Company: Waterman Industries
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4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	667	8189	9	OK
Steel failure (with lever arm)*	667	1199	56	OK
Pryout Strength (Concrete Breakout Strength controls)*	667	14906	5	OK
Concrete edge failure in direction y-**	4000	17511	23	OK

* anchor having the highest loading **anchor group (relevant anchors)

4.1 Steel Strength

V_{sa} = ESR value refer to ICC-ES ESR-3814
$\phi V_{steel} \geq V_{ua}$ ACI 318-11 Table D.4.1.1

Variables

$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
0.33	85000

Calculations

V_{sa} [lb]
17060

Results

V_{sa} [lb]	ϕ_{steel}	ϕ_{eb}	ϕV_{sa} [lb]	V_{ua} [lb]
17060	0.600	0.800	8189	667

4.2 Steel failure (with lever arm)

$V_s^M = \frac{\alpha_M \cdot M_s}{L_b}$ bending equation for stand-off
$M_s = M_s^0 \left(1 - \frac{N_{ua}}{\phi N_{sa}}\right)$ resultant flexural resistance of anchor
$M_s^0 = (1.2)\ (S)\ (f_{u,min})$ characteristic flexural resistance of anchor
$\left(1 - \frac{N_{ua}}{\phi N_{sa}}\right)$ reduction for tensile force acting simultaneously with a shear force on the anchor
$S = \frac{\pi(d)^3}{32}$ elastic section modulus of anchor bolt at concrete surface
$L_b = z + (n)(d_0)$ internal lever arm adjusted for spalling of the surface concrete
$\phi V_s^M \geq V_{ua}$ ACI 318-11 Table D.4.1.1

Variables

α_M	$f_{u,min}$ [psi]	N_{ua} [lb]	ϕN_{sa} [lb]	z [in.]	n	d_0 [in.]
2.00	85000	6035	18479	1.500	0.500	0.750

Calculations

M_s^0 [in.lb]	$\left(1 - \frac{N_{ua}}{\phi N_{sa}}\right)$	M_s [in.lb]	L_b [in.]
2783.038	0.673	1874.140	1.875

Results

V_s^M [lb]	ϕ_{steel}	ϕV_s^M [lb]	V_{ua} [lb]
1999	0.600	1199	667

Approved AsNoted
BY: Ken Upmal
DATE: 11/29/2017
RESUBMIT: NO
RECEIVED: November 13, 2017
CKD BY: DV/BK (Green Int'l.)
STATE OF VERMONT
AGENCY OF TRANSPORTATION

Input data and results must be checked for agreement with the existing conditions and for plausibility!
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