = T(d-a/2) 0.85 0 verride 0.75 Section Capacity, Mn = T(d-a/2) 0.85 0 verride 0.75 Section Capacity, Mn = T(d-a/2) 0.95 0 verride 0.75 Number of bars at front or back face = 0.79 inche 4 barsAverage parapet thickness = Total Area of Steel = 0.79 inche 4 barsTotal Area of Steel = 0.79 inche 0.75 Section Capacity, Mn = T(d-a/2) C = T = as *fy = h = id' = B1 = 0.85-0.05(fc - 4000)/1000 <0.85 = $a = C/bB1fc =$ Mw = Mr = (phi)Mn = 1.0 Section Capacity, Mn = T(d-a/2) C = T = as *fy = h = id' = B1 = 0.85-0.05(fc - 4000)/1000 <0.85 = $a = C/bB1fc =$ Mw = Mr = (phi)Mn =Note, calca are for impacts win segment, not at endsAdditional flexural resistance at top of wall, Mb = Longitudinal length of distribution of impact force, Lt (LRFD T. A13.2.1) =Note, calca are for impacts win segment, not at endsAdditional flexural resistance at top of wall, Mb = Longitudinal length of yield line, Lc (LRFD A13.3.1-2) = Resistance, Rw (LRFD A13.3.1-1) =Note, calca are for impacts win segment, not at endsNote, calca are for impacts win segment, not at	TERMINE BARRIER CAPACITY FO	OR EXTREME EVENT LC	OAD (LRFD A13.3.1):	
Vertical reinforcement bar spacing =9Average parapet thickness =min. width at basefortal Area of Steel =0.41d' = thickness of design section - cover - bar size/16 =12.00d' = thickness of design section - cover - bar size/16 =0.02resistance Factor, phi (AASHTO 5.5.4.2) =0section Capacity, Mn = T(d-a/2)overrideC = T = as*fy =6.79h = 'd' =0.85a = C/b81fc =0.01Mumber of bars at front or back face =Average parapet thickness =fortal Area of Steel =d' = thickness of design section - cover - bar size/16 =bhi (AASHTO 1.3.2 for extreme event limit state) =section Capacity, Mn = T(d-a/2)C = T = as*fy =h = 'd' =base of design section - cover - bar size/16 =bhi (AASHTO 1.3.2 for extreme event limit state) =section Capacity, Mn = T(d-a/2)C = T = as*fy =h = 'd' =base 0.05(fc - 4000)/1000 <0.85 =		ut an axis parallel to the longitu	idinal axis of the bridge, Mc:	
Average parapet thickness = 15.00 inche Total Area of Steel = 0.44 inche Resistance Tota Area of Steel = 12.00 C = T = a5*fy = 12.00 averride 12.00 inche a = $(7bB1Fc = 0.55 - 0.05(Fc - 4000)/1000 < 0.85 = a = (7bB1Fc = 0.75)Number of bars at front or back face = 4Average parapet thickness = 12.00 averride 12.00 inchea = (7bB1Fc = 0.75) 12.00 inchebased on #5 anchors only 12.00 inchea = (7bB1Fc = 0.75) 12.00 inche12.00$ inche 12.00 inche 12.00 inche 12.00 inche 12.00 inche 12.00 inche 1				
Total Area of Šteel = $d' = thickness of design section - cover - bar size/16 =Resistance Factor, phi (AASHTO 5.5.4.2) =Section Capacity, Mn = T(d-a/2)C = T = as*fy =h = 'd' =based on #5 anchors onlyB1 = 0.85-0.05(fc - 4000)/1000 <0.85 =$			main suide	
d' = thickness of design section - cover - bar size/16 = 12.00 12.00 1.00 $(ASHTO 5.5.4.2) =$ Section Capacity, Mn = T(d-a/2) 0verride 0.75 0 kips/f 12.00 inche 0.75 0 kips				0.41 inches^2/foc
Resistance Factor, phi (AASHTO 5.5.4.2) = 0.75 Section Capacity, Mn = T(d-a/2) override C = T = as *fy = 6.79 h = 'd' = 0.85-0.05(f'c - 4000)/1000 <0.85 = a = C/bB1f'C = 0.19 Mc = Mr = (phi)Mn = 0.50 for -4 mural resistance of cantilevered parapet about vertical axis, Mw: Horizontal reinforcement bar size = 0.75 Number of bars at front or back face = 0.75 Number of bars at front or back face = 0.75 Number of bars at front or back face = 0.75 inche 0.19 inche 0.20 C = T = as *fy = 0.75 Section Capacity, Mn = T(d-a/2) C = T = as *fy = 0.75 Section Capacity, Mn = T(d-a/2) C = T = as *fy = 0.75 Mural resistance at top of wall, Mb = 0.85 .0.05(f'c - 4000)/1000 <0.85 = a = C/bB1f'C = 0.79 inche 0.25 Mote, calcs are for impacts win segment, not at ends Additional flexural resistance at top of wall, Mb = 0.00 foot-4 and for Parapet, H = Critical length of yield line, Lc (LRFD A13.3.1-2) = Resistance, Rw (IRFD A13.3.1-1) = 0		ar size/16 =		
$C = T = as^{+}fy =$ 6.79 $h = 'd' =$ based on #5 anchors only $B1 = 0.85 \cdot 0.05(fc - 4000)/1000 < 0.85 =$ 0.19 $a = C/BB1'c =$ 0.19 $Mc = Mr = (phi)Mn =$ 5.05tural resistance of cantilevered parapet about vertical axis, Mw:orizontal reinforcement bar size =# 4Number of bars at front or back face =4Number of bars at front or back face =4Number of bars at front or back face =15.0inche0.79inche12.01inche0.79inche13.13inche10.13inche10.01inche10.01bisection Capacity, Mn = T(d-a/2)47.12 $C = T = as^{+}fy =$ 47.12 $h = 'd' =$ 1.02bisection Capacity, Mn = T(d-a/2)47.12 $C = T = as^{+}fy =$ 1.23 $h = 'd' =$ 1.32inche0.85 $a = C/bB1'c =$ 0.95Mw = Mr = (phi)Mn =1.02ninal resistance to to ransverse load, Rw:Note, calcs are for impacts win segment, not at endsAdditional flexural resistance at top of wall, Mb =0.00.ongitudinal Length of distribution of impact force, Lt (LRFD T. A13.2.1) =0.01etell top Argaet, H =15.65Critical length of yield line, Lc (LRFD A13.3.1-2) =15.65Resistance, Rw (LRFD A13.3.1-1) =59.30	-			
h = 'd' =based on #5 anchors only12.00incheB1 = 0.85-0.05(fc - 4000)/1000 <0.85 = a = C/bB1f'c = Mc = Mr = (phi)Mn =0.850.35incheMc = Mr = (phi)Mn =5.055.05foot -4Wural resistance of cantilevered parapet about vertical axis, Mw: Horizontal reinforcement bar size = Number of bars at front or back face = Average parapet thickness = Total Area of Steel = d' = thickness of design section - cover - bar size/16 = obi (AASHTO 1.3.2 for extreme event limit state) =#4Section Capacity, Mn = T(d-a/2) C = T = as*fy = a = C/bB1f'c = Mw = Mr = (phi)Mn = $(4, 21, 22)$ ($1, 22, 33, 56, 56, 56, 56, 56, 56, 56, 56, 56, 56$	Section Capacity, Mn = T(d-a/2)		override	
B 1 = 0.85-0.05(fc - 4000)/1000 <0.85 = a = C/bB1fc = Mc = Mr = (phi)Mn = wural resistance of cantilevered parapet about vertical axis, Mw: Horizontal reinforcement bar size = Number of bars at front or back face = Average parapet thickness = Total Area of Steel = d^4 bars Average parapet thickness = Total Area of Steel = d^4 bars d^4 bars 15.0 inche 0.79 inche $d^7.12$ kips/f $d^7.12$				6.79 kips/foot
a = C/bB1f'c = 0.19 inche Mc = Mr = (phi)Mn = 5.05 foot-4 Kural resistance of cantilevered parapet about vertical axis, Mw: # 4 Horizontal reinforcement bar size = # 4 Number of bars at front or back face = 4 Average parapet thickness = 15.0 Total Area of Steel = 0.79 ichter = 12.13 inche 10 Verage face strip = 12.13 ichter = 0.85 Section Capacity, Mn = T(d-a/2) 47.12 C = T = as*fy = 47.12 h = 'd' = 13.21 B1 = 0.85-0.05(f'c - 4000)/1000 <0.85 =			based on #5 anchors only	
Mc = Mr = (phi)Mn =5.05foot-AAverage parapet about vertical axis, Mw: Horizontal reinforcement bar size =# 4Number of bars at front or back face =4Average parapet thickness =15.0Total Area of Steel =0.79ichter at the intervent of				
Horizontal reinforcement bar size = $# 4$ Number of bars at front or back face = 4 Average parapet thickness = 15.0 inche Total Area of Steel = 0.79 inche: 0.79 inche: 1.213 inche: 0.85 inche: 0.95				5.05 foot-kips/foo
Number of bars at front or back face =4Average parapet thickness =15.0fotal Area of Steel =0.79of = thickness of design section - cover - bar size/16 =12.13inche12.13inche10bhi (AASHTO 1.3.2 for extreme event limit state) =10C = T = as*fy =47.12h = 'd' =12.13B1 = 0.85-0.05(f'c - 4000)/1000 <0.85 =	ural resistance of cantilevered parapet abo	ut vertical axis, Mw:		
Average parapet thickness =150Total Area of Steel =0.79of = thickness of design section - cover - bar size/16 =0.79ohi (AASHTO 1.3.2 for extreme event limit state) =10Section Capacity, Mn = T(d-a/2) 47.12 C = T = as*fy =47.12h = 'd' =1.0B1 = 0.85-0.05(f'c - 4000)/1000 <0.85 =				
fortal Area of Steel = 0.79 inched' = thickness of design section - cover - bar size/16 = $1.2.13$ inchebhi (AASHTO 1.3.2 for extreme event limit state) = 1.0 Section Capacity, Mn = T(d-a/2) $1.2.13$ incheC = T = as*fy = 47.12 kips/fh = 'd' = $1.2.13$ incheB1 = 0.85-0.05(fc - 4000)/1000 <0.85 =				
d' = thickness of design section - cover - bar size/16 = 12.13 inche bhi (AASHTO 1.3.2 for extreme event limit state) = 100 Section Capacity, Mn = T(d-a/2) C = T = as*fy = 47.12 kips/f h = 'd' = 12.13 inche B1 = 0.85-0.05(f'c - 4000)/1000 <0.85 = 0.85 a = C/bB1f'c = 0.85 Mw = Mr = (phi)Mn = 45.02 for -4 minal resistance to transverse load, Rw: Note, calcs are for impacts w/in segment, not at ends Additional flexural resistance at top of wall, Mb = 0.00 foot-4 activitical length of distribution of impact force, Lt (LRFD T. A13.2.1) = 0.00 foot-4 Critical length of yield line, Lc (LRFD A13.3.1-2) = 2.67 feet Resistance, Rw (LRFD A13.3.1-1) = 0.00 foot-4 Critical length of yield line, Lc (LRFD A13.3.1-2) = 0.00 foot-4 Critical length of yield line, Lc (LRFD A13.3.1-2) = 0.00 foot-4 Critical length of yield line, Lc (LRFD A13.3.1-2) = 0.00 foot-4 Critical length of yield line, Lc (LRFD A13.3.1-2) = 0.00 foot-4 Critical length of yield line, Lc (LRFD A13.3.1-2) = 0.00 foot-4 Critical length of yield line, Lc (LRFD A13.3.1-2) = 0.00 foot-4 Critical length of yield line, Lc (LRFD A13.3.1-2) = 0.00 foot-4 Critical length of yield line, Lc (LRFD A13.3.1-2) = 0.00 foot-4 Critical length of yield line, Lc (LRFD A13.3.1-2) = 0.00 foot-4 Critical length of yield line, Lc (LRFD A13.3.1-2) = 0.00 foot-4 Critical length of yield line, Lc (LRFD A13.3.1-2) = 0.00 foot-4 Critical length of yield line, Lc (LRFD A13.3.1-2) = 0.00 foot-4 Critical length of yield line, Lc (LRFD A13.3.1-2) = 0.00 foot-4 Critical length of yield line, Lc (LRFD A13.3.1-2) = 0.00 foot-4 Critical length of yield line, Lc (LRFD A13.3.1-2) = 0.00 foot-4 Critical length of yield line, Lc (LRFD A13.3.1-2) = 0.00 foot-4 Critical length of yield line, Lc (LRFD A13.3.1-2) = 0.00 foot-4 Critical length of yield line, Lc (LRFD A13.3.1-2) = 0.00 foot-4 Critical length of yield line, Lc (LRFD A13.3.1-2) = 0.00 foot-4 Critical length of yield line, Lc (LRFD A13.3.1-2) = 0.00				0.79 inches
bh (AASHTO 1.3.2 for extreme event limit state) = 10 Section Capacity, Mn = T(d-a/2) $C = T = as^{+}fy = 47.12$ kips/f h = 'd' = 21.23 inche B1 = 0.85-0.05(f'c - 4000)/1000 <0.85 = 20.85 a = C/bB1f'c = 1.32 inche Mw = Mr = (phi)Mn = 2520 for -4 minal resistance to transverse load, Rw: Note, calcs are for impacts w/in segment, not at ends Additional flexural resistance at top of wall, Mb = 0.00 for t-4 Longitudinal length of distribution of impact force, Lt (LRFD T. A13.2.1) = 2.67 feet Height of Parapet, H = 2.67 feet Critical length of yield line, Lc (LRFD A13.3.1-2) = 2.67 feet Resistance, Rw (LRFD A13.3.1-1) = 2.67 feet		ar size/16 =		12.13 inches
$ \begin{array}{c} C = T = as^{*} fy = \\ h = 'd' = \\ B1 = 0.85 - 0.05(fc - 4000)/1000 < 0.85 = \\ a = C/bB1fc = \\ Mw = Mr = (phi)Mn = \\ \end{array} $				
h = 'd' = 12.13 inche B1 = 0.85-0.05(fc - 4000)/1000 < 0.85 =				
B1 = 0.85-0.05(f°c - 4000)/1000 <0.85 =	-			47.12 kips/foot
a = C/bB1f'c = 1.32 Mw = Mr = (phi)Mn = 1.32 ninal resistance to transverse load, Rw: Note, calcs are for impacts w/in segment, not at ends Additional flexural resistance at top of wall, Mb = 0.0 .ongitudinal Length of distribution of impact force, Lt (LRFD T. A13.2.1) = 0.0 Height of Parapet, H = 2.67 Critical length of yield line, Lc (LRFD A13.3.1-2) = 15.65 Resistance, Rw (LRFD A13.3.1-1) = 59.30				
Mw = Mr = (phi)Mn = 45.02 minal resistance to transverse load, Rw: Note, calcs are for impacts w/in segment, not at ends Additional flexural resistance at top of wall, Mb = 0.0 Longitudinal Length of distribution of impact force, Lt (LRFD T. A13.2.1) = 3.5 Height of Parapet, H = 2.67 Critical length of yield line, Lc (LRFD A13.3.1-2) = 15.65 Resistance, Rw (LRFD A13.3.1-1) = 59.30				
Additional flexural resistance at top of wall, Mb = 0.0 foot-H Longitudinal Length of distribution of impact force, Lt (LRFD T. A13.2.1) = 3.5 feet Height of Parapet, H = 2.67 feet Critical length of yield line, Lc (LRFD A13.3.1-2) = 15.65 feet Resistance, Rw (LRFD A13.3.1-1) = 59.30 kips				45.02 foot-kips/foo
Longitudinal Length of distribution of impact force, Lt (LRFD T. A13.2.1) = 3.5 feet Height of Parapet, H = 2.67 feet Critical length of yield line, Lc (LRFD A13.3.1-2) = 15.65 feet Resistance, Rw (LRFD A13.3.1-1) = 59.30 kips			Note, calcs are for impacts w/in se	
Height of Parapet, H = 2.67 Critical length of yield line, Lc (LRFD A13.3.1-2) = 15.65 Resistance, Rw (LRFD A13.3.1-1) = 59.30				0.0 foot-kips
Critical length of yield line, Lc (LRFD A13.3.1-2) = 15.65 Resistance, Rw (LRFD A13.3.1-1) = 59.30 kips		t force, Lt (LRFD T. A13.2.1) =		
Resistance, Rw (LRFD A13.3.1-1) = 59.30 kips	• · ·	-2) =		
ransverse Load, Ft (LRFD T.A13.2.1) = 54.0 kips	U	<u> </u>		
	Transverse Load, Ft (LRFD T.A13.2.1) =			54.0 kips
Status = Sufficient Capacity is Provided			_	