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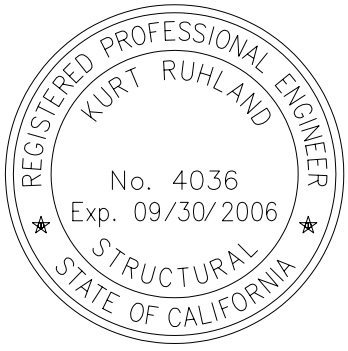
APC

SYMMETRA LX UNIT

Structural Calculations
For Seismic Anchorage

(also covers the following LX unit configurations: SYAF8KT, SYA4K8P, SYA8K8P, SYAF16KT, SYA8K16P, SYA12K16P, SYA16K16P, SYAF16KXR9T, SYA8K16PXR, SYA12K16PXR, SYA16K16PXR, SYAXR9B9, SYBFXR9)



Prepared for:
American Power Conversion

October 15, 2004
RMJ Job No. 04272

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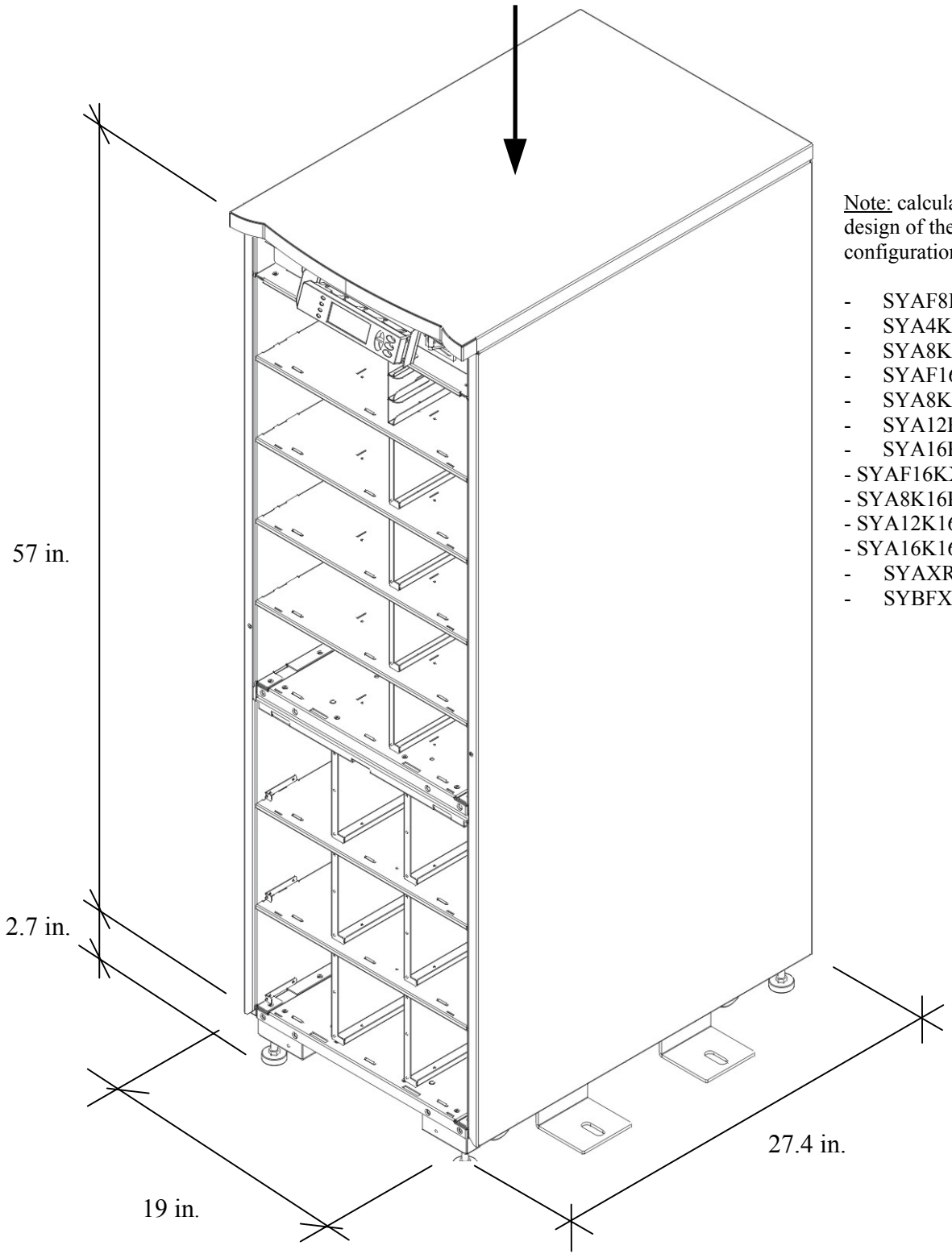
SYMMETRA LX
APC

Job No. 04272 Date: Oct.-04
By: RM Page: 1

MODEL: SYMMETRA LX UNIT

(fully loaded w/ 5 power modules &
13 Battery Modules, governs design)

Dead Load = 400 lbs
Live Load = 997 lbs



Note: calculations also apply to design of the following LX configurations:

- SYAF8KT = 217LBS
- SYA4K8P = 314LBS
- SYA8K8P = 411LBS
- SYAF16KT = 256LBS
- SYA8K16P = 450LBS
- SYA12K16P = 547LBS
- SYA16K16P = 644LBS
- SYAF16KXR9T = 400LBS
- SYA8K16PXR = 1042LBS
- SYA12K16PXR = 1075LBS
- SYA16K16PXR = 1108LBS
- SYAXR9B9 = 768LBS
- SYBFXR9 = 192LBS

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SYMMETRA LX UNIT
APC
Job No. 04272 Date: 10/15/04
By: AM Page: 2

19" x 27.4" x 59.7" SYMMETRA LX UNIT Seismic Stability

Load Case: Fully Loaded: w/ 5 power modules and 13 battery modules (Anchorage at ground floor)

Unit		Center of Mass-Unit		Center of Mass-Contents	
Length=	19 inches	Length=	9.63 inches	Length=	10.15 inches
Width=	27.4 inches	Width=	13.6 inches	Width=	11.8 inches
Height=	59.7 inches	Height=	32.8 inches	Height=	26.2 inches

Unit	Part	Weight (lbs)	X (in)	Y (in)	Z (in)
Sym. LX					
	Frame	400	9.37	13.6	32.8
	Max Content Wt.	997	8.85	11.8	26.2

Seismic Force (See bottom of page)

C_a=	0.66	(Zone 4, N_a=1.5)
I_p=	1	(Importance factor)
a_p=	1	(Cabinets)
R_p=	3	(Cabinets)
h_x/h_r=	0	(Floor) ← calc. at ground floor
W=	1397 lbs	

F_p=	0.16	W=	220 lbs
F_{pmin}=	0.33	W=	461 lbs
F_{pmax}=	1.89	W=	2634 lbs
F_p=	0.33	W=	461 lbs

Longitudinal Anchorage Spacing= 21.6 in.
Transverse Anchorage Spacing= 10 in.

Longitudinal Stability

Overturning moment= 12950 in-lbs
0.9 X Resisting moment= 11314 in-lbs

Anchorage Force (lbs)

76 total

Transverse Stability

Overturning moment= 12950 in-lbs
0.9 X Resisting moment= 15484 in-lbs

Anchorage Force (lbs)

Stable, No Anchorage Required

1997 Uniform Building Code
Section 1632 - Lateral Force on Elements of Structures, Nonstructural Components and Equipment Supported by Structures

The total design lateral seismic force, Fp, shall be determined from the following formula:

Fp = 4.0CaIpWp

Alternatively, Fp may be calculated using the following formula:

Fp = apCaIp*(1+3*hx/hr)*Wp/Rp

Except that:

Fp shall not be less than 0.7CaIpWp and
need not be more than 4CaIpWp

19" x 27.4" x 59.7" SYMMETRA LX UNIT Seismic Stability - Anchorage at Gound Floor

ANCHORAGE

CONDITION	ANCHORAGE FORCE	ANCHORS	CAPACITY	SCREWS	CAPACITY
SINGLE UNIT	76/2=38 lb	1-3/8"ϕ	784 lb	2-#12	746 lb
GANGED UNITS	---	1-3/8"ϕ	784 lb	2-#12	746 lb

CHECK COMBINED SHEAR/TENSION

P_{max}= 38 lb V_{max}= 461/4 bolts= 115.25 lb

P_{allow}= 784 lb V_{allow}= 1018 lb

(38/784)^(5/3)+(115.25/1018)^(5/3)= 0.03 <1 OK

ANCHOR CAPACITIES

3/8"ϕ Red Head Trubolt Wedge Anchors (ICBO Report No. 1372)
Embedded 3 " into 3000 psi Reg. Wt. Concrete

1-3/8"ϕ: 588 x 1.33= 784 lb
2-3/8"ϕ: spaced at 6 "= 784 x 2= 1568 lb
2-3/8"ϕ: spaced at 4 "= 784 x 2 x 0.8= 1294 lb
2-3/8"ϕ: spaced at 3 "= 784 x 2 x 0.7= 1098 lb
3-3/8"ϕ: spaced at 6 "= 784 x 3= 2352 lb

	Capacity
#12 Sheet metal screw into 18 GA. Min (SSMA / ICBO No. 4943P) =	280 x 1.33= 373 lb

∴ Use 3/8" ϕ "Red Head" Trubolt Wedge Anchors at +/- 21.6" o.c. for single unit.
For ganged units use 3/8" ϕ "Red Head" Trubolt Wedge Anchors at +/- 43.2" o.c. max. as shown on installation details.

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SYMMETRA LX UNIT
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Job No. 04272 Date: 10/15/04
By: AM Page: 4

19" x 27.4" x 59.7" SYMMETRA LX UNIT Seismic Stability

Load Case: Fully Loaded: w/5 power modules and 13 battery modules (Anchorage at Second Floor or Above)

Unit		Center of Mass-Unit		Center of Mass-Contents	
Length=	19 inches	Length=	9.63 inches	Length=	10.15 inches
Width=	27.4 inches	Width=	13.6 inches	Width=	11.8 inches
Height=	59.7 inches	Height=	32.8 inches	Height=	26.2 inches

Unit	Part	Weight (lbs)	X (in)	Y (in)	Z (in)
Sym. RT					
	Frame	400	9.37	13.6	32.8
	Max Content Wt.	997	8.85	11.8	26.2

Seismic Force (See bottom of page)

C_a=	0.66	(Zone 4, N_a=1.5)
I_p=	1	(Importance factor)
a_p=	1	(Cabinets)
R_p=	3	(Cabinets)
h_x/h_r=	1	(Floor) ← calc. at roof
W=	1397	lbs

F_p=	0.63	W=	878 lbs
F_{pmin}=	0.33	W=	461 lbs
F_{pmax}=	1.89	W=	2634 lbs
F_p=	0.63	W=	878 lbs

Longitudinal Anchorage Spacing= 21.6 in.
Transverse Anchorage Spacing= 10 in.

Longitudinal Stability

Overturning moment= 24666 in-lbs
0.9 X Resisting moment= 11314 in-lbs

Anchorage Force (lbs)

618 total

Transverse Stability

Overturning moment= 24666 in-lbs
0.9 X Resisting moment= 15484 in-lbs

Anchorage Force (lbs)

918 total

1997 Uniform Building Code
Section 1632 - Lateral Force on Elements of Structures, Nonstructural Components and Equipment Supported by Structures

The total design lateral seismic force, Fp, shall be determined from the following formula:

Fp = 4.0CaIpWp

Alternatively, Fp may be calculated using the following formula:

Fp = apCaIp*(1+3*hx/hr)*Wp/Rp

Except that:

Fp shall not be less than 0.7CaIpWp and
need not be more than 4CaIpWp

19" x 27.4" x 59.7" SYMMETRA LX UNIT — Seismic Stability - Anchorage at 2nd Floor & Above

ANCHORAGE

CONDITION	ANCHORAGE FORCE	ANCHORS	CAPACITY	SCREWS	CAPACITY
SINGLE UNIT	918/2=459 lb	1-3/8"ϕ	784 lb	2-#12	746 lb
GANGED UNITS	---	1-3/8"ϕ	784 lb	2-#12	746 lb

CHECK COMBINED SHEAR/TENSION

P_{max}= 459 lb V_{max}= 878/4 bolts= 219.5 lb

P_{allow}= 784 lb V_{allow}= 1018 lb

(459/784)^(5/3)+(219.5/1018)^(5/3)= 0.49 <1 OK

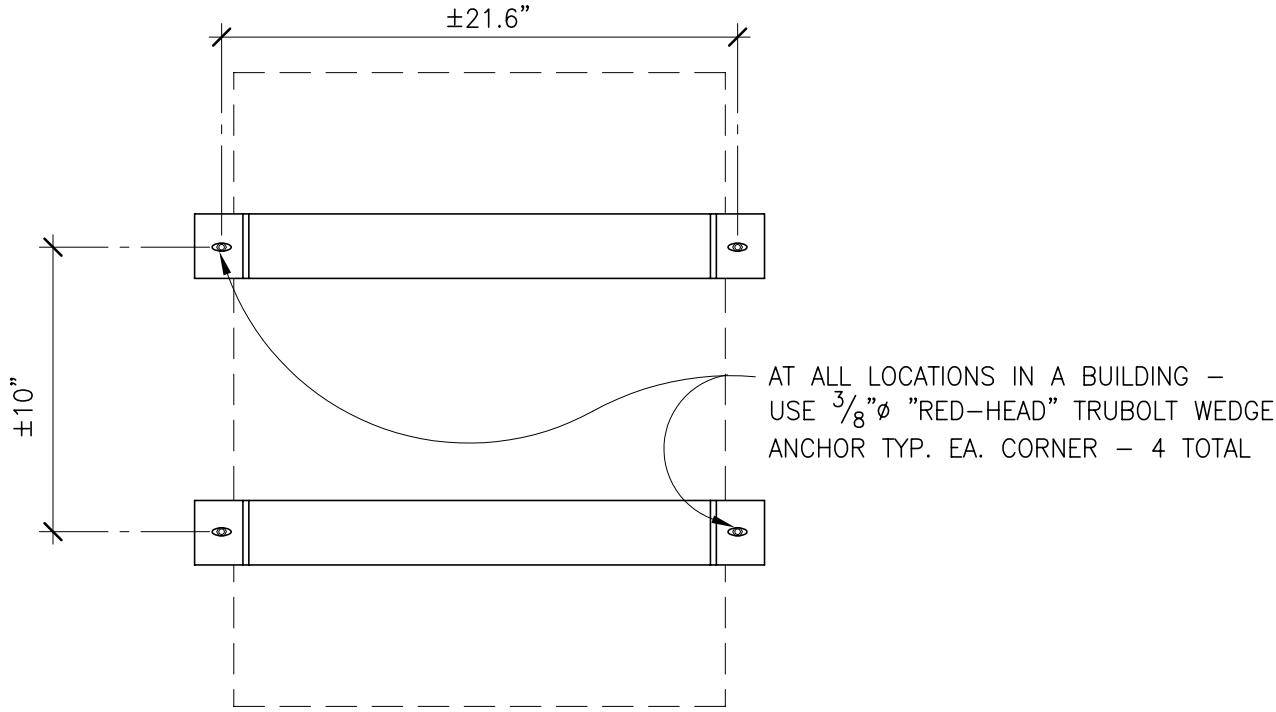
ANCHOR CAPACITIES

3/8"ϕ Red Head Trubolt Wedge Anchors (ICBO Report No. 1372)
Embedded 3 " into 3000 psi Reg. Wt. Concrete

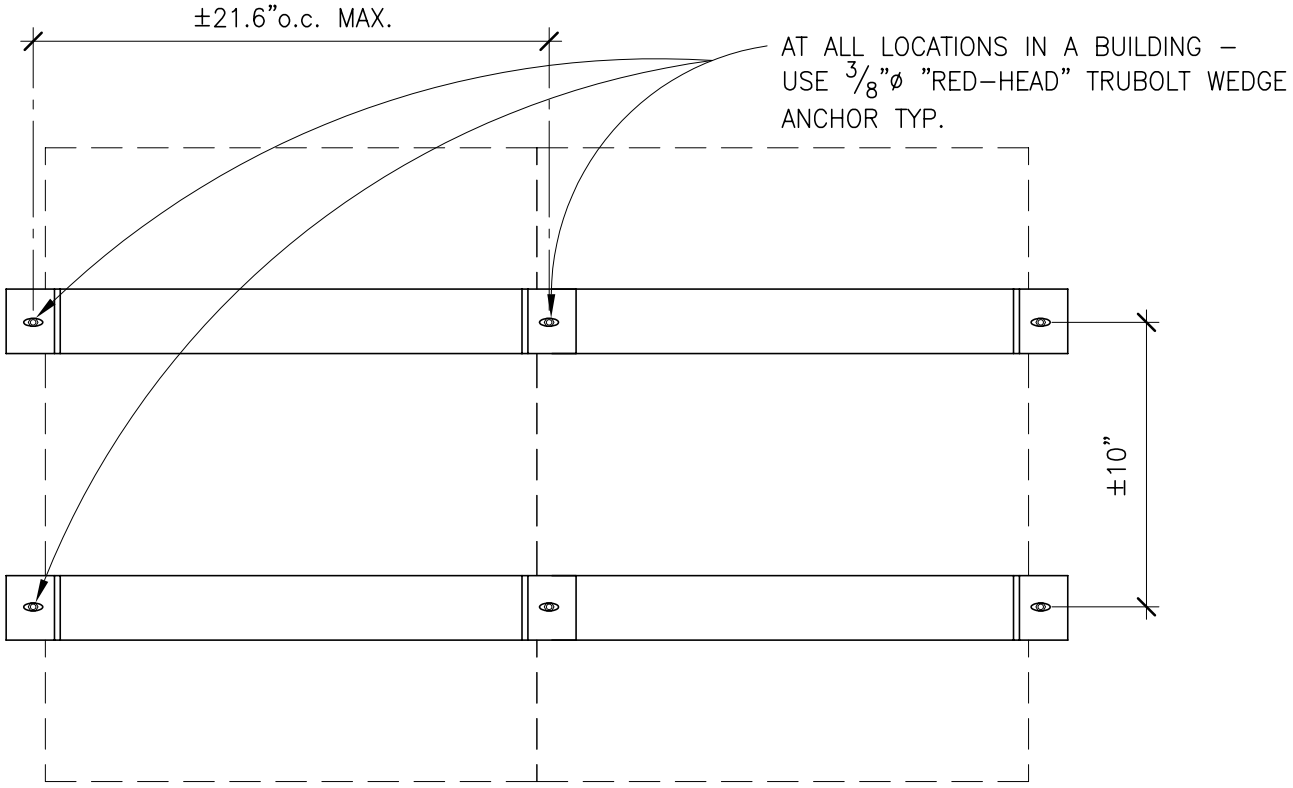
1-3/8"ϕ: 588 x 1.33= 784 lb
2-3/8"ϕ: spaced at 6 "= 784 x 2= 1568 lb
2-3/8"ϕ: spaced at 4 "= 784 x 2 x 0.8= 1294 lb
2-3/8"ϕ: spaced at 3 "= 784 x 2 x 0.7= 1098 lb
3-3/8"ϕ: spaced at 6 "= 784 x 3= 2352 lb

	Capacity
#12 Sheet metal screw into 18 GA. Min (SSMA / ICBO No. 4943P) =	280 x 1.33= 373 lb

∴ Use 3/8" ϕ "Red Head" Trubolt Wedge Anchors at +/- 21.6" o.c. for single unit.
For ganged units use 3/8" ϕ "Red Head" Trubolt Wedge Anchors at +/- 43.2" o.c. max. as shown on installation details.



SINGLE UNIT PLAN



GANGED UNIT PLAN

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Sheet No. 1 OF 3

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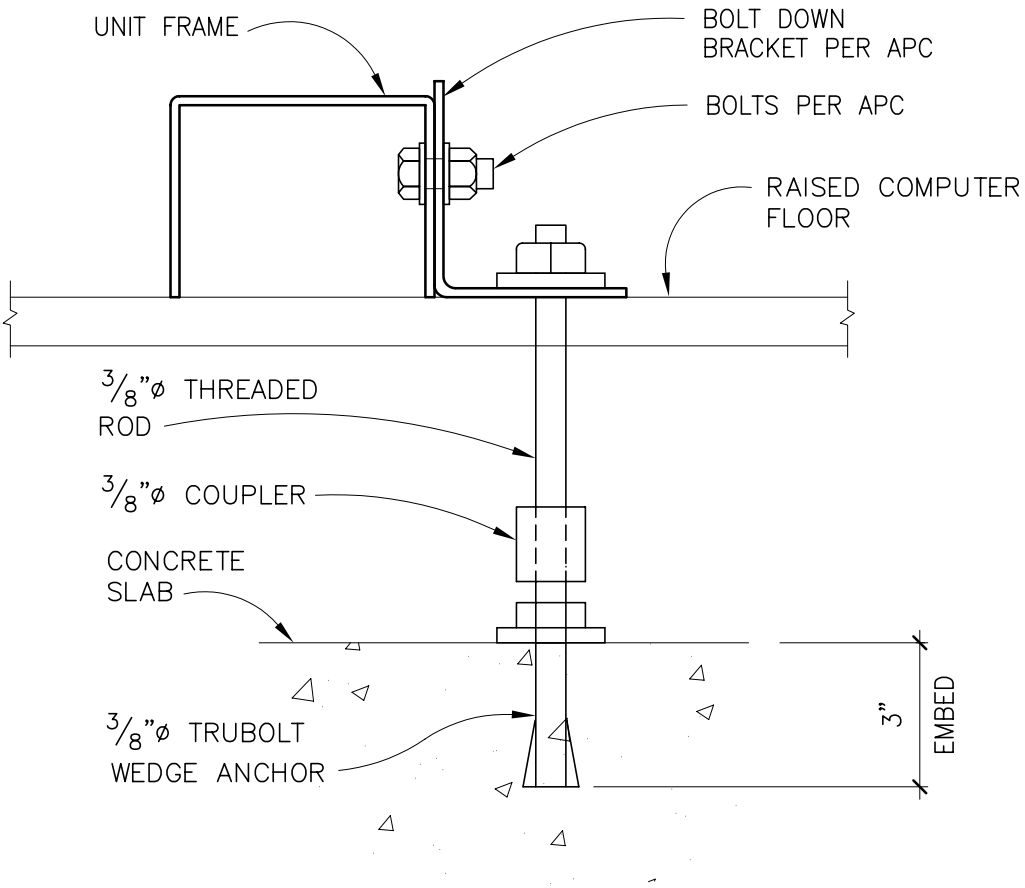

ANCHORAGE AT RAISED FLOOR

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Sheet No. 2 OF 3

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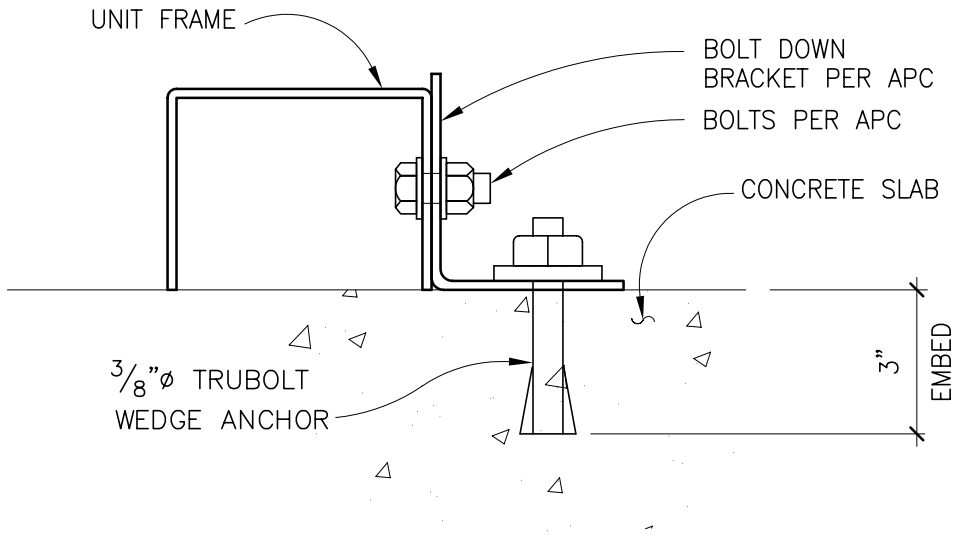

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Sheet No. 3 OF 3

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