San Bernardino City Unified School District

PROPOSITION 39
ENERGY EFFICIENCY UPGRADES
EEP3

793 North E St, San Bernardino,
CA 92410

ADDENDUM 06

February 27, 2019

Prepared By

JOHN SERGIO FISHER & ASSOCIATES
5567 Reseda Blvd., Suite 209, Los Angeles, CA 91356
(818) 344-3045; FAX (818) 344-0338

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Los Angeles, CA 91356
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ADDENDUM 6

To: **All bidders**
From: **John Fisher, AIA, Principal**
Project: **SBCUSD Proposition 39 Energy Efficiency Upgrades EEP3 Phase 2 - Energy Upgrades**
Date: February 27, 2019

NOTICE TO BIDDERS
This Addendum forms a part of the Contract and modifies the original documents. It is intended that all work affected by the following modifications shall conform with related provisions and general conditions of the contract of the original drawings and specifications. Modify the following items wherever appearing in any drawing or sections of the specifications. Acknowledge receipt of Addendum No. 6 in the space provided on the Bid Form. Failure to do so may subject bidder to disqualification.

- **Please see attached drawing and files for:**

1. **Bid Package # 1 (Phase 2) – Pacific High School Pool Heaters - Revisions - Sheet M202**

2. **Bid Package # 1 (Phase 2) – Pacific High School Pool Heaters - Structural calculation for pool heaters' supporting rack.**

End of Addendum

Job: ______________________
Engineer: ______________________
Contractor: ______________________
Prepared By: ______________________
Model: ______________ Date: __________

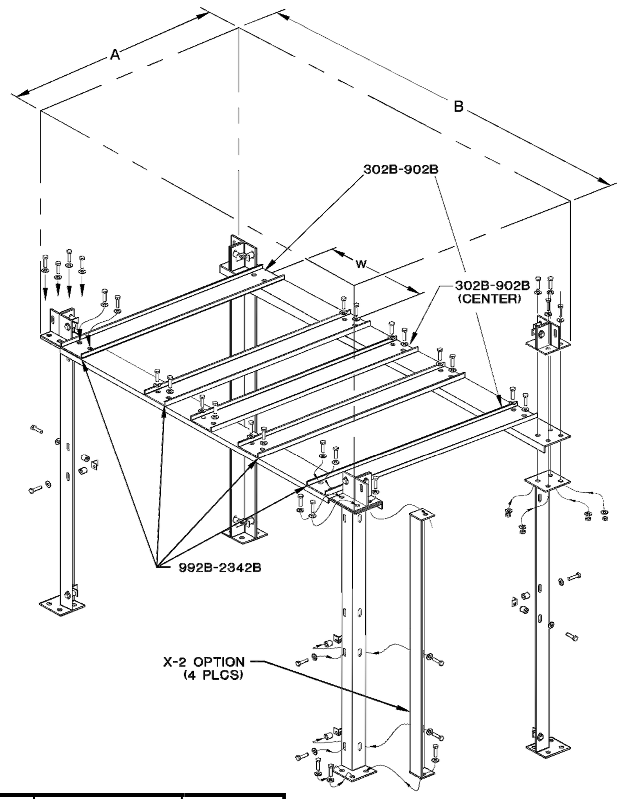
SureRack® Kit

Stacking System for
Hi Delta® Boilers
Models 302B-2342B

Features

- Two-boiler Vertical Stack
- No Vent Offset Required
- Small Footprint
- Low Ceiling Height
- Heavy Duty Construction

See installation manual 240792



Hi Delta Model	SureRack Kit (X-1) Part No.	Weight (lbs.)	Dimensions (in.) A	B	W	Cross Beams	Above-Grade Add-On (X-2)	Stacked Boiler Height (in.)
302B	006906	201	30	41-1/4	CTR.	3	P/N 007046	72-1/4
402B	006907	214		48-1/4				
502B	006908	228		55-1/4				
652B	006909	257		65-3/4				
752B	006910	265		72-3/4				
902B	006911	276		83-1/4				
992B	011563	340	37-1/2	64-1/8	16-13/16	4	P/N 007053	87-1/2
1262B	011564	361		75-1/2	20-9/16			
1532B	011565	371		87	26-3/8			
1802B	011566	408		98-1/8	30-1/8			
2002B	011567	430		109-1/2	33-15/16			
2072B	011567	430		109-1/2	33-15/16			
2342B	011568	458		121	37-11/16			

Raypak

Catalog No.: 1000.92E Effective: 06-15-15 Replaces: 11-15-07

1. REMOVE EXISTING POOL HEATER CONTROL PANEL.
CAP AND PROTECT EXISTING CONDUIT AND WIRING FOR NEW CONTROL PANEL CONNECTION.
CONTRACTOR TO PROVIDE ADEQUATE EXTENSION FOR THE NEW CONNECTION.

PHOTO #5 – (E) BOILER CONTROL PANEL

SCALE NONE 2

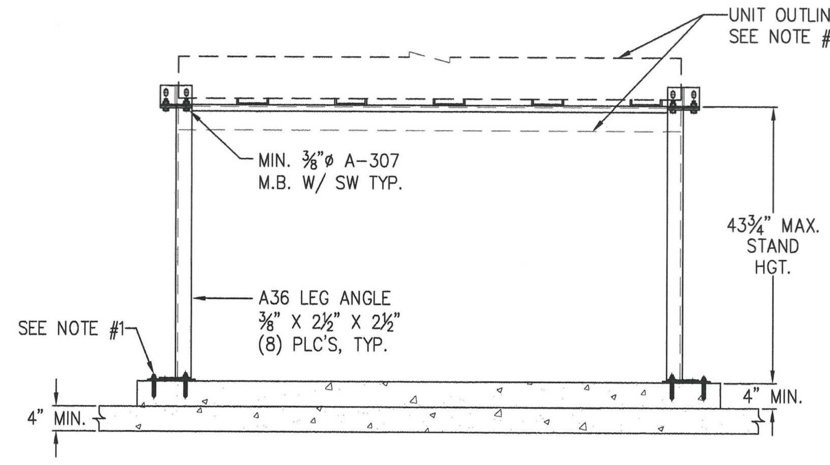
POINT OF REMOVAL

1. TEMPORARY REMOVE ALL THE UTILITY PIPING UP TO POINT OF REMOVALS AS INDICATED.

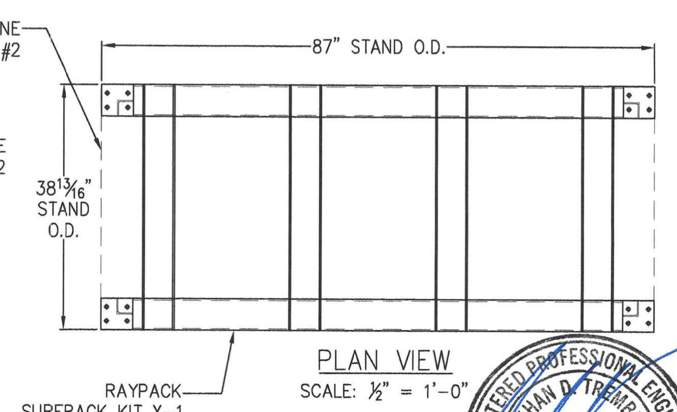
PHOTO #4 – (E) COLD WATER, GAS, ELEC. CONNECTIONS

SCALE NONE 1

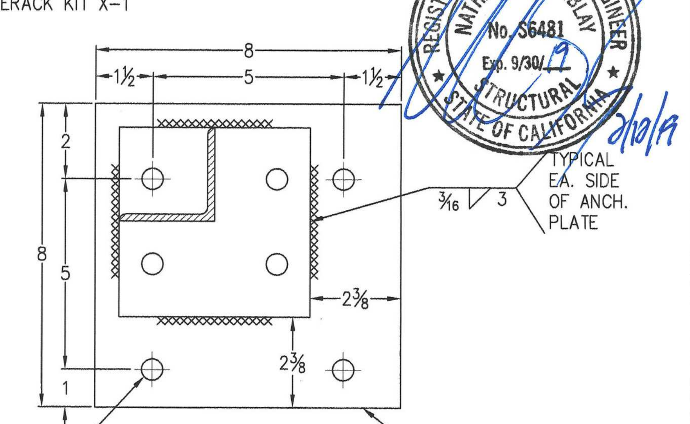
MARK	MAKE	MODEL	WEIGHT
UPPER BOILER UNIT	RAYPACK	1532B	1225 LBS.
LOWER BOILER UNIT	RAYPACK	1532B	1225 LBS.



ELEVATION VIEW
SCALE: ½" = 1'-0"



PLAN VIEW
SCALE: ½" = 1'-0"



ANCHOR PLATE DETAIL
SCALE: 3" = 1'-0"

REGISTERED PROFESSIONAL ENGINEER NATHAN M. TREGLIA No. S6481 Exp. 9/30/20 STRUCTURAL STATE OF CALIFORNIA 2/12/19

NOTE(S):
1. USE ½"ø ASTM A 193 Gr B7 CARBON STEEL THREADED ROD W/ A-194 NUT, MIN. 4" EMBEDMENT, MIN. 6" EDGE DISTANCE, & MIN. 8" CONC. THICKNESS (4" THICK HKP + 4" THICK SLAB) IN MIN. 3000 PSI HARDROCK CONCRETE. INSTALL W/ HAMMER DRILL & CARBIDE BIT & SET W/ HIT-RE 500-SD ADHESIVE AS PER THE ICC ESR-2322. INSTALL WITH SPECIAL INSPECTION PER THE ICC-2322.
2. M.W. SAUSSE' & CO. INC. IS NOT RESPONSIBLE FOR STRUCTURAL INTEGRITY OF THE EQUIPMENT/UNIT WHEN ANCHORED AS SHOWN.
3. ALL HARDWARE & MATERIALS TO BE SUPPLIED BY OTHERS.
4. THIS DESIGN IS ONLY APPLICABLE FOR UNIT INSTALLED ON GRADE.
5. RAYPAK SURERACK X-2 ADD-ON NOT NEEDED FOR INSTALLATION.

M. W. SAUSSÉ & CO., INC. 28744 WITHERSPOON PKWY, VALENCIA, CA 91355 PHONE: (661) 257-3311 FAX: (661) 257-7673 Vibrex STEEL FRAME STAND	JOB NAME: PACIFIC HIGH SCHOOL POOL HEATER - SURERACK SUPPORT FRAME ANALYSIS	REVISIONS:	DRN: FS	ENG: FS
	CUST: MAROKO & SHWE, INC.	A:	DATE: 2/12/19	
	CUST. P.O.:		DRAWING NO.:	
	MECH. ENGR.:	B:	63592-1	
	MARK: RAYPAK SURERACK SUPPORT FRAME	C:		

BOILER SURERACK KIT AND ANCHORAGE

SCALE NONE 3

GENERAL NOTES

REGISTERED PROFESSIONAL ENGINEER No. 26903 Renewal: 9/30/20 MECHANICAL STATE OF CALIFORNIA

MAROKO & SHWE, INC.
Mechanical Engineers
1106-B W. MAGNOLIA BLVD.
BURBANK, CA 91506
(818) 840-0280 FAX(818) 840-0284

SUBMITTALS:

NO.	DESCRIPTION	DATE

John Sergio Fisher & Associates Inc.
5567 Reseda Blvd #209
Tarzana California 91356
(818) 344-3045
fax (818) 344-0338
E-mail: mail@jsfarchs.com
jsfa
Architecture & Planning
John Fisher AIA

LICENSED ARCHITECT JOHN SERGIO FISHER NO. C-4487 REN 5/31/19 STATE OF CALIFORNIA

IDENTIFICATION STAMP
DIVISION OF THE STATE ARCHITECT
OFFICE OF REGULATION SERVICES

FILE #
APPL: 04-117886

AC________ F/LS________ SS________
DATE:

KEY PLAN

Client:
SAN BERNARDINO CITY UNIFIED SCHOOL DISTRICT

PROP 39 ENERGY PROJECTS

Job Name:
PACIFIC HIGH SCHOOL
POOL HEATER REPLACEMENT

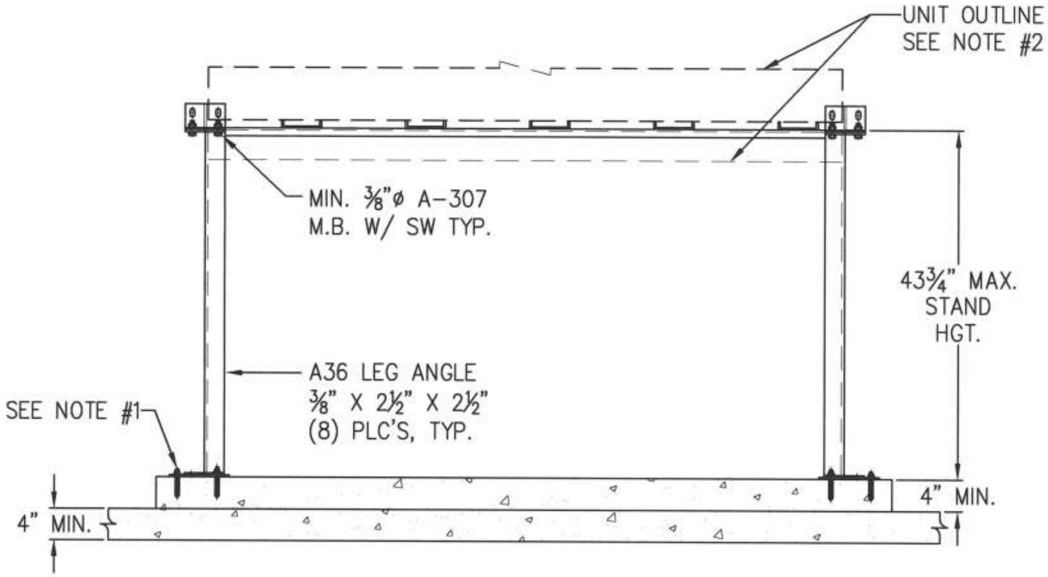
DISTRICT OFFICE:
777 NORTH F STREET, SAN BERNARDINO, CA 92407

Drawing Title

DETAILS

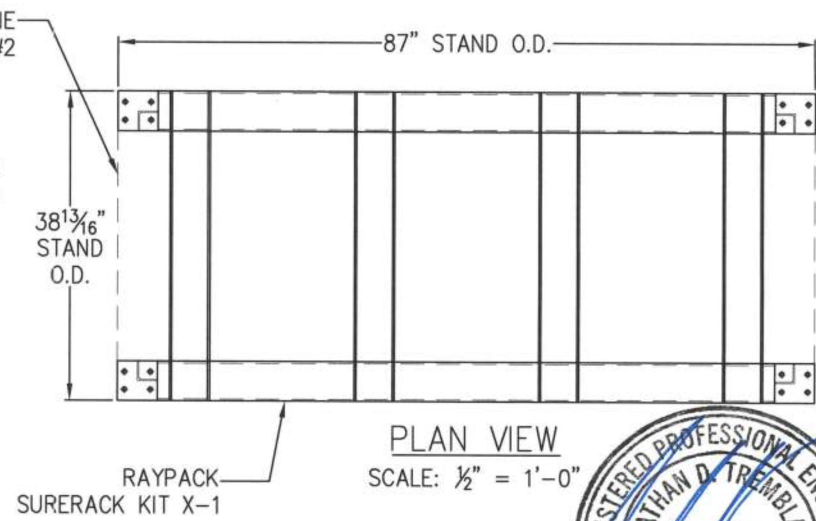
Project No: 1715
Phase: JANUARY 21, 2019
Drawing No:
Date:
M 202
Scale: AS SHOWN

MARK	MAKE	MODEL	WEIGHT
UPPER BOILER UNIT	RAYPACK	1532B	1225 LBS.
LOWER BOILER UNIT	RAYPACK	1532B	1225 LBS.



ELEVATION VIEW

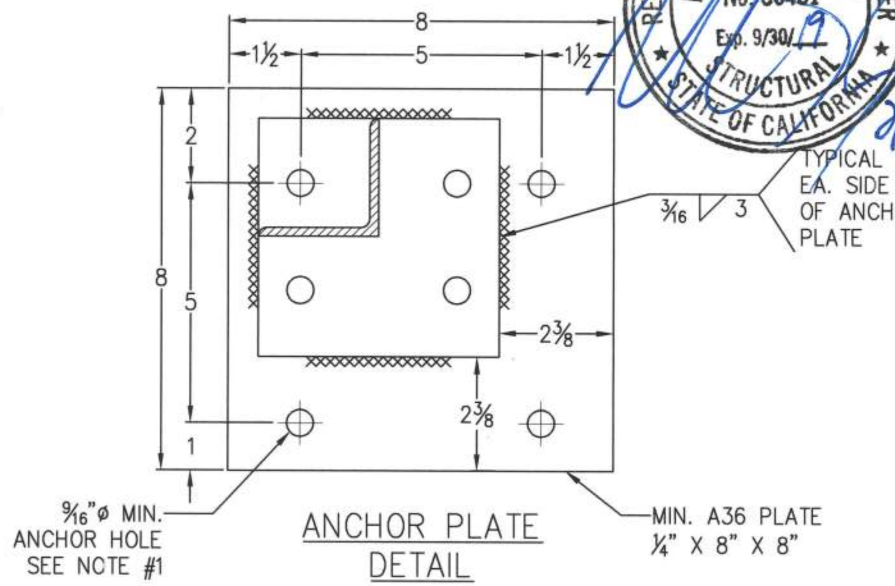
SCALE: ½" = 1'-0"



PLAN VIEW

SCALE: ½" = 1'-0"

REGISTERED PROFESSIONAL ENGINEER
NATHAN D. TREMBLAY
No. S6481
Exp. 9/30/19
STRUCTURAL
STATE OF CALIFORNIA
2/10/19



ANCHOR PLATE DETAIL

SCALE: 3" = 1'-0"

NOTE(S):

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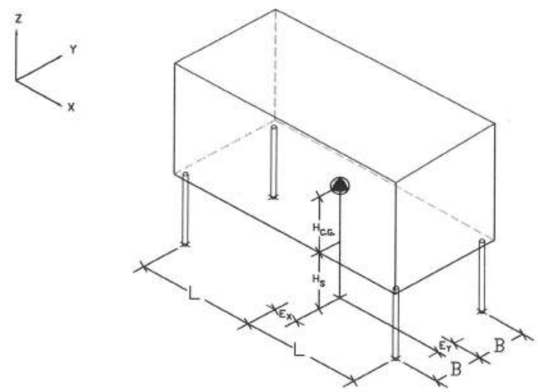
M. W. SAUSSÉ & CO., INC.
28744 WITHERSPOON PKWY, VALENCIA, CA 91355
PHONE: (661) 257-3311 FAX: (661) 257-7673

Vibrex STEEL FRAME STAND

JOB NAME :	PACIFIC HIGH SCHOOL POOL HEATER - SURERACK SUPPORT FRAME ANALYSIS	REVISIONS :	DRN : FS / ENG : FS
CUST :	MAROKO & SHWE, INC.	A :	DATE : 2/12/19
CUST. P.O. :			DRAWING NO. :
MECH. ENGR. :		B :	63592-1
MARK :	RAYPAK SURERACK SUPPORT FRAME	C :	

CALCULATIONS FOR RIGID ANCHORAGE; 2016 CBC & ASCE 7-10

CALCULATES WORST CASE LOADING FOR (4) ANCHOR POINTS. (UNITS: LBS & INCHES)
USING COMBINED LOAD EQUATIONS 16-5: U = 1.2D + 1.0E & 16-7: U = 0.9D + 1.0E



HORIZONTAL SEISMIC FORCE:		
13.3-2: F_{ph}=1.6*S_{ds}*I_p*Wp (MAX)	=	2967.62
13.3-1: F_{ph}=(0.4*a_p*S_{ds}/(R_p/I_p))(1+2z/h_r)Wp	=	296.76
13.3-3: F_{ph}=0.3*S_{ds}*I_p*Wp (MIN)	=	556.43
CONTROLLING HOR. SEISMIC FORCE: F_{ph}	=	556.43
OVERTURNING MOMENT: M=F_{ph}*$H_{C.G.}$	=	36515.68
VERTICAL SEISMIC FORCE: F_{pv} = 0.2S_{ds}Wp	=	370.95
SPECTRAL RESP. ACCEL'N: S_{ds}=2/3*F_a*S_s	=	1.16
- SITE COEFFICIENT (TABLE 1615.1.2): F_a	=	0.80
- MAPPED SPECTRAL ACCEL'N (FIG. 1615(3)): S_s	=	2.18
IMPORTANCE FACTOR: I_p	=	1.00
COMPONENT AMPLIFICATION FACTOR: a_p	=	1.00
COMP. RESPONSE MODIFICATION FACTOR: R_p	=	2.50
EQUIPMENT ELEVATION / ROOF ELEVATION: z/h_r (WITH RESPECT TO GRADE)	=	0.00
EQUIPMENT + STAND WEIGHT: Wp (lbs)	=	1596.00
L:	=	43.50
B:	=	18.75
E_X:	=	4.35
E_Y:	=	1.88
HEIGHT TO CG. UNIT: $H_{C.G.}$	=	21.88
HEIGHT OF STAND: H_S	=	43.75

Ix=4*B*B	=	1406.25
Iy=4*L*L	=	7569.00
γ (DIR. OF Vrot-CRIT. ANCHOR): $\tan^{-1}$(B/L)	=	23.32
α (DIR. OF Vdir-CRIT. ANCHOR): tan-1(E_Y/E_X)	=	23.32
β: γ - α =	=	180.00
θ (DIR. OF F_{ph} FOR MAX UPLIFT): tan-1((L*I_x)/(B*I_y))	=	23.32
VERTICAL REACTIONS (WITH 0.9D or 1.2D):		F_{ph} ACTS IN MOST CRITICAL DIRECTION.
R_m (DUE TO OVERTURNING MOMENT)	=	530.18
$R_{e\,MAX}$ (DUE TO ECCENTRICITY):	=	98.35
$R_{e\,MIN}$ (DUE TO ECCENTRICITY):	=	61.25
$R_{v\,MAX}$ (DUE TO VERTICAL LOADS):	=	571.54
$R_{v\,MIN}$ (DUE TO VERTICAL LOADS):	=	266.36
P_{MAX} (MAX DOWNWARD REACTION): R_m+$R_{e\,MAX}$+$R_{v\,MAX}$	=	1200.06
P_{MIN} (MAX UPLIFT/ANCH. POINT - IF POS.): R_m+$R_{e\,MIN}$-$R_{v\,MIN}$	=	**325.07**
P_{MIN} (MAX UPLIFT/ANCH. POINT - IF POS.): $\Omega_O R_m$+$R_{e\,MIN}$-$R_{v\,MIN}$	=	**1120.34**
HORIZONTAL REACTIONS:		
V_{rot} (SHEAR DUE TO ECCENTRICITY):	=	7.42
V_{dir} (DIRECT SHEAR):	=	139.11
V_{MAX} (TOTAL SHEAR/ANCH. POINT) :	=	**146.53**
$\Omega_O V_{MAX}$ (TOTAL SHEAR/ANCH. POINT) :	=	**355.19**

REGISTERED PROFESSIONAL ENGINEER
NATHAN D. TREMBLAY
No. S6481
Exp. 9/30/19
STRUCTURAL
STATE OF CALIFORNIA

2/12/19

ANCHOR BOLTS:

SEE SHEET 63517-C1.4 FOR ANCHOR BOLT DESIGN.

ANCHOR BOLT DIAMETER: = 1/2
TYPE OF ANCHOR BOLT: CARBON STEEL HILTI HIT-RE 500 V3 ADHESIVE ANCHOR BOLT IN MIN. 3000psi HARDROCK CONCRETE. SEE THE FOLLOWING SHEETS FOR ANCHOR BOLT DESIGN AND COMBINED LOADING CHECK.

FOR DESIGN OF THE VERTICAL MEMBERS/LEGS OF THE STAND:

P_{MAX}: R_m+$R_{e\,MAX}$+$R_{v\,MAX}$	=	1200.06	MAX DOWNWARD REACTION ON LEG
V_{MAX}:	=	146.53	MAX SHEAR LOAD ON LEG

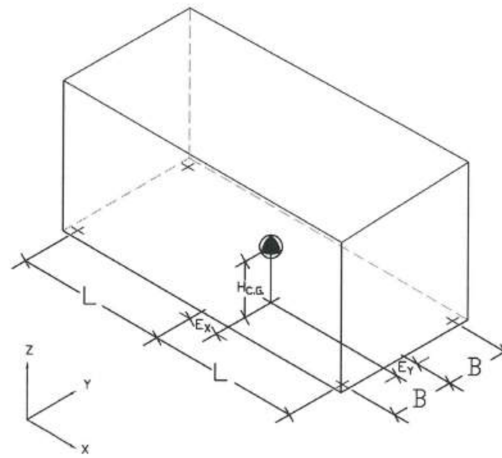
JOB NAME:	PACIFIC HIGH SCHOOL POOL HEATER - SURERACK SUPPORT FRAME ANALYSIS	**M. W. SAUSSE' & CO., INC.**	
CUST.:	MAROKO & SHWE, INC.	PREPARED BY :	FS
MECH. ENG.:		DATE :	11-Feb-19
MARK:	RAYPAK SURERACK SUPPORT FRAME	SHEET NO. :	63592-C1.0

CALCULATIONS FOR RIGID ANCHORAGE TO CONCRETE; 2015 IBC/2016 CBC & ASCE 7-10, LRFD

CALCULATES WORST CASE LOADING FOR (4) ANCHOR POINTS. (UNITS: LBS & INCHES)
USING COMBINED LOAD EQUATIONS 16-4, 16-5, 16-6, & 16-7

SEISMIC/WIND FORCES - CH. 13, 26, & 29 OF ASCE 7

13.3-2: $F_p=\Omega_0 1.6^*S_{ds}{}^*I_p{}^*Wp$ (MAX)	=	5694.45 lbs
13.3-1: $F_p=\Omega_0(0.4^*a_p{}^*S_{ds}/(R_p/I_p))(1+2z/h_r)Wp$	=	569.45 lbs
13.3-3: $F_p=\Omega_0 0.3^*S_{ds}{}^*I_p{}^*Wp$ (MIN)	=	1067.71 lbs
Ω_0 PER ASCE 7-10, NOTE C, TABLE 13.6-1	=	2.50
CONTROLLING HOR. SEISMIC FORCE: F_p	=	1067.71 lbs
SEISMIC OVERTURNING MOMENT: $M=F_{ph}{}^*H_{C.G.}$	=	23356.16 lb-in
VERTICAL SEISMIC FORCE: $F_{pv} = 0.2S_{ds}Wp$	=	284.72 lbs
SPECTRAL RESP. ACCEL'N: S_{ds}	=	1.16
IMPORTANCE FACTOR: I_p	=	1.00
COMPONENT AMPLIFICATION FACTOR: a_p	=	1.00
COMP. RESPONSE MODIFICATION FACTOR: R_p	=	2.50
EQUIPMENT ELEVATION / ROOF ELEVATION: z/h_r (WITH RESPECT TO GRADE)	=	0.00



EQUIPMENT WEIGHT & GEOMETRY

EQUIPMENT WEIGHT: Wp	=	1225.00 lbs
L:	=	43.50 in
B:	=	18.75 in
E_X:	=	4.35 in
E_Y:	=	1.88 in
HEIGHT TO CG.: $H_{C.G.}$	=	21.88 in
NO. OF ANCHORS PER POINT (N)	=	1.00

ANCHOR GROUP FORCES

$I_X = 4^*B^*B$	=	1406.25 in^4
$I_Y = 4^*L^*L$	=	7569.00 in^4
γ (DIR. OF Vrot-CRIT. ANCHOR): $\tan^{-1}(B/L)$	=	23.32
α (DIR. OF Vdir-CRIT. ANCHOR): $\tan$-1(E_Y/E_X)	=	23.32
$\beta: \gamma - \alpha =$	=	180.00
θ (DIR. OF F_{ph} FOR MAX UPLIFT): $\tan$-1$((L^*I_X)/(B^*I_Y))$	=	23.32

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FROM SEISMIC LOADS (LOAD APPLIED TO CRITICAL ANGLE)

VERTICAL REACTIONS (WITH 1.2D OR 0.9D):

R_m (DUE TO OVERTURNING MOMENT)	=	339.11 lbs
$R_{e\,MAX}$ (DUE TO ECCENTRICITY):	=	87.74 lbs
$R_{e\,MIN}$ (DUE TO ECCENTRICITY):	=	40.89 lbs
$R_{v\,MAX}$ (DUE TO VERTICAL LOADS):	=	438.68 lbs
$R_{v\,MIN}$ (DUE TO VERTICAL LOADS):	=	204.44 lbs
P_{MAX} (MAX DOWNWARD REACTION): $R_m+R_{e\,MAX}+R_{v\,MAX}$	=	865.53 lbs
P_{MIN} (MAX UPLIFT/ANCH. POINT - IF POS.): $R_m+R_{e\,MIN}-R_{v\,MIN}$	=	**175.56 lbs**
P_{MIN} (NO OVERSTRENGTH): $R_m/\Omega_0+R_{e\,MIN}-R_{v\,MIN}$	=	0.00 lbs

HORIZONTAL REACTIONS:

V_{rot} (SHEAR DUE TO ECCENTRICITY):	=	26.69 lbs
V_{dir} (DIRECT SHEAR):	=	266.93 lbs
V_{MAX} (TOTAL SHEAR/ANCH. POINT):	=	**293.62 lbs**
V_{MAX} (NO OVERSTRENGTH):	=	117.45 lbs

ANCHOR BOLT DIAMETER: = 1/2

TYPE OF ANCHOR BOLT: CARBON STEEL HILTI HIT-RE 500 V3 ADHESIVE ANCHOR BOLT IN MIN. 3000psi HARDROCK CONCRETE. SEE THE FOLLOWING SHEETS FOR ANCHOR BOLT DESIGN AND COMBINED LOADING CHECK.

JOB NAME:	PACIFIC HIGH SCHOOL POOL HEATER - SURERACK SUPPORT FRAME ANALYSIS	**M.W. SAUSSE' & CO., INC.**		
CUST.:	MAROKO & SHWE, INC.		PREPARED BY :	FS
MECH. ENG.:			DATE :	11-Feb-19
MARK:	RAYPAK SURERACK SUPPORT FRAME		SHEET NO. :	63592-C1.1

COLUMN CHECK - 2016 CBC & ASCE 7-10 - LRFD DESIGN

COLUMN HEIGHT AND FORCES

FROM SHEET- 63592-C1.0

$P_H = V_{MAX} =$	146.53	lbs
$P_V = P_{MAX} =$	1200.064	lbs
$H_{column} =$	43.75	in

COLUMN PROPERTIES

ANGLE 2-1/2 X 2-1/2 X 3/8

$K =$	2.0	(PINNED BOTTOM, FREE TRANSLATION FIXED ROTATION TOP)
$r =$	0.749	in
$A_s =$	1.73	in^2
$Z_{min} =$	1.010	in^3
$I_{min} =$	0.972	in^4
$f_{yield} =$	36000	psi

COLUMN CHECK

DEMAND -

$P_u = P_v =$ 1200 lbs

$M_u = P_H * H_{column} =$ 6411 lb-in

CAPACITY -

$K(H_{column})/r =$ 117

$0.9F_{cr} =$ 38300 psi

$Pn = 0.9A_s*F_{cr} =$ 66259 lbs

$M_n = f_{yield}*Z_{min} =$ 32724 lbs

COMBINED LOAD CHECK -

$$1.0 \geq \frac{P_u}{P_n} + \frac{M_u}{M_n} = 0.21$$ OK!

CHECK DEFLECTIONS

COLUMN -

$\Delta_{MAX} \leq H_{column}/180 =$ 0.243 in

$$\Delta_{COLUMN} = \frac{P_H H^3_{column}}{3EI_{min}} = 0.145$$ DEFLECTION OK

REGISTERED PROFESSIONAL ENGINEER NATHAN D. TREMBLAY No. S6481 Exp. 9/30/19 STRUCTURAL STATE OF CALIFORNIA

2/12/19

USE 2-1/2 X 2-1/2 X 3/8" ANGLE FOR STAND LEGS.

JOB NAME:	PACIFIC HIGH SCHOOL POOL HEATER - SURERACK SUPPORT FRAME ANALYSIS	M. W. SAUSSÉ & CO., INC.	
CUST.:	MAROKO & SHWE, INC.	PREPARED BY:	FS
MECH. ENG.:		DATE:	11-Feb-19
MARK:	RAYPAK SURERACK SUPPORT FRAME	SHEET NO.:	63592-C1.2

ANCHOR BOLT FORCE CALCULATION FOR CUSTOM RMLS BASEPLATE LAYOUT

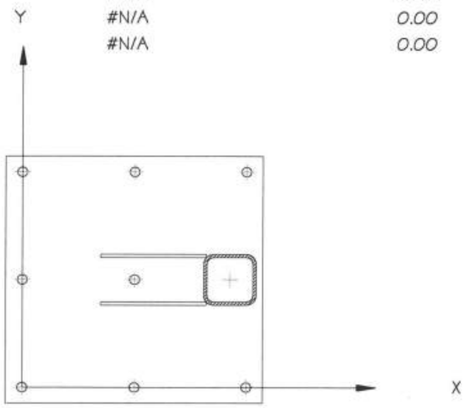
ISOLATOR FORCES AND DIMENSIONS

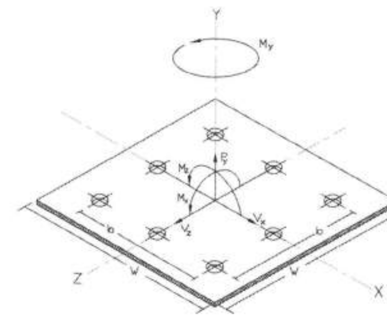
MOUNTING HOLE	X	Y
1.00	0.00	0.00
2.00	5.00	0.00
3.00	5.00	5.00
4.00	0.00	5.00
#N/A	0.00	0.00
#N/A	0.00	0.00
#N/A	0.00	0.00
#N/A	0.00	0.00
#N/A	0.00	0.00
#N/A	0.00	0.00
#N/A	0.00	0.00
#N/A	0.00	0.00

PLATE FORCES SHEET 63592-C1.0 THRU C1.2 (W/ Ω_0)

V_X (UPPER + LOWER UNIT)	=	648.81
P_Y (UPPER + LOWER UNIT)	=	1295.89
V_Z (UPPER + LOWER UNIT)	=	0.00
M_X	=	0.00
M_Y	=	0.00
M_Z	=	16026.33
N: # OF MOUNTING HOLES IN BASEPLAT	=	4

	X	Y
BOLT PATTERN DIM	5.00	5.00
LOADING CENTER F	0.85	0.36
CTR. OF RIGIDITY:	2.50	2.50
MOM. OF INERTIA: I_i	25.00	25.00





VERTICAL REACTIONS:

T_1	$= M_X * [((e_x / I_x)^2 * \cos(\theta)) + ((e_y / I_Y)^2 * \sin(\theta))]$	=	0.00 DUE TO MOMENT, M_X
T_2	$= M_Z * [((e_x / I_x)^2 * \cos(\theta)) + ((e_y / I_Y)^2 * \sin(\theta))]$	=	230.78 DUE TO MOMENT, M_Z
T_3	$= P_Y / n$	=	323.97 DUE TO UPLIFT, P_Y
T_4	$= P_Y * [(e_x - c_x) / (b_x / (2*I_x)) + (e_y - c_y) / (b_y / (2*I_Y))$	=	491.14 DUE TO ECCENTRICITY, P_Y
T_{ab}: $T_1+T_2+T_3+T_4$		=	**1045.90 TOTAL TENSION / BOLT**

HORIZONTAL REACTIONS:

V_1	$= V_X / n$	=	162.20 DIRECT SHEAR, V_X
V_2	$= V_Z / n$	=	0.00 DIRECT SHEAR, V_Z
V_3	$= V_X * [(e_x - c_x)^2 + (e_y - c_y)^2]^{1/2} / (b / 2^{1/2})$	=	123.97 SHEAR DUE TO ECCENTRICITY, V_X
V_3	$= V_Z * [(e_x - c_x)^2 + (e_y - c_y)^2]^{1/2} / (b / 2^{1/2})$	=	0.00 SHEAR DUE TO ECCENTRICITY, V_Z
V_4	$= M_Y / (b / 2^{1/2})$	=	0.00 SHEAR DUE TO ROTATION, M_Y
$V_{ab} = (V_1^2 + V_2^2 + (V_3 + V_4)^2)^{0.5}$		=	**204.15 TOTAL SHEAR / BOLT**

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BASEPLATE PROPERTIES

$b =$	2.5
$W =$	8
$t_{plate} =$	0.25
$f_{yield} =$	36000

PLATE CHECK

$e =$	4.64	in
$M_{plate} = (2T_{max} / \Omega_0) \times e =$	3882.37	lb-in
$Z_{plate} = W_z t_{plate}^2 / 4 =$	0.125	in^3
$M_n = 0.9 f_{yield} Z_{plate} =$	4050	lb-in > M_{plate} OK!!

WELD FRAME BASE TO MIN. 8X8X1/4" A36 STEEL BASEPLATE WITH 3/16" FILLET WELDS MIN. (WELDS OK PER INSPECTION). SEE THE FOLLOWING SHEETS FOR ANCHOR BOLT DESIGN.

JOB NAME:	PACIFIC HIGH SCHOOL POOL HEATER - SURERACK SUPPORT FRAME ANALYSIS	**M. W. SAUSSE' & CO., INC.**		
CUST.:	MAROKO & SHWE, INC.	PREPARED BY	:	FS
MECH. ENG.:		DATE	:	11-Feb-19
MARK:	RAYPAK SURERACK SUPPORT FRAME	SHEET NO.	:	63592-C1.3

HILTI HIT-RE 500 V3 ADHESIVE ANCHORS IN CONCRETE
(U.S. CUSTOMARY UNITS, ESR-3814 (REISSUED JANUARY '17) AND ACI-318 CHAPTER 17)

ANCHOR SPECIFICATIONS/PARAMETERS

INPUT

ANCHOR TYPE: THREADED ROD
STEEL TYPE: CARBON
GRADE: A 193 Gr B7
DIAMETER (d_O) = 0.5 in
n = 4 (NUMBER OF BOLTS PER ANCHOR POINT)
TEMPERATURE RANGE: A (A: MAX LONG TERM TEMP = 110°F, SHORT TERM = 130°F, B: MAX LONG TERM TEMP = 110°F, SHORT TERM = 176°F, NOTE 2, TABLE 9 OF ESR)
SEISMIC CONDITIONS?: YES

STEEL STRENGTH (TENSION AND SHEAR)

$\alpha_{V,seis}$ = 1 (TABLE 6 OF ESR)
Φ_{sN} = 0.75 (TENSION STRENGTH REDUCTION FACTOR FOR DUCTILE STEEL; ACI-318 17.3.3)
Φ_{sV} = 0.65 (SHEAR STRENGTH REDUCTION FACTOR FOR DUCTILE STEEL; ACI-318 17.3.3)
A_{se} = 0.1418 in^2 (TABLE 6 FROM ESR)
N_{sa} = 17735 lbs (TABLE 6 FROM ESR)
V_{sa} = 10640 lbs (TABLE 6 FROM ESR)

$\Phi_{sN}{}^*N_{sa}$ = 13301.3 lbs (ACI 318, 17.4.1.2) ← DESIGN STEEL TENSION STRENGTH
$\Phi_{sV}{}^*V_{sa}{}^*\alpha_{V,seis}$ = 6916 lbs (ACI 318, 17.5.1.2) ← DESIGN STEEL SHEAR STRENGTH

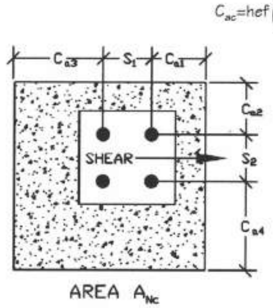
CONCRETE

BREAKOUT TENSION

h_{min} = 5.25 in (MIN. CONCRETE THICKNESS, TABLE 7 OF ESR)
S_{min} = 2.5 in (MIN. ANCHORAGE SPACING, TABLE 7 OF ESR)
$C_{a,min}$ = 2.5 in (MIN. ALLOWABLE EDGE DISTANCE, TABLE 7 OF ESR)
$h_{ef,min}$ = 2.375 in (MIN. ALLOWABLE EFFECTIVE EMBEDMENT, TABLE 7 OF ESR)
$h_{ef,max}$ = 10 in (MAX. ALLOWABLE EFFECTIVE EMBEDMENT, TABLE 7 OF ESR)
h_{ef} = 4 in (CHOSEN EFFECTIVE EMBED. USE AT LEAST $h_{ef,min}$ FROM ABOVE)
h_a = 8 in (MEMBER THICKNESS. IF UNKNOWN USE h_{min}, TABLE 7 IN ESR)

FOR CRITICAL EDGE DISTANCE FROM SECTION 4.1.10....

$C_{ac}=hef\left(\frac{t_{k,uncr}}{1160}\right)^{0.4}MAX\left[3.1-0.7\frac{h_a}{h_{ef}};1.4\right]=$ 7.87 in GIVEN $t_{k,uncr}$ = 1673.717 psi
WHERE $t_{k,uncr} \le k_{c,uncr}(h_{ef}f'_c)^{1/2}/(\pi d)$



AREA A_{Nc}

C_{a1} = 6 in (USE AT LEAST $C_{a,min}$)
C_{a2} = 6 in (USE AT LEAST $C_{a,min}$ & ≥ C_{a1})
C_{a3} = 9 in (USE AT LEAST $C_{a,min}$ & ≥ C_{a2})
C_{a4} = 9 in (USE AT LEAST $C_{a,min}$ & ≥ C_{a2})
S_1 = 5 in (USE AT LEAST MIN. SPACING, ESR TABLE 7; USE 0 IF n=1)
S_2 = 5 in (USE AT LEAST MIN. SPACING, ESR TABLE 7; USE 0 IF n=1)
f'_c = 3000 psi (CONCRETE STRENGTH)
HARDROCK CONCRETE
λ_a = 1.00 (ACI-318, 17.2.6)
CRACKED CONCRETE CONDITION
k_c = 17 (UNCRACKED = 24, CRACKED = 17; ESR TABLE 7)
$\Psi_{ec,N}$ = 1 (ACI 17.4.2.4; 1.0 WHEN NO LOAD ECCENTRICITY)
$\Psi_{c,N}$ = 1 (ACI 17.4.2.6; 1.0 WITH CRACKING AT SERVICE LEVELS)
Φ_{cN} = 0.65 (TENSION CONCRETE BREAKOUT STRENGTH REDUCTION TABLE 7)
h_{ef} CHECK = h_{ef}' = 4 in (IF 3 OR MORE EDGES ARE LESS THAN 1.5*h_{ef}, 17.4.2.3 OF THE ACI-318)
$SIDE_\perp = min(C_{a2};1.5h_{ef}')+S_2+min(C_{a4};1.5h_{ef}')$ = 17 in
$SIDE_\parallel = min(C_{a1};1.5h_{ef}')+S_1+min(C_{a3};1.5h_{ef}')$ = 17 in
$A_{Nc} = SIDE_\perp{}^*SIDE_\parallel$ = 289 in^2 (PROJECTED FAILURE SURFACE AREA, ACI-318 17.4.2.1)
$A_{NcO} = n^*9^*(h_{ef}')^2$ = 576 in^2 (PROJECTED FAILURE SURFACE AREA OF SINGLE ANCHOR WITHOUT INFLUENCE ACI-318 17.4.2.1)
$\Psi_{ed,N} = 0.7+0.3^*C_{a1}/(1.5^*h_{ef}')$ = 1.00 (IF $C_{a1} \ge 1.5h_{ef}$ THEN = 1.0)

$$\Psi_{cp,N}=\frac{max|C_{a1};1.5h_{ef}'|}{C_{ac}}= 0.762$$ ≤ 1.0 (IF LARGER THAN 1 USE $\Psi_{cp,N}$ = 1.0)

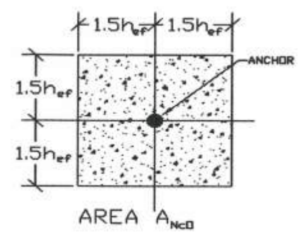
$$N_b=\lambda_a k_c * \sqrt{f'_c} * (h_{ef}')^{1.5} = 7449.03 \text{ lbs}$$

$$N_{cb}=\frac{A_{Nc}}{A_{NcO}}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b = \text{N/A (MORE THAN ONE ANCHOR)}$$

$$N_{cb}=\frac{A_{Nc}}{A_{NcO}}\Psi_{ec,N}\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b = 2847.92$$

(VALUES ARE IN POUNDS)

$\Phi_{cN}\,N_{cb}$ = 1851.15 lbs ← DESIGN CONCRETE BREAKOUT STRENGTH IN TENSION



AREA A_{NcO}

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JOB NAME:	PACIFIC HIGH SCHOOL POOL HEATER - SURERACK SUPPORT FRAME ANALYSIS	M. W. SAUSSE' & CO., INC.	
CUST.:	MAROKO & SHWE, INC.	PREPARED BY :	FS
MECH. ENG.:		DATE :	11-Feb-19
MARK:	RAYPAK SURERACK SUPPORT FRAME	SHEET NO. :	63592-C1.4

CHECK SIDE-FACE BLOWOUT

$A_{brg} =$ 0.1418 in^2 (BEARING AREA OF CONCRETE AT ANCHOR BOTTOM. USE A_{se} TO BE CONSERVATIVE)

FOR SINGLE ANCHORS -

CHECK $C_{a2} \rightarrow C_{a2} < 3C_{a1} \rightarrow$ 6 < 18

REDUCTION FACTOR FROM $C_{a2} = \dfrac{1 + {C_{a2}}/{C_{a1}}}{4} =$ 0.5 $\rightarrow$ WHERE $1.0 \leq C_{a2}/C_{a1} \leq 3.0 \rightarrow$ TRUE!

$N_{sb} = 160 C_{a1}\sqrt{A_{brg}}\sqrt{f_c'} =$ 19800.2 lbs $\rightarrow$ REDUCED VALUE = 9900.1 lbs (ACI 318, 17.4.4.1)

FOR MULTIPLE ANCHORS (GROUPS) -

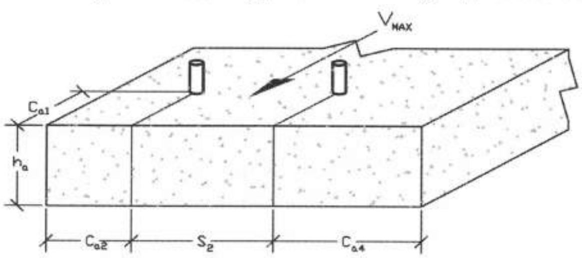
CHECK BOLT SPACING $\rightarrow S < 6C_{a1} \rightarrow$ 5 < 36

$N_{sbg} = \left(1 + \dfrac{S}{6C_{a1}}\right) N_{sb} =$ 22550.2 lbs (ACI-318 17.4.4.2)

$\Phi_{cN} N_{sb} =$ 14657.7 lbs ← CONCRETE SIDE-FACE BLOWOUT STRENGTH

SHEAR STRENGTH

$d_O =$ 0.5 in (OUTSIDE DIAMETER OF ANCHOR BOLT OR ROD)
$C_{a1} =$ 6 in (FROM PREVIOUS PAGE OF CALCULATIONS)
$C_{a2} =$ 6 in (FROM PREVIOUS PAGE OF CALCULATIONS)
$C_{a4} =$ 9 in (FROM PREVIOUS PAGE OF CALCULATIONS)
$S_2 =$ 5 in (FROM PREVIOUS PAGE OF CALCULATIONS)
$\ell_e =$ 4 in (TYPICALLY = h_{ef}, NO MORE THAN $8d_a$ ACI-318 SECTION 17.5.2.2)
$\Psi_{ec,V} =$ 1 (ACI 17.5.2.5; 1.0 WHEN NO LOAD ECCENTRICITY)
$h_a =$ 8 in (THICKNESS OF CONCRETE MEMBER)
$\Phi_{cV} =$ 0.70 (SHEAR CONCRETE BREAKOUT STRENGTH REDUCTION; ACI-318 & ESR TABLES 8 OR 24)
$\Psi_{c,V} =$ 1.2 (1.0 FOR CONC. W/O REINFORCEMENT, 1.2 FOR CONC. W/ REINFORCEMENT, 1.4 SEE 17.5.2.7 OF ACI)
$n_V =$ 2 (NO. OF ANCHORS IN ROW CLOSEST TO EDGE OF CONCRETE)
$C_{a1}' =$ 6.00 in (C_{a1} ADJUSTED WHEN C_{a2} & C_{a4} ARE LESS THAN $1.5C_{a1}$, 17.52.4)



$H = \min(h_a; 1.5C_{a1}') =$ 8 in
$B = \min(C_{a2}; 1.5C_{a1}') + S_2 + \min(C_{a4}; 1.5C_{a1}') =$ 20.000 in
$A_{Vc} = B * H =$ 160.0 in^2 (REFER TO ACI-318 17.5.2.1 AND 17.5.2.2)
$A_{VcO} = n_V * 4.5(C_{a1}')^2 =$ 324.0 in^2 (REFER TO ACI-318 D.6.2.1 AND 17.5.2.2)
$\Psi_{h,V} = (1.5C_{a1}'/h_a)^{1/2} =$ 1.06 (≥ 1.0, FROM ACI-318 SECTION 17.5.2.8)
$\Psi_{ed,V} = 0.7 + 0.3 * C_{a2}/(1.5 * C_{a1}') =$ 0.90 (IF $C_{a2} > 1.5h_a$ THEN = 1.0, ACI 318 17.5.2.6)

$V_b = 7\left(\dfrac{\ell_e}{d_O}\right)^{0.2}\sqrt{d_O}\sqrt{f'_c}(C_{a1})^{1.5} =$ 6039.3 OR $V_b = 9\lambda_a (f_c')^{1/2} * c_{a1}^{1.5} =$ 7244.86

$\rightarrow V_b =$ 6039.3 lbs

$V_{cb} = \dfrac{A_{Vc}}{A_{VcO}}\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_b =$ N/A (MORE THAN ONE ANCHOR)

$V_{cb} = \dfrac{A_{Vc}}{A_{VcO}}\Psi_{ec,V}\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_b =$ 3416.36

(VALUES ARE IN POUNDS)

$\Phi_{cV} V_{cb} =$ 2391.45 lbs ← DESIGN SHEAR CONRETE STRENGTH

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EPOXY BOND STRENGTH (PULLOUT)

PULLOUT STRENGTH

$\tau_{cr} =$ 1305.2 psi (CHARACTERISTIC BOND STRENGTH; ESR TABLE 8 & 11 & NOTE #1)
$\tau_{uncr} =$ 2342.3 psi (CHARACTERISTIC BOND STRENGTH; ESR TABLE 8 & 11 & NOTE #1)
$d_a =$ 0.5 in (STEEL ANCHOR DIAMETER)
$\Psi_{ec,Na} =$ 1 (LOAD ECCENTRICITY FACTOR, SEE EQ. 17.4.5.3 ACI 318)
$\Phi_d =$ 0.65 (EPOXY BOND STRENGTH REDUCTION; ESR, TABLE 8 & 11)
$\alpha_{N,seis} =$ 0.93 (TABLES 8 & 11 OF ESR)
$\lambda_a =$ 1.00 (ACI-318, 17.2.6)

$C_{Na} = 10d_a(\tau_{uncr}/1100)^{1/2} =$ 7.30 in (CRITICAL EDGE DISTANCE; ACI 318, EQ. 17.4.5.1d)

$SIDE_{\parallel} = \min(C_{Na},C_{a1}) + S_1 + \min(C_{Na},C_{a3}) =$ 18.30 in

$SIDE_{\perp} = \min(C_{Na},C_{a2}) + S_2 + \min(C_{Na},C_{a4}) =$ 18.30 in

$A_{Na} = SIDE_{\parallel} \times SIDE_{\perp} =$ 334.75 in^2 (PROJECTED FAILURE SURFACE AREA, ESR SECTION 4.1.4, ACI-318 17.4.5.1)

$A_{NaO} = n^*(2C_{Na})^2 =$ 851.75 in^2 (PROJECTED FAILURE SURFACE AREA OF SINGLE ANCHOR WITHOUT INFLUENCE ESR SEC. 4.1.4, ACI-318 17.4.5.1)

$\Psi_{ed,Na} = 0.7+0.3^*C_{a,1}/C_{cr,Na} =$ 0.95 (IF $C_{a1} \geq C_{Na}$ THEN = 1.0; EQN 17.4.5.4a & 17.4.5.4b)

$\Psi_{cp,Na} = C_{a,1}/C_{ac} =$ 1.0 psi (ESR SECTION 4.1.4, TABLES 8 OR 24)

$N_{ba} = \lambda_a \tau_{cr}{}^* \pi^* d_a{}^* h_{ef} =$ 8200.89 lbs (ESR SECTION 4.1.4, EQ. 17.4.5.2)

$N_a = \frac{A_{Na}}{A_{NaO}} \Psi_{ed,Na} \Psi_{cp,Na} N_{ba} =$ N/A (MORE THAN ONE ANCHOR)

$N_a = \frac{A_{Na}}{A_{NaO}} \Psi_{ec,Na} \Psi_{ed,Na} \Psi_{cp,Na} N_{ba} =$ 3051.29

(VALUES ARE IN POUNDS)

$\alpha_{N,seis} \Phi_d N_a =$ 1844.5 lbs ← DESIGN EPOXY BOND (PULLOUT) STRENGTH

PRYOUT FROM SHEAR STRENGTH (ESR SECTION 4.1.7)

$k_{cp} =$ 2

$V_{cp} = \min(k_{cp}{}^*\Phi_{aN}N_a ; k_{cp}{}^*\Phi_{cN}N_{cb}) =$ 3689.01 lbs ← DESIGN PRYOUT (DUE TO SHEAR) STRENGTH

CONTROLLING STRENGTH FOR ANCHORAGE

TENSILE STRENGTH -

STEEL =	13301.3		N_d
CONCRETE =	1851.1		
EPOXY BOND =	1844.5	<= CONTROLLING STRENGTH	
SIDE-FACE BLOWOUT =	14657.7		

SHEAR STRENGTH -

STEEL =	6916		V_d
CONCRETE =	2391.45	<= CONTROLLING STRENGTH	
PRYOUT STRENGTH =	3689.01		

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FOR ASD ADJUSTMENT FACTORS AND ALLOWABLE LOADS

INPUT...

$\alpha =$ 1.00 (ASD CONVERSION FACTOR, IF APPLICABLE.)

SEISMIC TENSION FACTOR (F_{SCN}) = 0.75 (PER SECTION 17.2.3.4.4, REDUCE TO 0.75 FOR SEISMIC DESIGN TENSION WHEN CONCRETE CONTROLS)

DEAD LOAD TENSION FACTOR (F_{DLN}) = 1.00 (0.75 WHEN ANCHOR IS UNDER SUSTAINED DEAD LOAD TENSION, SECTION 4.1.1 OF ESR)

$T_{all} = N_{all} = F_{DLN}F_{SCN}N_d/\alpha =$ **1383 lbs**

$V_{all} = F_{SCV}V_d/\alpha =$ **2391 lbs**

GIVEN BOLT FORCES FROM SHEET: 63592-C1.3

INPUT HERE

$T_{ab} =$ 1045.90 lbs

$V_{ab} =$ 204.15 lbs

CHECK COMBINED LOADING (ACI 318 EQN. 17.6.3)

$\frac{T_{ab}}{T_{al}} + \frac{V_{ab}}{V_{all}} =$ 0.84 ≤ 1.2

ANCHOR OK!

ANCHORAGE SUMMARY:

1/2 in DIAMETER ASTM
A 193 Gr B7 CARBON STEEL THREADED ROD W/ A-194 NUT,
4 in MIN. EMBEDMENT,
6 in MIN. EDGE DISTANCE,
8 in MIN. CONCRETE THICKNESS
3000 psi HARDROCK CONCRETE.
INSTALL IN CONCRETE WITH A HAMMER DRILL AND CARBIDE BIT AND SET WITH HILTI HIT-RE 500 V3 ADHESIVE AS PER THE ICC ESR-3814.
SPECIAL INSPECTION REQUIRED PER SECTION 4.4 OF THE ESR-3814.