[redacted]

RMJ

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Principals
Peter Robinson, S.E.
Jayson E. Haines, S.E.

APC
by Schneider Electric

SYMMETRA PX40 UPS & INFRASTRUXURE PDU SYMMETRA PX40 UPS, SYMMETRA PX40 XR Battery Cabinet, & INFRASTRUXURE PDU

Structural Calculations For Seismic Anchorage

REGISTERED PROFESSIONAL ENGINEER
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No. 4801
Exp. 12/31/2011
STRUCTURAL
STATE OF CALIFORNIA

Prepared for:

APC
RMJ Job No.: 11210
August 26, 2011
RMJ Job No. 11210
Valid Thru August 26, 2012

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APC by Schneider Electric

SYMMETRA PX40 UPS & INFRASTRUXURE PDU SYMMETRA PX40 UPS, SYMMETRA PX40 XR Battery Cabinet, & INFRASTRUXURE PDU

Table of Contents

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Symmetra PX40, Symmetra PX40 UPS, Infrastruxure PDU Units by APC
Nationwide
RMJ Job# 11210

Project Description:

This project involves providing server anchorage support for units located throughout the United States. Calculations have been assembled according to two distinct seismic regions low & moderate, and high. A map has been created based on Figures 3.3-1 & 3.3-2 of ASCE 7-05 to define the two different seismic regions. Please note our seismic map shows three distinct regions low, moderate, and high, but for simplicity of our calculations low and moderate were combined into one region. The map also shows a solid line near the New Madrid Fault where the value of S_s exceeds 2.75. In this area of extreme seismic potential, all anchorage is site specific. The other seismic regions have been determined according to the table included below;

Seismic Design Data			
Seismic design region	**Short period spectral response acceleration S_s**	**Short-period site coefficient F_a**	**Design spectral response acceleration at short periods S_{DS}**
Low	0.4	1.5	0.4
Moderate	1.5	1.0	1.0
High	2.75	1.0	2.0

4” Concrete Slab

Units to be ganged (3-minimum) located on the ground level assumed to have a total weight of unit plus contents of 2,100lbs. Hilti Kwik Bolt KB-TZ Carbon Steel expansion bolts shall be used to anchor the APC equipment. Calculations are only intended for the Symmetra PX40, Symmetra PX40 UPS, and Infrastruxure PDU APC units. Calculations are based on the assumptions that anchors are not located within any boundary edges, 4” thick concrete minimum thickness, 2” minimum embedment, and 2,500 psi concrete strength.

Results

Please see the table below for a quick review of our results.

Bolt Alignment	Max Tension (lbf.)	Max Shear (lbf.)	% Capacity
Ground Level	1,100	1,250	99
50% Bld. Ht.	949	1,132	99

Our results show that units on the ground level the Hilti Kwik Bolt KB-TZ (3/8” Dia. with a 2” embedment) resists a max tension force of 1,275#, and max shear force of 1,125#. Anchorage for units located on the upper floor using the Hilti Kwik Bolt KB-TZ (3/8” Dia. with a 1¾” embedment) resists a max tension force of 1,051#, and max shear force of 1,132#. I have included the Hilti output files along with my hand calculations in the appendix section of this calculation packet. Site specific engineering is required where S_S is greater than 2.75. Design is in accordance with the 2009 International Building Code along with the 2010 California Building Code.

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Symmetra PX40, Symmetra PX40 UPS, Infrastruxure PDU Units by APC
Scope, Assumptions, and Limitations
RMJ Job #11210
August 25, 2011

Special Note:
Server rack anchorage calculations are valid under the 2006 & 2009 International Building Code & 2010 California Building Code thru date noted on cover sheet. After valid thru date, contact APC for updates.

- Special Inspection shall be provided for expansion bolt installation.
- Existing concrete shall have a minimum compressive strength of 2,500 psi.
- Importance factor is assumed to be 1.0.
- Soil class is assumed to be D.
- Calculations and anchorage are done in accordance with the 2006 and 2009 IBC, 2010 California Building Code and ASCE7-05.
- Maximum S_s value is 2.75. Where value of S_s exceeds 2.75, site specific calculations are required for all anchorages. S_s values can exceed 2.75 near the New Madrid fault.
- The minimum slab on grade thickness is assumed to be 4”.
- Hilti KWIK Bolt KB-TZ to be used with a minimum embedment of 2.5”.
- Maximum weight of enclosure and contents has been listed in the table below

	High Seismic	*Low and Moderate Seismic*
	Ground Level	Ground Level
Max Wt. of Enclosure and Contents (lb)	***2,100 #***	***2,100 #***

- Enclosure is assumed to stay rigid during seismic loading (design by others).
- Ganged Units based on a Minimum of 2 Units.
- Calculations are for Symmetra PX40, Symmetra PX40 UPS, and Infrastruxure PDU units.

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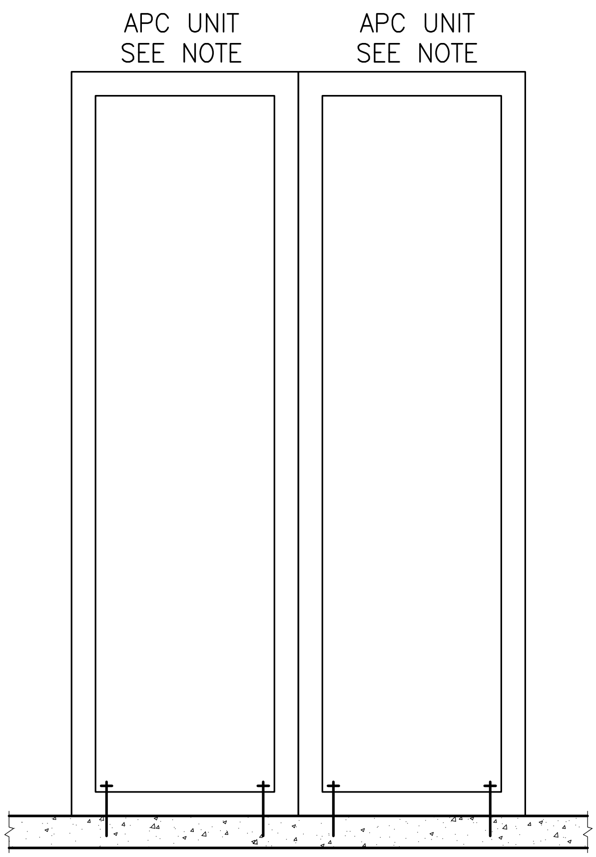
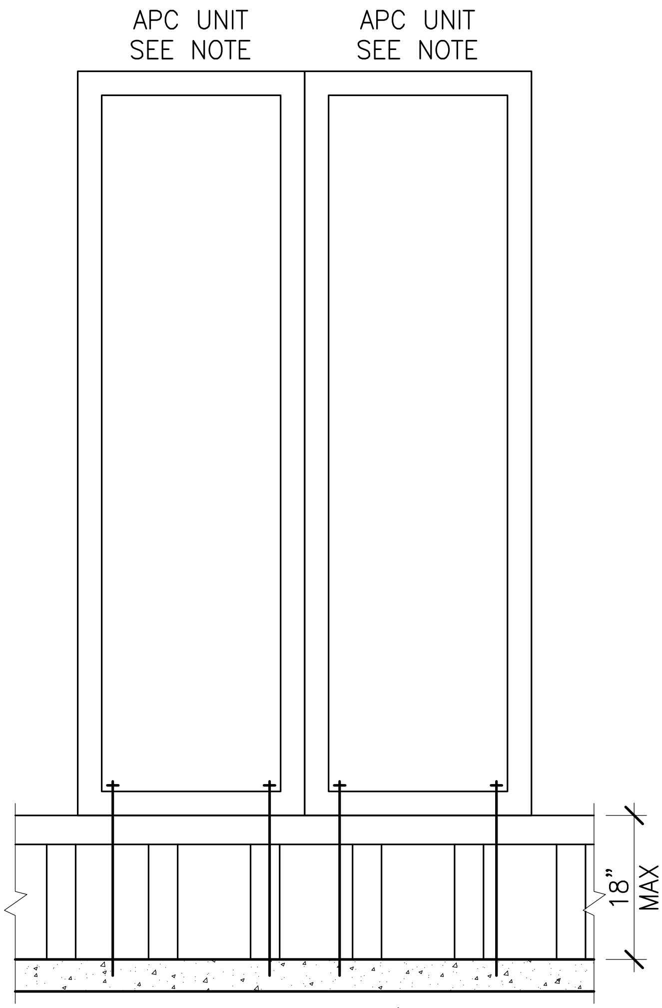
DESIGN SCENARIOS AND CONDITIONS

NOTE:
CALCULATIONS FOR THE FOLLOW APC UNITS:
SYMMETRA PX40 UPS, SYMMETRA PX 40 XR Battery Cabinet, & INFRASTRUXURE PDU



CONC. SLAB OR CONC. OVER METAL DECK (DIRECT FRAME TO FLOOR) REFER TO DRAWINGS SK3, SK4, SK5, SK7



RAISED COMP. FLOOR (ANCHOR FRAME TO SUB-FLOOR) REFER TO DRAWINGS SK3, SK4, SK6, SK8

DESIGN CRITERIA
- PROVIDE SPECIAL INSPECTION FOR EXPANSION ANCHOR
- (E) CONC. MIN COMPRESSIVE STRENGTH 2,500 psi
- GROUND FLOOR
- INSTALLATION AT <50% OF BUILDING HEIGHT
- GANGED UNITS (3 OR MORE)
- HIGH, MODERATE & LOW SEISMIC REGIONS
- CALCULATION PER IBC 2009/CBC 2010
- IMPORTANCE FACTOR 1.0
- WEIGHT OF ENCLOSURE AND CONTENTS TO NOT EXCEED 2,100 LBS

MAX UNIT WEIGHT (LB)		
SEISMIC CATEGORY	GROUND LEVEL	>50% OF BLDG HT.
LOW AND MODERATE	2,100	2,100
HIGH	2,100	2,100

FASTENER SELECTION
HILTI KB-TZ $^{3}/_{8}$" ø BOLT

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SYMMETRA & INFRASTRUXURE CABINET ANCHORAGE

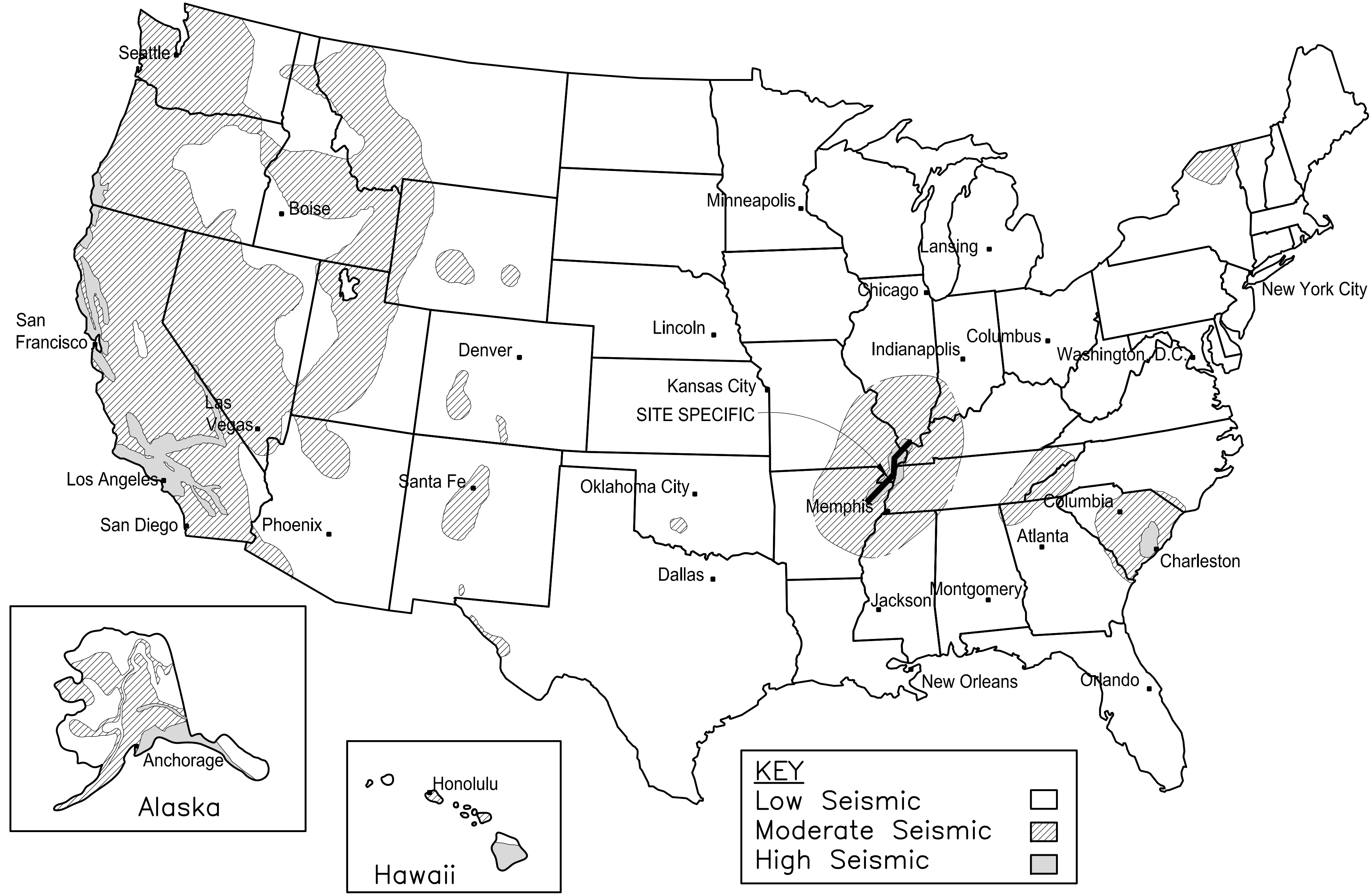
USA

Signed by MAS

Date 7/2011

Job No. 11210

Sheet No. SK2



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Seismic Risk Location Map
APC Unit

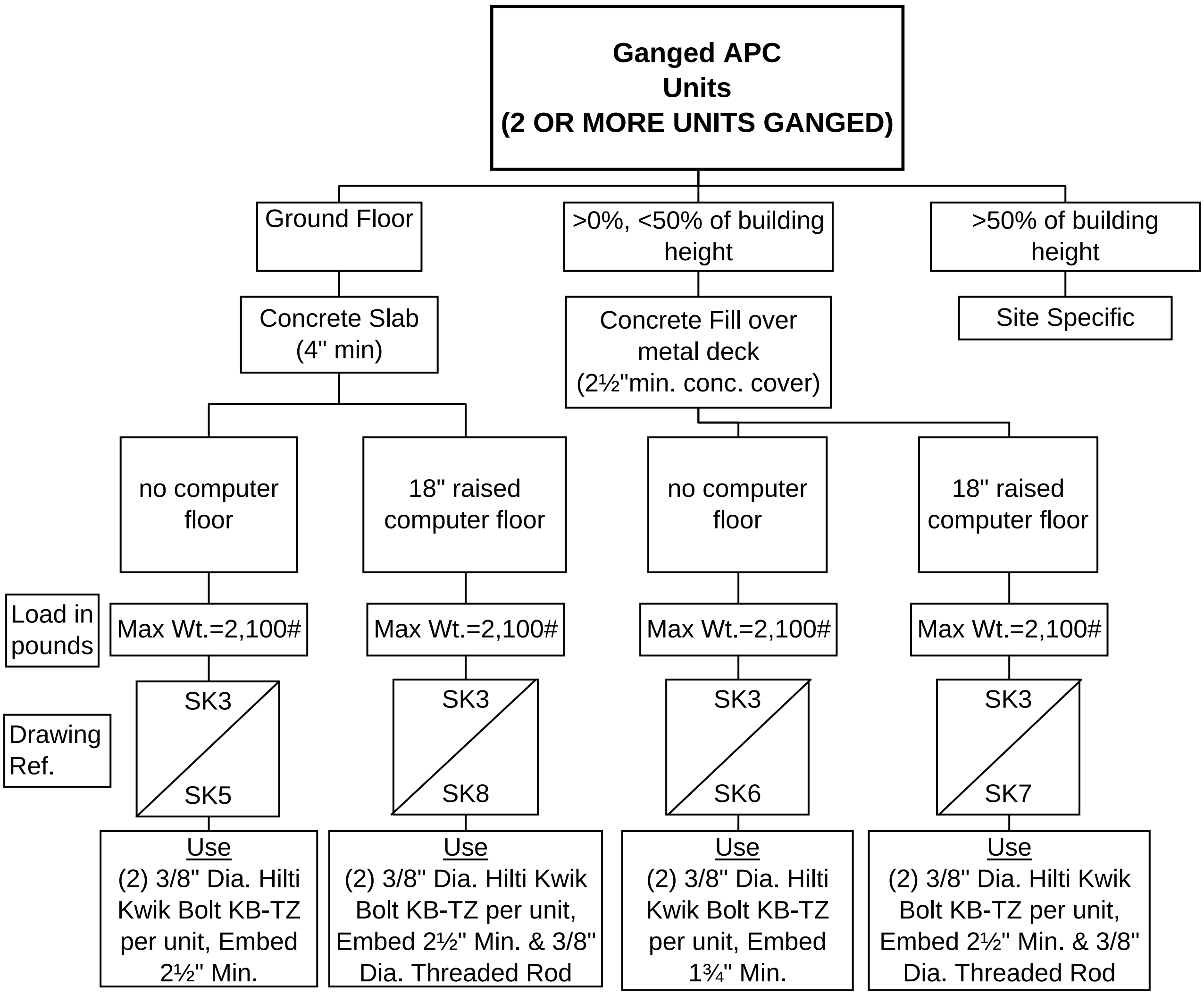
USA

Date 07–11

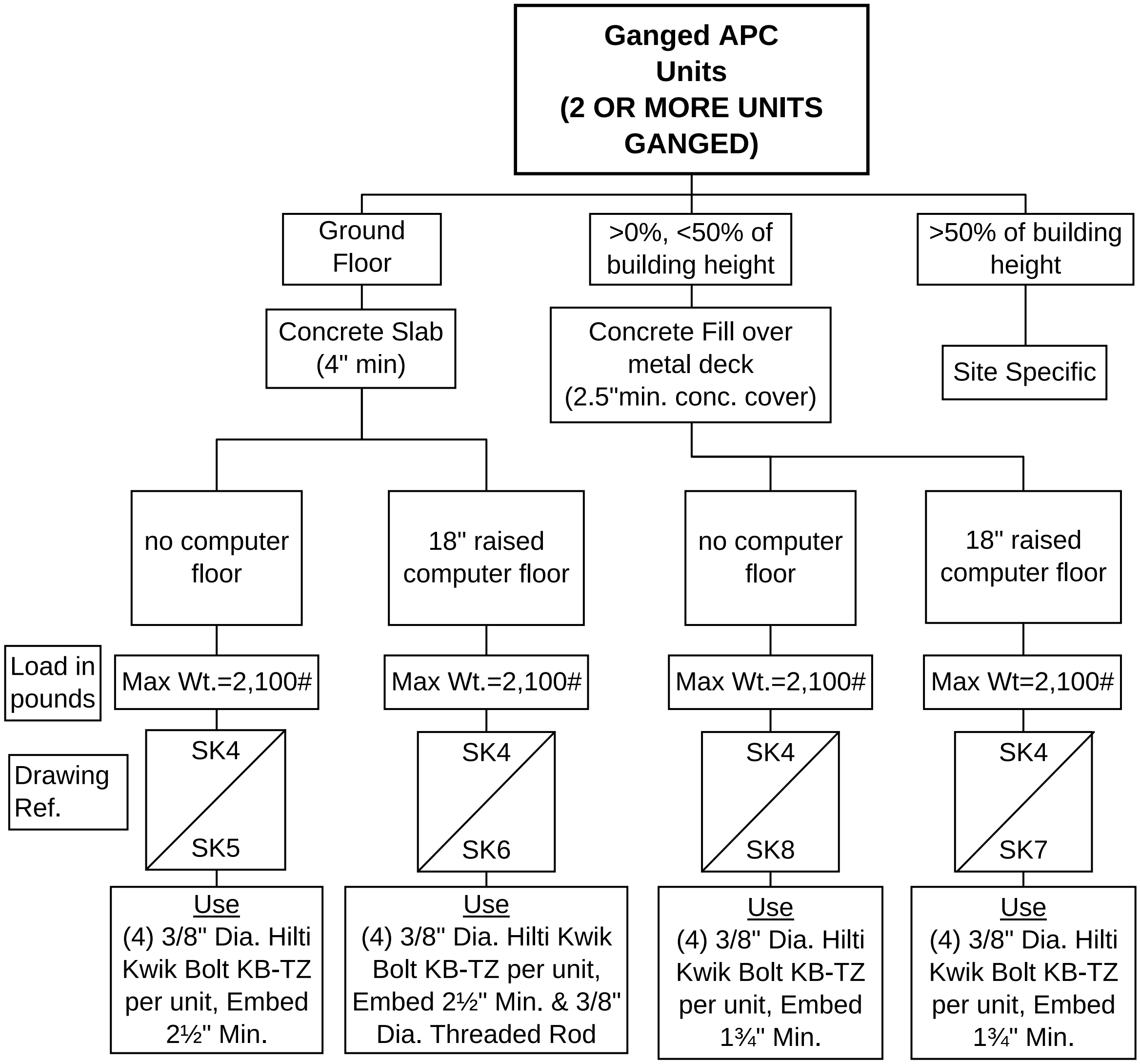
Job No. 11210

Sheet No. 1 OF 1

Low & Moderate Seismic



High Seismic



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Low & Moderate Seismic Calculations

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Find the Seismic Design Category (SDC) **Unit : APC-Unit**

Project Location: Low & Moderate Seismic
Latitude: Varies Longitude: Varies

Soil Classification: D Table 1613.5.2 & Section 1613.5.2
Occupancy Category: II Table 1604.5

Information from U.S. Geological Survey Website
http://earthquake.usgs.gov/research/hazmaps/

S_S=	1.500	g	
S_1=	1.070	g	
F_a=	1.000		Table 1613.5.3(1)
F_v=	1.500		Table 1613.5.3(2)
S_{MS}=	1.50	g	(Equation 16-37)
S_{M1}=	1.61	g	(Equation 16-38)
S_{DS}=	1.000	g	(Equation 16-39)
S_{D1}=	1.070	g	(Equation 16-40)

Seismic Design Category (SDC): **Varies**

Load Case: ***<u>Ganged Unit (Ground floor)</u>***

# of Units ganged (min.)= 2

Single Unit Dimension	
Width(w) (in) =	37.21
Depth(D) (in) =	18
Frame Height (in) =	82
Frame Weight (lb.) =	2,100

			Center of Gravity Location		
Unit	**Part**	**Weight (lbs)**	**X (in)**	**Y (in)**	**Z (in)**
2 - APC-Unit	Frame	4,200	18.0	18.61	41

Seismic Force			
S_{DS} =	1.0	Low & Moderate Seismic	
I_p =	1.0	(Importance)	
a_p =	1.0	(Cabinets)	
R_p =	2.5	(Cabinets)	
z/h =	0.0	(Ground Floor)	
F_p =	0.160	W	
$F_{p,min}$ =	0.30	W	
$F_{p,max}$ =	1.60	W	
Use F_p =	**0.30**	**W**	

Longitudinal Anchorage Spacing (in) = 38.25
Transverse Anchorage Spacing (in) = 37.21

Longitudinal Overturning

Overturning Moment = 0.30 (41 in. x 4200lbs.) = 51,660 lb-in

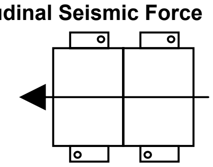
0.9xResisting Moment = 0.9 (4200 lbs. x18 in.)= 68,040 lb-in

Add 30% increase due to 13.4.2. ASCE-7-05

Anchorage Force =	0	lbs
Shear Force =	819	lbs/per bolt

<u>APC-Unit unit Plan</u>

Longitudinal Seismic Force



2 ganged units
Total # of bolts/Unit = 2

Design Bolts for 0 lbs tension, 819 lbs. shear, transverse direction

Transverse Overturning

Overturning Moment = 0.30 (41 in. x 4200lbs.) = 51,660 lb-in

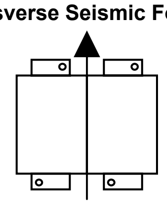
0.9xResisting Moment = 0.9 (4200 lbs x18.605 in.) = 70,327 lb-in

Add 30% increase due to 13.4.2. ASCE-7-05

Anchorage Force =	0	lbs/per bolt
Shear Force =	819	lbs/per bolt

<u>Ganged APC-Unit unit Plan</u>

Transverse Seismic Force



2 ganged units
Total # of bolts/Unit = 2

Design Bolts for 0 lbs tension, 819 lbs. shear, transverse direction

Drawing Reference See: <u>SK2 & SK4</u>

Load Case: ***Ganged units on 18in raised computer floor (Ground Floor)***

# of Units ganged (min.)= 2

Single Unit Dimension

Width(w) (in) =	37.21
Depth(D) (in) =	18
Frame Height (in) =	82
Frame Weight (lb.) =	2,100

Raised Floor = 18 in

Unit	Part	Weight (lbs)	Center of Gravity Location X (in)	Y (in)	Z (in)
2 - APC-Unit	Frame	4,200	18.0	18.605	59

Longitudinal Anchorage Spacing (in) = 38.25
Transverse Anchorage Spacing (in) = 37.21

Seismic Force

S_{DS} =	1.0	Low & Moderate Seismic
I_p =	1.0	(Importance)
a_p =	1.0	(Cabinets)
R_p =	2.5	(Cabinets)
z/h =	0.0	(Ground Floor)
F_p =	0.160	W
$F_{p,min}$ =	0.30	W
$F_{p,max}$ =	1.60	W
Use F_p =	**0.30**	**W**

Longitudinal Overturning

Overturning Moment = 0.3 (59 in. x 4200lbs.) = 74,340 lb-in

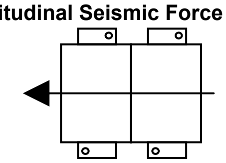
0.9xResisting Moment = 0.9 (4200 lbs. x18 in.)= 68,040 lb-in

Add 30% increase due to 13.4.2. ASCE-7-05

Anchorage Force =	642	lbs/per bolt
Shear Force =	819	lbs/per bolt

Ganged APC-Unit unit Plan

Longitudinal Seismic Force



2 ganged units
Total # of bolts/Unit = 2

Design Bolts for 1 lbs tension, 819 lbs. shear, longitudinal direction

Transverse Overturning

Overturning Moment = 0.3 (59in. x 4200lbs.) = 74,340 lb-in

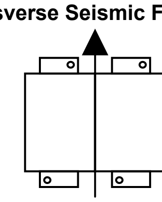
0.9xResisting Moment = 0.9 (4200 lbs x18.605 in.) = 70,327 lb-in

Add 30% increase due to 13.4.2. ASCE-7-05

Anchorage Force =	70	lbs/per bolt
Shear Force =	819	lbs/per bolt

Ganged APC-Unit unit Plan

Transverse Seismic Force



2 ganged units
Total # of bolts/Unit = 2

Design Bolts for 70 lbs tension, 819 lbs. shear, transverse direction

Drawing Reference See: SK2 & SK4

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Load Case: Ganged Unit (≤ 50% of Bldg. Ht.)

# of Units ganged (max)= 2

Single Unit Dimension	
Width(w) (in) =	37.21
Depth(D) (in) =	18
Frame Height (in) =	82
Frame Weight (lb.) =	2,100

			Center of Gravity Location		
Unit	**Part**	**Weight (lbs)**	**X (in)**	**Y (in)**	**Z (in)**
2 - APC-Unit	Frame	4,200	18.0	18.605	41

Longitudinal Anchorage Spacing (in) = 38.25
Transverse Anchorage Spacing (in) = 37.21

Seismic Force		
S_{DS} =	1.0	Low & Moderate Seismic
I_p =	1.0	(Importance)
a_p =	1.0	(Cabinets)
R_p =	2.5	(Cabinets)
z/h =	0.5	(50% of bldg ht.)
F_p =	0.320	W
$F_{p,min}$ =	0.30	W
$F_{p,max}$ =	1.60	W
Use F_p =	**0.32**	**W**

Longitudinal Overturning

Overturning Moment = 0.32 (82/2 in. x 4200lbs.) = 55,104 lb-in

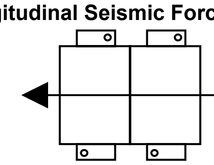
0.9xResisting Moment = 0.9 (4200 lbs. x18 in.)= 68,040 lb-in

Add 30% increase due to 13.4.2. ASCE-7-05

Anchorage Force =	0	lbs
Shear Force =	874	lbs/per bolt

Ganged APC-Unit unit Plan

Longitudinal Seismic Force



2 ganged units
Total # of bolts/Unit = 2

Design Bolts for 0 lbs tension, 874 lbs. shear, longitudinal direction

Transverse Overturning

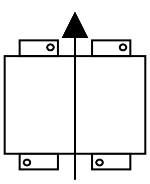
Overturning Moment = 0.32 (82/2 in. x 4200lbs.) = 55,104 lb-in

0.9xResisting Moment = 0.9 (4200 lbs x18.605 in.) = 70,327 lb-in

Add 30% increase due to 13.4.2. ASCE-7-05

Anchorage Force =	0	lbs/per bolt
Shear Force =	874	lbs/per bolt

Ganged APC-Unit unit Plan



2 ganged units
# of bolts per unit = 2

Design Bolts for 00 lbs tension, 874 lbs. shear, transverse direction

Drawing Reference See: SK2 & SK4

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Load Case: ***Ganged units on 18in raised computer floor (≤50% of Bldg. Ht.)***

# of Units ganged (max)= 2

Single Unit Dimension

Width(w) (in) =	37.21
Depth(D) (in) =	18
Frame Height (in) =	82
Frame Weight (lb.) =	2,100

Raised Floor = 18 in

Seismic Force

S_{DS} =	1.0	Low & Moderate Seismic
I_p =	1.0	(Importance)
a_p =	1.0	(Cabinets)
R_p =	2.5	(Cabinets)
z/h =	0.5	(50% of bldg ht.)
F_p =	0.320	W
$F_{p,min}$ =	0.30	W
$F_{p,max}$ =	1.60	W
Use F_p =	**0.32**	**W**

			Center of Gravity Location		
Unit	**Part**	**Weight (lbs)**	**X (in)**	**Y (in)**	**Z (in)**
2 - APC-Unit	Frame	4,200	19.1	18.605	59

Longitudinal Anchorage Spacing (in) = 38.25
Transverse Anchorage Spacing (in) = 37.21

Longitudinal Overturning

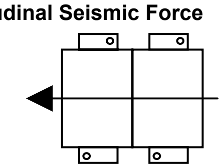
Overturning Moment = 0.32 (59 in. x 4200lbs.) = 79,296 lb-in

0.9xResisting Moment = 0.9 (4200 lbs. x19.125 in.)= 72,293 lb-in

Add 30% increase due to 13.4.2. ASCE-7-05

Anchorage Force =	119	lbs/per bolt
Shear Force =	874	lbs/per bolt

Ganged APC-Unit unit Plan
Longitudinal Seismic Force



2 ganged units
# of bolts per unit = 2

Design Bolts for 0 lbs tension, 874 lbs. shear, longitudinal direction

Transverse Overturning

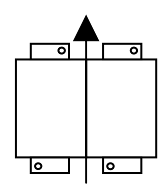
Overturning Moment = 0.3 (59in. x 4200lbs.) = 79,296 lb-in

0.9xResisting Moment = 0.9 (4200 lbs x18.605 in.) = 70,327 lb-in

Add 30% increase due to 13.4.2. ASCE-7-05

Anchorage Force =	157	lbs/per bolt
Shear Force =	874	lbs/per bolt

Ganged APC-Unit unit Plan
Transverse Seismic Force



2 ganged units
# of bolts per unit = 2

Design Bolts for 157 lbs tension, 874 lbs. shear, transverse direction

Drawing Reference See: SK2 & SK4

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High Seismic Calculations

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Find the Seismic Design Category (SDC)

Unit : APC-Unit

Project Location: High Seismic
Latitude: Varies Longitude: Varies

Soil Classification: D Table 1613.5.2 & Section 1613.5.2
Occupancy Category: II Table 1604.5

Information from U.S. Geological Survey Website
http://earthquake.usgs.gov/research/hazmaps/

S_S=	2.750	g	
S_1=	1.070	g	
F_a=	1.000		Table 1613.5.3(1)
F_v=	1.500		Table 1613.5.3(2)
S_{MS}=	2.75	g	(Equation 16-37)
S_{M1}=	1.61	g	(Equation 16-38)
S_{DS}=	1.833	g	(Equation 16-39)
S_{D1}=	1.070	g	(Equation 16-40)

Seismic Design Category (SDC): **Varies**

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Load Case: ***Ganged Unit (Ground floor)***

# of Units ganged (min)= 2

Single Unit Dimension

Width(w) (in) =	37.21
Depth(D) (in) =	18
Frame Height (in) =	82
Max Weight (lb.) =	2,100

			Center of Gravity Location		
Unit	**Part**	**Weight (lbs)**	**X (in)**	**Y (in)**	**Z (in)**
2 - APC-Unit	Frame	4,200	19.13	18.605	41

Seismic Force		
S_{DS} =	1.83	High Seismic
I_p =	1.0	(Importance)
a_p =	1.0	(Cabinets)
R_p =	2.5	(Cabinets)
z/h =	0.0	(Ground Floor)
F_p =	0.293	W
$F_{p,min}$ =	0.55	W
$F_{p,max}$ =	2.93	W
Use F_p =	**0.55**	**W**

Longitudinal Anchorage Spacing (in) = 38.25
Transverse Anchorage Spacing (in) = 37.21

Longitudinal Overturning

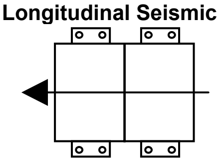
Overturning Moment = 0.55 (41 in. x 4200lbs.) = 94,710 lb-in

0.9xResisting Moment = 0.9 [(4200 lbs. - Vert. Comp.) x19.125 in.]= 45,785 lb-in
Vertical Component (0.2*SDS*Wp) = 1,540 lbs

Add 30% increase due to 13.4.2. ASCE-7-05

Anchorage Force =	831	lbs/per bolt
Shear Force =	751	lbs/per bolt

Ganged APC-Unit unit Plan



2 ganged units
Tot. # of bolts/unit = 4

Design Bolts for 831 lbs tension, 751 lbs. shear, longitudinal direction

Transverse Overturning

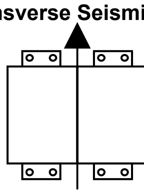
Overturning Moment = 0.55 (41 in. x 4200lbs.) = 94,710 lb-in

0.9xResisting Moment = 0.9 [(4200 lbs - Vert. Comp.) x18.605 in.] = 44,540 lb-in
Vertical Component (0.2*SDS*Wp) = 1,540 lbs

Add 30% increase due to 13.4.2. ASCE-7-05

Anchorage Force =	438	lbs/per bolt
Shear Force =	751	lbs/per bolt

Ganged APC-Unit unit Plan



2 ganged units
Tot. # of bolts/unit = 4

Design Bolts for 438 lbs tension, 751 lbs. shear, transverse direction

Drawing Reference See: SK4 & SK5

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APC
High Seismic

Job No. : 11210 Date: 08/25/11
By: MAS Page: 18

Load Case: ***<u>Ganged units on 18in raised computer floor (Ground floor)</u>***

\# of Units ganged (min)= 2

Raised Floor = 18 in

Single Unit Dimension	
Width(w) (in) =	37.21
Depth(D) (in) =	18
Frame Height (in) =	82
Max Weight (lb.) =	2,100

			Center of Gravity Location		
Unit	**Part**	**Weight (lbs)**	**X (in)**	**Y (in)**	**Z (in)**
2 - APC-Unit	Frame	4,200	19.1	18.605	59

Longitudinal Anchorage Spacing (in) = 38.25

Transverse Anchorage Spacing (in) = 37.21

Seismic Force			
S_{DS} =	1.83	High Seismic
I_p =	1.0	(Importance)
a_p =	1.0	(Cabinets)
R_p =	2.5	(Cabinets)
z/h =	0.0	(Ground Floor)
F_p =	0.293	W
$F_{p,min}$ =	0.55	W
$F_{p,max}$ =	2.93	W
Use F_p =	**0.55**	**W**

Longitudinal Overturning

Overturning Moment = 0.55 (59 in. x 4200lbs.) = 136,290 lb-in

0.9xResisting Moment = 0.9 [(4200 lbs. - Vert. Comp.) x19.125 in.]= 45,785 lb-in

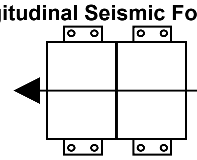
Vertical Component (0.2*SDS*Wp) = 1,540 lbs

Add 30% increase due to 13.4.2. ASCE-7-05

Anchorage Force =	769	lbs/per bolt
Shear Force =	751	lbs/per bolt

<u>Ganged APC-Unit unit Plan</u>

Longitudinal Seismic Force



2 ganged units

\# of bolts per unit = 4

Design Bolts for 769 lbs tension, 751 lbs. shear, longitudinal direction

Transverse Overturning

Overturning Moment = 0.55 (59in. x 4200lbs.) = 136,290 lb-in

0.9xResisting Moment = 0.9 [(4200 lbs - Vert. Comp.) x18.605 in.] = 44,540 lb-in

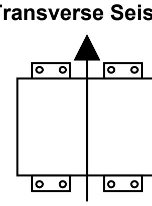
Vertical Component (0.2*SDS*Wp) = 1,540 lbs

Add 30% increase due to 13.4.2. ASCE-7-05

Anchorage Force =	801	lbs/per bolt
Shear Force =	751	lbs/per bolt

<u>Ganged APC-Unit unit Plan</u>

Transverse Seismic Force



2 ganged units

\# of bolts per unit = 4

Design Bolts for 801 lbs tension, 751 lbs. shear, longitudinal direction

Drawing Reference See: <u>SK4 & SK6</u>

Load Case: ***<u>Ganged Unit (≤ 50% of Bldg. Ht.)</u>***

\# of Units ganged (min)= 2

Seismic Force		
S_{DS} =	1.83	High Seismic
I_p =	1.0	(Importance)
a_p =	1.0	(Cabinets)
R_p =	2.5	(Cabinets)
z/h =	0.5	(50% of bldg ht.)
F_p =	0.587	W
$F_{p,min}$ =	0.55	W
$F_{p,max}$ =	2.93	W
Use F_p =	**0.59**	**W**

Single Unit Dimension

Width(w) (in) =	37.21
Depth(D) (in) =	18
Frame Height (in) =	82
Max Weight (lb.) =	2,100

			Center of Gravity Location		
Unit	**Part**	**Weight (lbs)**	**X (in)**	**Y (in)**	**Z (in)**
2 - APC-Unit	Frame	4,200	19.1	18.605	41

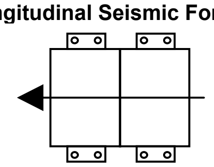
Longitudinal Anchorage Spacing (in) = 38.25
Transverse Anchorage Spacing (in) = 37.21

Longitudinal Overturning

Overturning Moment = 0.59 (41 in. x 4200lbs.) = 101,024 lb-in

0.9xResisting Moment = 0.9 [(4200 lbs. - Vert. Comp.) x19.125 in.]= 45,785 lb-in
Vertical Component (0.2*SDS*Wp) = 1,540 lbs

Ganged APC-Unit unit Plan
Longitudinal Seismic Force



2 ganged units

Add 30% increase due to 13.4.2. ASCE-7-05

Anchorage Force =	469	lbs
Shear Force =	801	lbs/per bolt

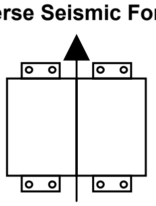
\# of bolts per unit = 4

Design Bolts for 469 lbs tension, 801 lbs. shear, longitudinal direction

Transverse Overturning

Overturning Moment = 0.59 (41 in. x 4200lbs.) = 101,024 lb-in

Ganged APC-Unit unit Plan
Transverse Seismic Force



0.9xResisting Moment = 0.9 [(4200 lbs - Vert. Comp.) x18.605 in.] = 44,540 lb-in
Vertical Component (0.2*SDS*Wp) = 1,540 lbs

2 ganged units

Add 30% increase due to 13.4.2. ASCE-7-05

Anchorage Force =	493	lbs/per bolt
Shear Force =	801	lbs/per bolt

\# of bolts per unit = 4

Design Bolts for 493 lbs tension, 801 lbs. shear, longitudinal direction

Drawing Reference See: <u>SK4 & SK8</u>

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APC
High Seismic

Job No. : 11210   Date: 08/25/11
By: MAS   Page: 20

Load Case: <u>Ganged unit on 18in raised computer floor (≤ 50% of Bldg. Ht.)</u>

\# of Units ganged (min)= 2

Single Unit Dimension	
Width(w) (in) =	37.21
Depth(D) (in) =	18
Frame Height (in) =	82
Max Weight (lb.) =	2,100

Raised Floor = 18 in

Seismic Force		
S_{DS} =	1.83	High Seismic
I_p =	1.0	(Importance)
a_p =	1.0	(Cabinets)
R_p =	2.5	(Cabinets)
z/h =	0.5	(50% of bldg ht.)
F_p =	0.587	W
$F_{p,min}$ =	0.55	W
$F_{p,max}$ =	2.93	W
Use F_p =	**0.59**	**W**

			Center of Gravity Location		
Unit	**Part**	**Weight (lbs)**	**X (in)**	**Y (in)**	**Z (in)**
2 - APC-Unit	Frame	4,200	19.1	18.605	59

Longitudinal Anchorage Spacing (in) = 38.25

Transverse Anchorage Spacing (in) = 37.21

<u>Longitudinal Overturning</u>

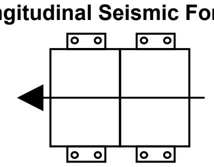
Overturning Moment = 0.59 (59 in. x 4200lbs.) = 145,376 lb-in

0.9xResisting Moment = 0.9 (4200 lbs. x19.125 in.)= 45,785 lb-in

Vert. Comp. (0.2*SDS*Wp)= 1,540 lbs

<u>Ganged APC-Unit unit Plan</u>

Longitudinal Seismic Force



2 ganged units

Add 30% increase due to 13.4.2. ASCE-7-05

Anchorage Force =	846	lbs/per bolt
Shear Force =	801	lbs/per bolt

\# of bolts per unit = 4

Design Bolts for 846 lbs tension, 801 lbs. shear, longitudinal direction

<u>Transverse Overturning</u>

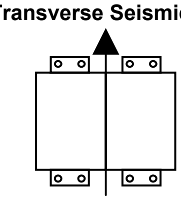
Overturning Moment = 0.59 (59in. x 4200lbs.) = 145,376 lb-in

0.9xResisting Moment = 0.9 [(4200 lbs - Vert. Comp.) x18.605 in.] = 44,540 lb-in

Vertical Component (0.2*SDS*Wp) = 1,540 lb-in

<u>Ganged APC-Unit unit Plan</u>

Transverse Seismic Force



2 ganged units

Add 30% increase due to 13.4.2. ASCE-7-05

Anchorage Force =	881	lbs/per bolt
Shear Force =	801	lbs/per bolt

\# of bolts per unit = 4

Design Bolts for 881 lbs tension, 801 lbs. shear, longitudinal direction

Drawing Reference See: <u>SK4 & SK7</u>

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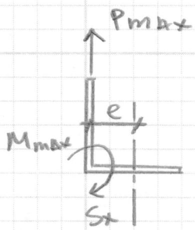
FIND CAPACITY OF SEISMIC BRACKET



$M_{max} = P_{max} \times \frac{L}{2}$

$S_x = \frac{bd^2}{6}$ $\quad b = 4.86''$

$d = 0.12''$

$\phi = 0.75$

Pmax

$\phi F_y = \frac{M}{S_x} \Rightarrow M_{max} = S_x(\phi F_y)$

$P_{max} = \frac{S_x(\phi F_y) \cdot 2}{L}$

$= \frac{\left(\frac{4.86 \times 0.12^2}{6}\right)(0.75 \times 36) \cdot 2}{.84} \times 1.33$

$= 997\#$

MAX DEMAND 967# ∴ (O.K.)

RMJ

Structural Engineers

Robinson
Meier
Juilly & Associates

Principals
Peter Robinson, S.E.
Jayson E. Haines, S.E.

Drawing Details

103 Linden Avenue
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GENERAL NOTES

DESIGN

Design conforms to the International Building Code, 2009 Edition, & the California Building Code, 2010 Edition.

Design live loads:
Importance Factor 1.0
Seismic Design Category (SDC)....D
Ss..............................Varies

Dimensions: refer to rough concrete surfaces, face of studs, face of conc. block, top of sheathing, or top of slab, unless otherwise indicated.

Typical Details: and notes on these sheets shall apply unless specifically shown or noted otherwise. Construction details not fully shown or noted shall be similar to details for similar conditions. All work and construction shall comply with all applicable building codes, regulations, and safety requirements.

Discrepancies: The Contractor shall inform the Architect in writing, during the bidding period, of any discrepancies or omissions noted on the drawings or in the specifications, or of any variations needed in order to conform to codes, rules, and regulations. Upon receipt of such information, the Architect will send written instructions to all concerned. Any such discrepancy, omission, or variation not reported shall be the responsibility of the Contractor, and work shall be performed in a manner as directed by the Architect.

EXISTING CONSTRUCTION

Existing construction shown on the drawings was obtained from existing drawings or field surveys. The Contractor shall verify all existing conditions and shall notify the Architect of all exceptions before proceeding with the work. The removal, cutting, drilling, etc. of existing work shall be performed with great care and small tools in order not to jeopardize the structural integrity of the building. If existing structural members, not indicated for removal, interfere with the new work, the Structural Engineer shall be notified immediately, and approval obtained, before removal of the existing members.

FASTENERS

Wedge Anchors: Hilti Kwik Bolt Wedge Anchor, types as indicated per ICBO evaluation report No. 1917 or by manufacture having current ICBO evaluation report with values Iin shear and tension) equal or greater.

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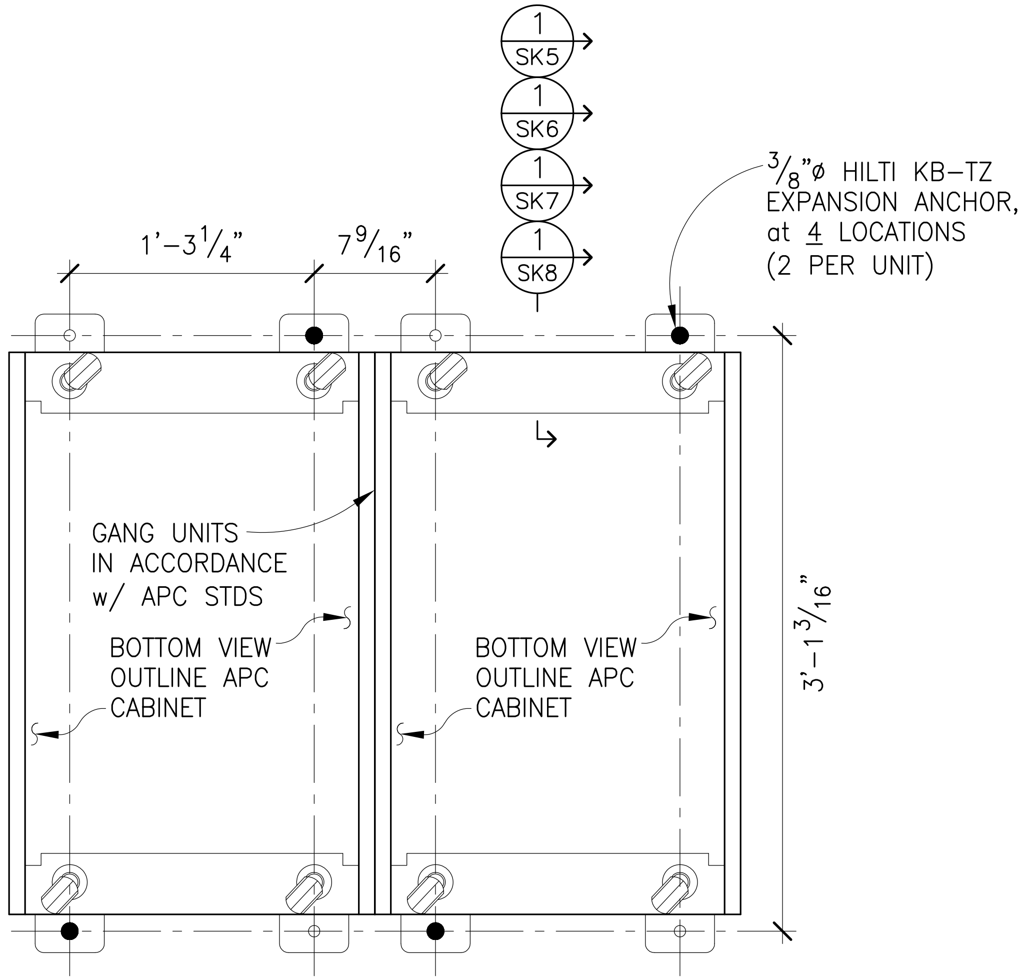
NOTES:
*SEE MANUFACTURE DRAWINGS FOR EXACT DIMENSIONS AND SIZE OF APC UNITS
*UNITS TO HAVE A MAX FRAME WEIGHT OF 2,100 LBS



LOW SEISMIC

GANG UNIT BOTTOM PLAN VIEW
(3 UNITS OR MORE GANGED TOGETHER)

PLAN 1 / SK3
1"=1'-0"

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SYMMETRA & INFRASTRUXURE CABINET ANCHORAGE

USA

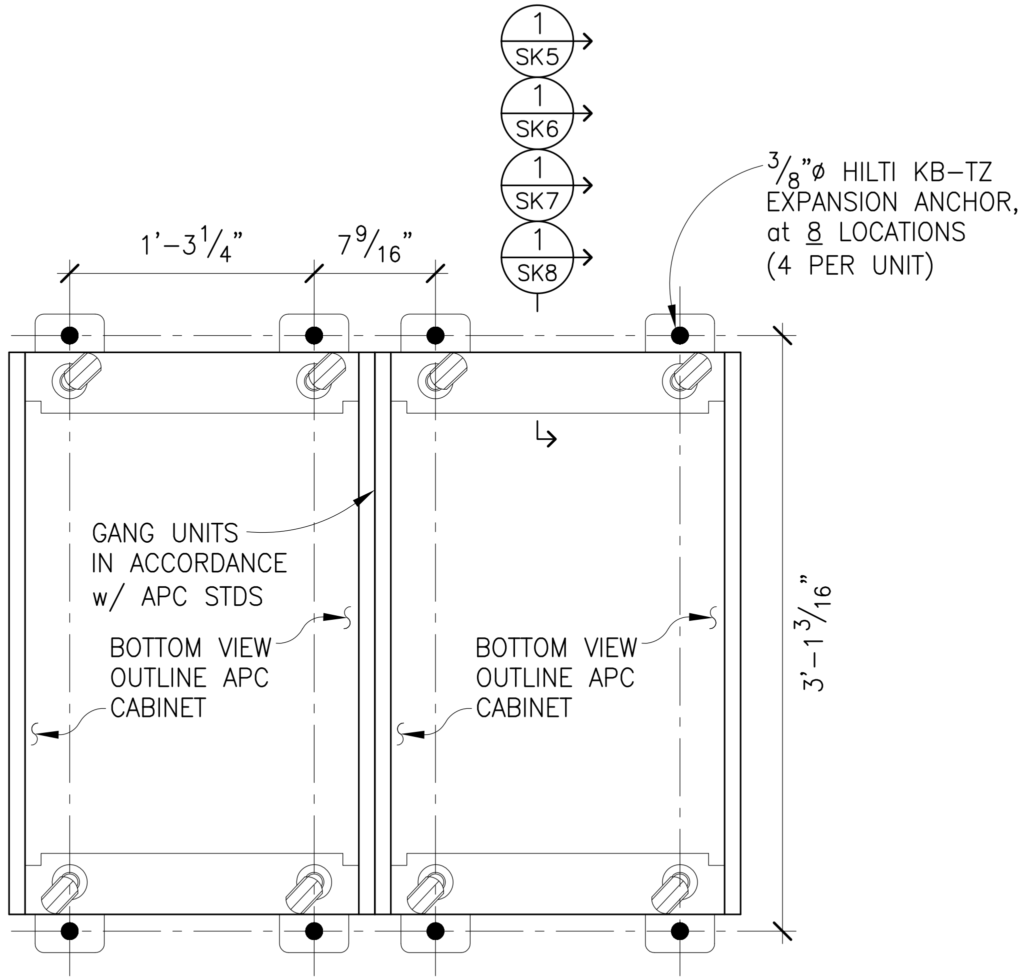
Job No. 11210

Sheet No. SK3

Signed by MAS

Date 7/2011

NOTES:
*SEE MANUFACTURE DRAWINGS FOR EXACT DIMENSIONS AND SIZE OF APC UNITS
*UNITS TO HAVE A MAX FRAME WEIGHT OF 2,100 LBS



HIGH SEISMIC

GANG UNIT BOTTOM PLAN VIEW
(3 UNITS OR MORE GANGED TOGETHER)

PLAN

1"=1'-0"

1 / SK4

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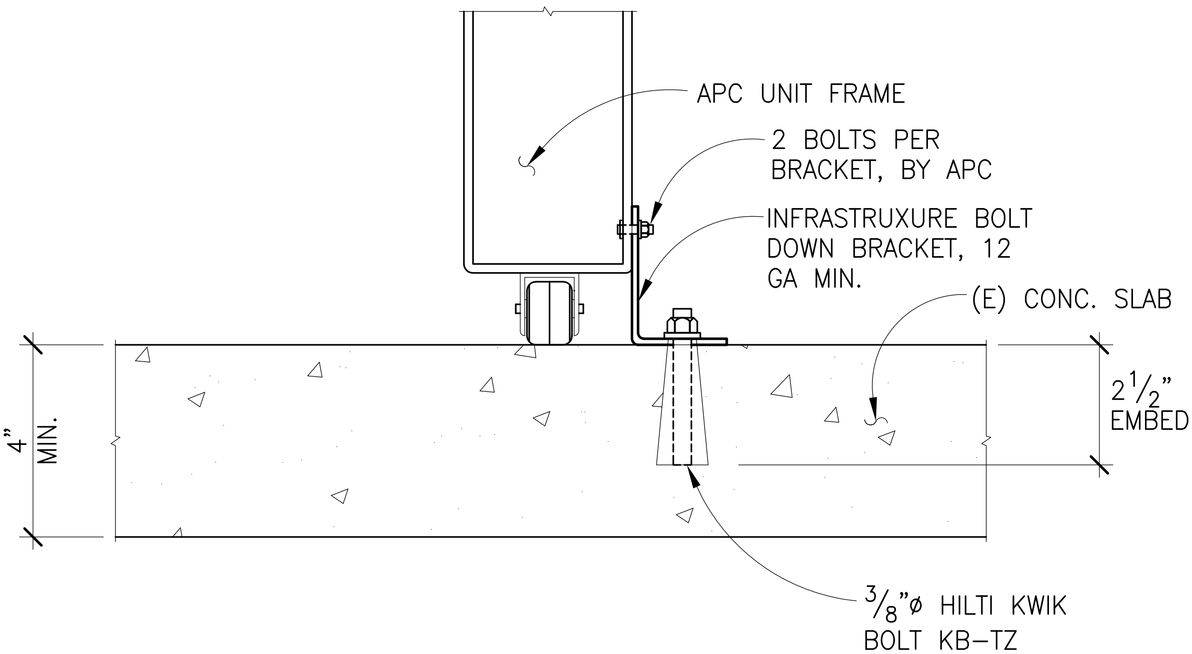
	Signed by MAS — Date 7/2011	



CONCRETE SLAB INSTALLATION

DETAIL 1/SK5

3"=1'-0"

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SYMMETRA & INFRASTRUXURE CABINET ANCHORAGE

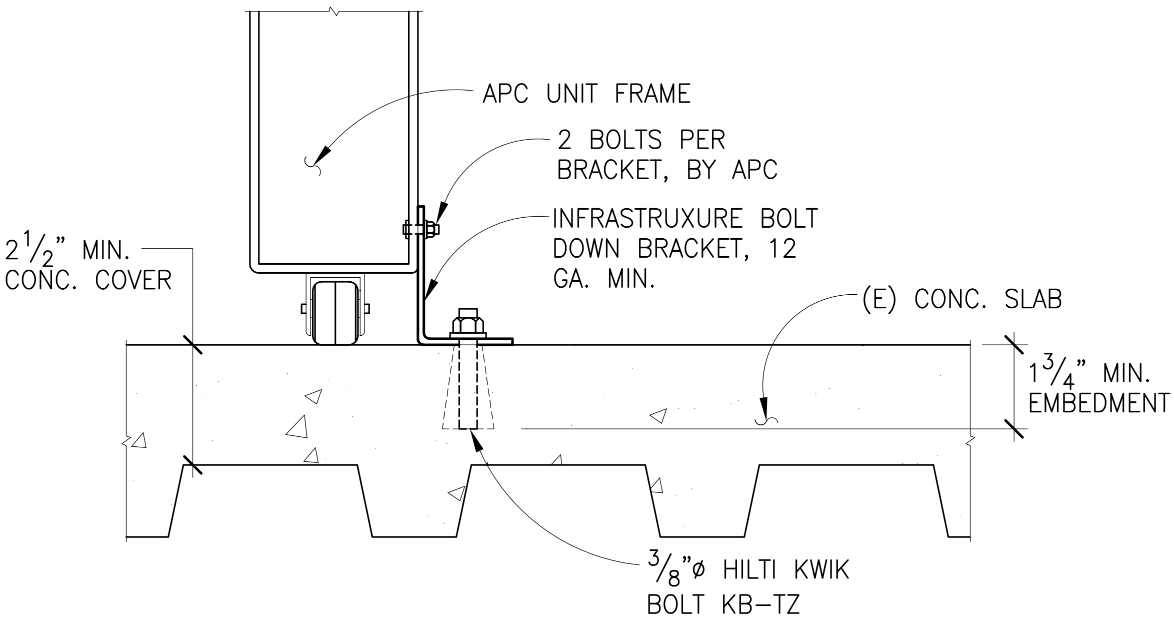
USA

Job No. 11210

Sheet No. SK5

Signed by MAS

Date 7/2011



CONCRETE FILL OVER METAL DECK INSTALLATION

DETAIL 1 / SK6

3"=1'-0"

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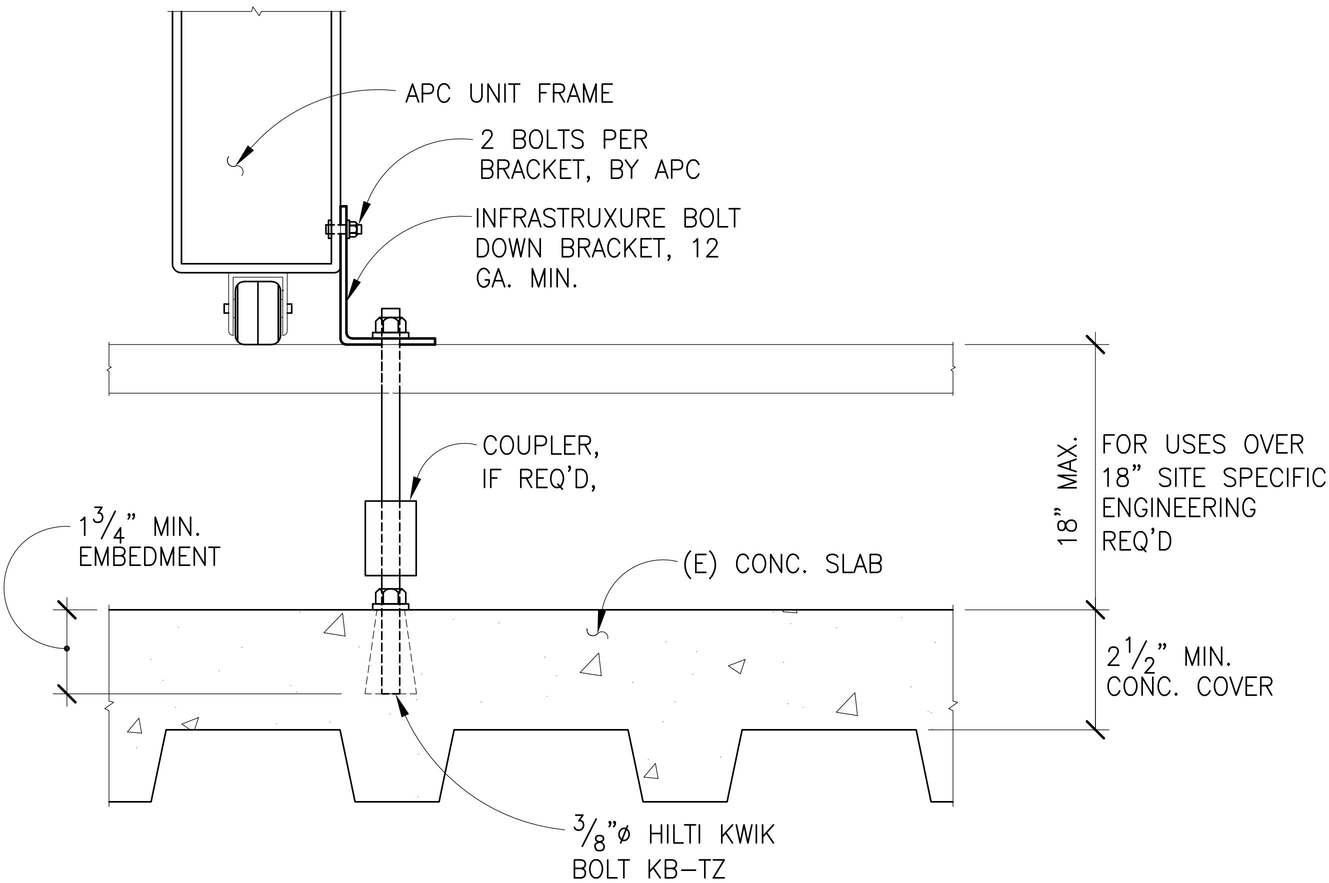
	Signed by MAS — Date 7/2011	



RAISED COMPUTER OVER CONC. FILLED METAL DECK INSTALLATION

DETAIL 1 / SK7

3"=1'-0"

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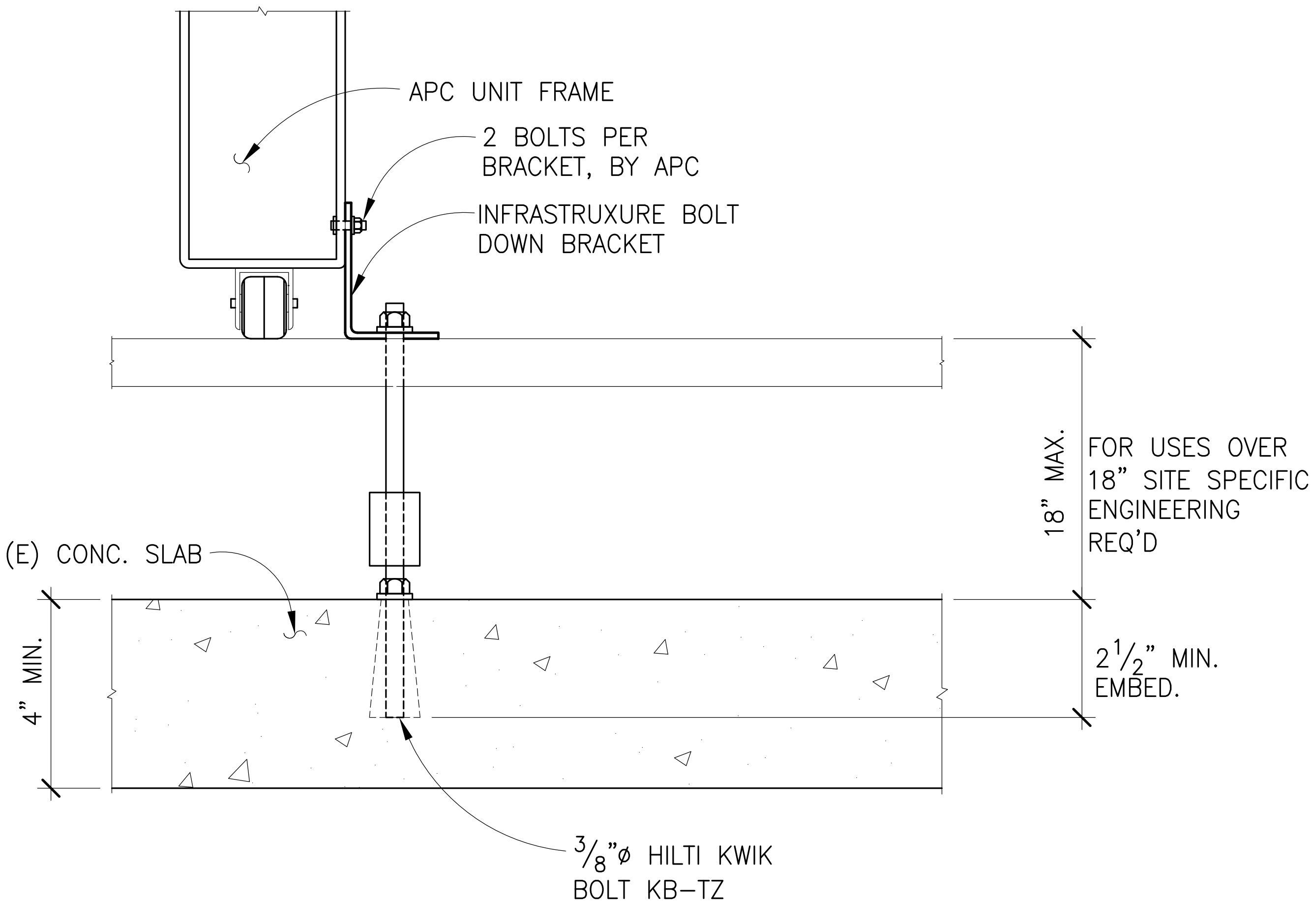
	USA	Sheet No. SK7
	Signed by MAS Date 7/2011	



RAISED COMPUTER OVER CONC. SLAB INSTALLATION

DETAIL 1/SK8

3"=1'–0"

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SYMMETRA & INFRASTRUXURE CABINET ANCHORAGE

USA

Job No. 11210

Sheet No. SK8

Signed by MAS

Date 7/2011

RMJ

Structural Engineers

Robinson
Meier
Juilly & Associates

Principals
Peter Robinson, S.E.
Jayson E. Haines, S.E.

Appendix
(Hilti Output Files)

103 Linden Avenue
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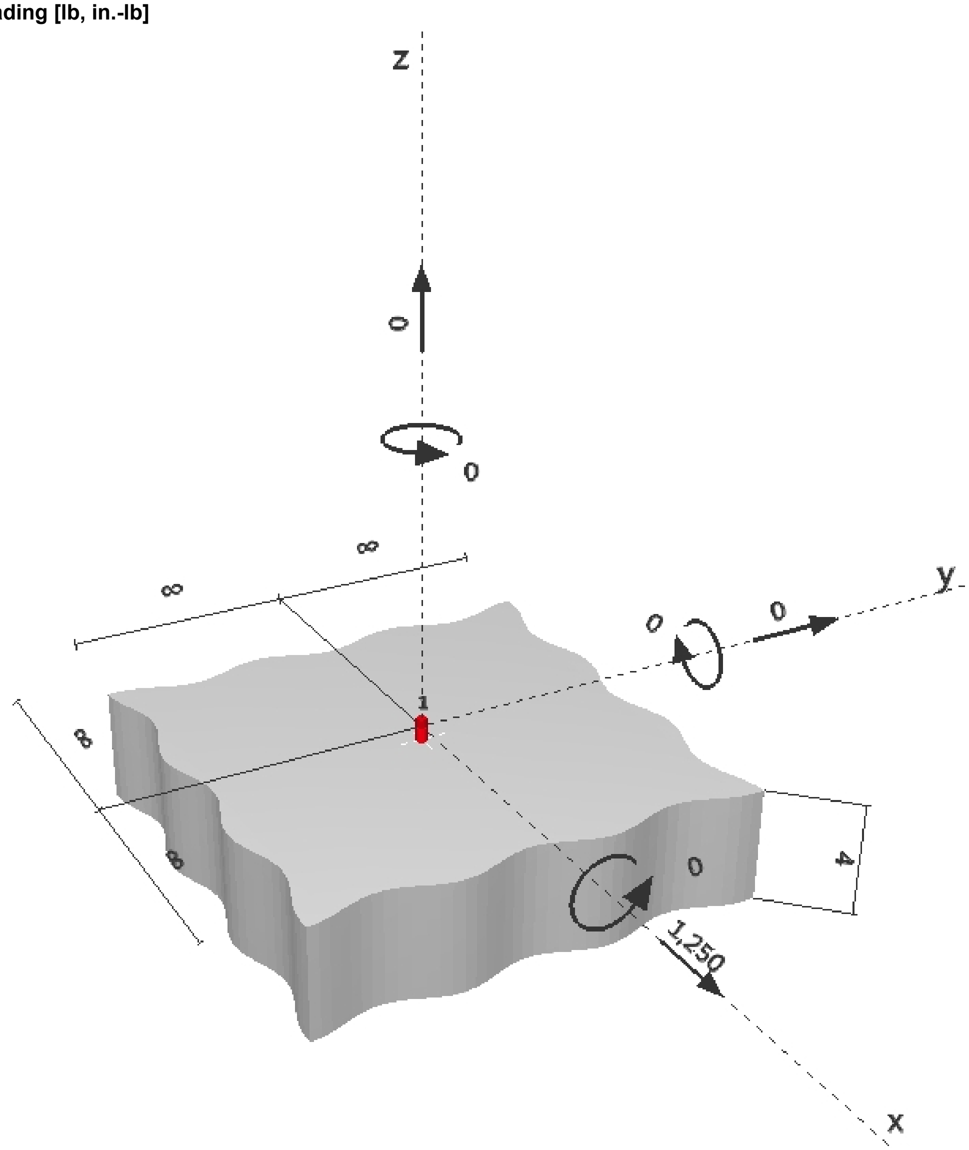
Company:	RMJ & Associates	Page:	1
Specifier:	Mario A. Sigala	Project:	APC Cabinet Anchorag
Address:	103 Linden Ave.	Sub-Project I Pos. No.:	11210
Phone I Fax:	650.871.2282 | 650.871.2459	Date:	8/25/2011
E-Mail:	msigala@rmjse.com		

Specifier's comments: Shear Calculation

1. Input data

Anchor type and diameter:	**Kwik Bolt TZ - CS, 3/8 (2)**
Effective embedment depth:	h_{ef} = 2.000 in., h_{nom} = 2.625 in.
Material:	Carbon Steel
Evaluation Service Report::	ESR 1917
Issued I Valid:	9/1/2009 | -
Proof:	design method ACI 318 / AC 193
Stand-off installation:	- (Recommended plate thickness: not calculated)
Profile	no profile
Base material:	cracked concrete , 2500, f_c' = 2500 psi; h = 4.000 in.
Reinforcement:	tension: condition B, shear: condition B; no supplemental splitting reinforcement present edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F):	yes (D.3.3.6)

Geometry [in.] & Loading [lb, in.-lb]



Company:	RMJ & Associates	Page:	2
Specifier:	Mario A. Sigala	Project:	APC Cabinet Anchorag
Address:	103 Linden Ave.	Sub-Project I Pos. No.:	11210
Phone I Fax:	650.871.2282 | 650.871.2459	Date:	8/25/2011
E-Mail:	msigala@rmjse.com		

2. Load case/Resulting anchor forces

Load case (governing):

Anchor reactions [lb]
Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	0	1250	1250	0

max. concrete compressive strain [‰]: 0.00
max. concrete compressive stress [psi]: 0
resulting tension force in (x/y)=(0.000/0.000) [lb]: 0
resulting compression force in (x/y)=(0/0) [lb]: 0

3. Tension load

Proof	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization β_N [%] = $N_{ua}/\phi N_n$	Status
Steel Strength*	N/A	N/A	N/A	N/A
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Strength**	N/A	N/A	N/A	N/A

* anchor having the highest loading **anchor group (anchors in tension)

4. Shear load

Proof	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization β_V [%] = $V_{ua}/\phi V_n$	Status
Steel Strength*	1250	1466	85	OK
*Steel failure (with lever arm)**	N/A	N/A	N/A	N/A
Pryout Strength**	1250	1262	99	OK
Concrete edge failure in direction**	N/A	N/A	N/A	N/A

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

Steel Strength

Equations

V_{seis} = ESR value	refer to ICC-ES ESR 1917
$\phi V_{steel} \geq V_{ua}$	ACI 318-08 Eq. (D-1)

Variables

n	$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
1	0.05	125000

Calculations

V_{sa} [lb]
2255

Results

V_{sa} [lb]	ϕ_{steel}	ϕV_{sa} [lb]	V_{ua} [lb]
2255	0.650	1466	1250

Company:	RMJ & Associates	Page:	3
Specifier:	Mario A. Sigala	Project:	APC Cabinet Anchorag
Address:	103 Linden Ave.	Sub-Project I Pos. No.:	11210
Phone I Fax:	650.871.2282 | 650.871.2459	Date:	8/25/2011
E-Mail:	msigala@rmjse.com		

Pryout Strength (Concrete Breakout Strength controls)

Equations

$V_{cp} = k_{cp} \left[\left(\frac{A_{Nc}}{A_{Nc0}}\right) \psi_{ed,N}\, \psi_{c,N}\, \psi_{cp,N}\, N_b \right]$ ACI 318-08 Eq. (D-30)

$\phi\, V_{cp} \geq V_{ua}$ ACI 318-08 Eq. (D-1)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\, h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\, e_N'}{3\, h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\, \lambda\, \sqrt{f_c'}\, h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$	c_{ac} [in.]	k_c
1	2.000	0.000	0.000	-	1.000	-	17

λ	f_c' [psi]
1	2500

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
36.00	36.00	1.000	1.000	1.000	1.000	2404

Results

V_{cp} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\, V_{cp}$ [lb]	V_{ua} [lb]
2404	0.700	0.750	1.000	1262	1250

5. Warnings

- Condition A applies when supplementary reinforcement is used. The Φ factor is increased for non-steel Design Strengths except Pullout Strength and Pryout strength. Condition B applies when supplementary reinforcement is not used and for Pullout Strength and Pryout Strength. Refer to ACI 318, Part D.4.4(c).
- Refer to the manufacturer's product literature for cleaning and installation instructions.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI318 or the relevant standard!
- The anchor plate is assumed to be sufficiently stiff in order to be not deformed when subjected to the actions!
- An anchor design approach for structures assigned to Seismic Design Category C, D, E or F is given in ACI 318-08 Appendix D, Part D.3.3.4 that requires the governing design strength of an anchor or group of anchors be limited by ductile steel failure. If this is NOT the case, Part D.3.3.5 requires that the attachment that the anchor is connecting to the structure shall be designed so that the attachment will undergo ductile yielding at a load level corresponding to anchor forces no greater than the controlling design strength. In lieu of D.3.3.4 and D.3.3.5, the minimum design strength of the anchors shall be multiplied by a reduction factor per D.3.3.6.
  An alternative anchor design approach to ACI 318-08, Part D.3.3 is given in IBC 2009, Section 1908.1.9. This approach contains "Exceptions" that may be applied in lieu of D.3.3 for applications involving "non-structural components" as defined in ASCE 7, Section 13.4.2.
  An alternative anchor design approach to ACI 318-08, Part D.3.3 is given in IBC 2009, Section 1908.1.9. This approach contains "Exceptions" that may be applied in lieu of D.3.3 for applications involving "wall out-of-plane forces" as defined in ASCE 7, Equation 12.11-1 or Equation 12.14-10.
- It is the responsibility of the user when inputing values for brittle reduction factors ($\phi_{nonductile}$) different than noted in ACI 318-08, Part D.3.3.6 to determine if they are consistent with the design provisions of ACI 318-08, ASCE 7 and the governing building code.
  Selection of $\phi_{nonductile}$ = 1.0 as a means of satisfying ACI 318-08, Part D.3.3.5 assumes the user has designed the attachment that the anchor is connecting to undergo ductile yielding at a force level <= the design strengths calculated per ACI 318-08, Part D.3.3.3.

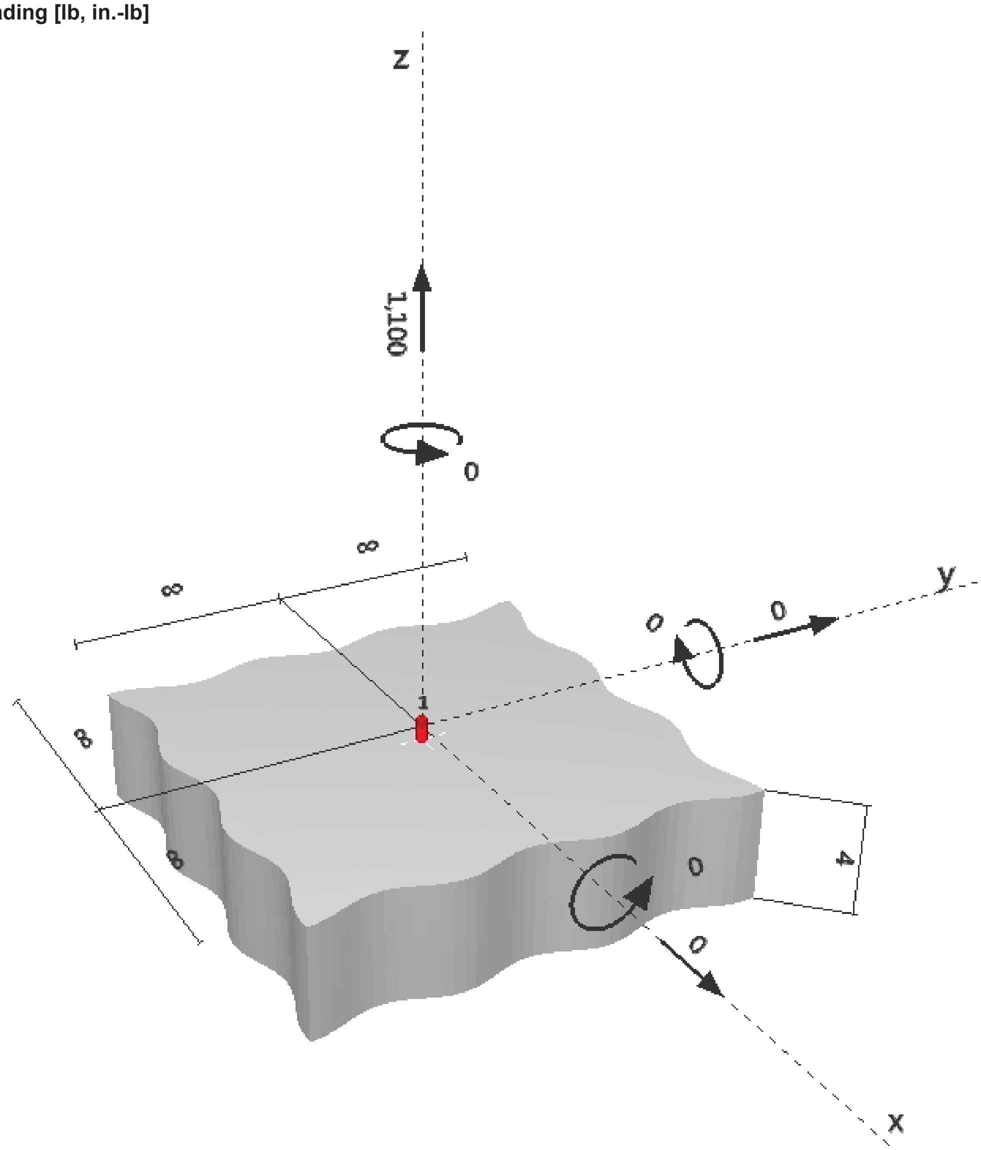
Company:	RMJ & Associates	Page:	1
Specifier:	Mario A. Sigala	Project:	APC Cab. Anchorage
Address:	103 Linden Ave.	Sub-Project I Pos. No.:	11210
Phone I Fax:	650.871.2282 | 650.871.2459	Date:	8/25/2011
E-Mail:	msigala@rmjse.com		

Specifier's comments: Tension Calculation

1. Input data

Anchor type and diameter:	**Kwik Bolt TZ - CS, 3/8 (2)**
Effective embedment depth:	h_{ef} = 2.000 in., h_{nom} = 2.625 in.
Material:	Carbon Steel
Evaluation Service Report::	ESR 1917
Issued I Valid:	9/1/2009 | -
Proof:	design method ACI 318 / AC 193
Stand-off installation:	- (Recommended plate thickness: not calculated)
Profile	no profile
Base material:	cracked concrete , 2500, f_c' = 2500 psi; h = 4.000 in.
Reinforcement:	tension: condition B, shear: condition B; no supplemental splitting reinforcement present edge reinforcement: none or < No. 4 bar
Seismic loads (cat. C, D, E, or F):	yes (D.3.3.6)

Geometry [in.] & Loading [lb, in.-lb]



Company:	RMJ & Associates	Page:	2
Specifier:	Mario A. Sigala	Project:	APC Cab. Anchorage
Address:	103 Linden Ave.	Sub-Project I Pos. No.:	11210
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E-Mail:	msigala@rmjse.com		

2. Load case/Resulting anchor forces

Load case (governing):

Anchor reactions [lb]
Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	1100	0	0	0

max. concrete compressive strain [‰]: 0.00
max. concrete compressive stress [psi]: 0
resulting tension force in (x/y)=(0.000/0.000) [lb]: 1100
resulting compression force in (x/y)=(0/0) [lb]: 0

3. Tension load

Proof	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization β_N [%] = $N_{ua}/\phi N_n$	Status
Steel Strength*	1100	4875	23	OK
Pullout Strength*	1100	1107	99	OK
Concrete Breakout Strength**	1100	1172	94	OK

* anchor having the highest loading **anchor group (anchors in tension)

Steel Strength

Equations

N_{sa} = ESR value refer to ICC-ES ESR 1917
$\phi N_{steel} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

n	$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
1	0.05	125000

Calculations

N_{sa} [lb]
6500

Results

N_{sa} [lb]	ϕ_{steel}	ϕN_{sa} [lb]	N_{ua} [lb]
6500	0.750	4875	1100

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Pullout Strength

Equations

$N_{pn,f'_c} = N_{p,2500}\sqrt{\frac{f'_c}{2500}}$ refer to ICC-ES ESR 1917

$\phi\, N_{pn,f'_c} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

f'_c [psi]	$N_{p,2500}$ [lb]
2500	2270

Calculations

$\sqrt{\frac{f'_c}{2500}}$
1.000

Results

N_{pn,f'_c} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\, N_{pn,f'_c}$ [lb]	N_{ua} [lb]
2270	0.650	0.750	1.000	1107	1100

Concrete Breakout Strength

Equations

$N_{cb} = \left(\frac{A_{Nc}}{A_{Nc0}}\right)\psi_{ed,N}\,\psi_{c,N}\,\psi_{cp,N}\,N_b$ ACI 318-08 Eq. (D-4)

$\phi\, N_{cb} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

A_{Nc} see ACI 318-08, Part D.5.2.1, Fig. RD.5.2.1(b)

$A_{Nc0} = 9\, h_{ef}^2$ ACI 318-08 Eq. (D-6)

$\psi_{ec,N} = \left(\frac{1}{1+\frac{2\,e'_N}{3\,h_{ef}}}\right) \leq 1.0$ ACI 318-08 Eq. (D-9)

$\psi_{ed,N} = 0.7 + 0.3\left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-08 Eq. (D-11)

$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-08 Eq. (D-13)

$N_b = k_c\,\lambda\,\sqrt{f'_c}\,h_{ef}^{1.5}$ ACI 318-08 Eq. (D-7)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$	c_{ac} [in.]	k_c	λ
2.000	0.000	0.000	393.701	1.000	4.375	17	1

f'_c [psi]
2500

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
36.00	36.00	1.000	1.000	1.000	1.000	2404

Results

N_{cb} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\, N_{cb}$ [lb]	N_{ua} [lb]
2404	0.650	0.750	1.000	1172	1100

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4. Shear load

Proof	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization β_V [%] = $V_{ua}/\phi V_n$	Status
Steel Strength*	N/A	N/A	N/A	N/A
*Steel failure (with lever arm)**	N/A	N/A	N/A	N/A
Pryout Strength**	N/A	N/A	N/A	N/A
Concrete edge failure in direction**	N/A	N/A	N/A	N/A

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

5. Warnings

- Condition A applies when supplementary reinforcement is used. The Φ factor is increased for non-steel Design Strengths except Pullout Strength and Pryout strength. Condition B applies when supplementary reinforcement is not used and for Pullout Strength and Pryout Strength. Refer to ACI 318, Part D.4.4(c).
- Refer to the manufacturer's product literature for cleaning and installation instructions.
- Checking the transfer of loads into the base material and the shear resistance are required in accordance with ACI318 or the relevant standard!
- The anchor plate is assumed to be sufficiently stiff in order to be not deformed when subjected to the actions!
- An anchor design approach for structures assigned to Seismic Design Category C, D, E or F is given in ACI 318-08 Appendix D, Part D.3.3.4 that requires the governing design strength of an anchor or group of anchors be limited by ductile steel failure. If this is NOT the case, Part D.3.3.5 requires that the attachment that the anchor is connecting to the structure shall be designed so that the attachment will undergo ductile yielding at a load level corresponding to anchor forces no greater than the controlling design strength. In lieu of D.3.3.4 and D.3.3.5, the minimum design strength of the anchors shall be multiplied by a reduction factor per D.3.3.6.
  An alternative anchor design approach to ACI 318-08, Part D.3.3 is given in IBC 2009, Section 1908.1.9. This approach contains "Exceptions" that may be applied in lieu of D.3.3 for applications involving "non-structural components" as defined in ASCE 7, Section 13.4.2.
  An alternative anchor design approach to ACI 318-08, Part D.3.3 is given in IBC 2009, Section 1908.1.9. This approach contains "Exceptions" that may be applied in lieu of D.3.3 for applications involving "wall out-of-plane forces" as defined in ASCE 7, Equation 12.11-1 or Equation 12.14-10.
- It is the responsibility of the user when inputing values for brittle reduction factors ($\phi_{nonductile}$) different than those noted in ACI 318-08, Part D.3.3.6 to determine if they are consistent with the design provisions of ACI 318-08, ASCE 7 and the governing building code.
  Selection of $\phi_{nonductile}$ = 1.0 as a means of satisfying ACI 318-08, Part D.3.3.5 assumes the user has designed the attachment that the anchor is connecting to undergo ductile yielding at a force level <= the design strengths calculated per ACI 318-08, Part D.3.3.3.

Fastening meets the design criteria!

Design Expansion Anchor

Try: 3/8" ϕ Hilti KB-TZ

$h_{eff} = 1\,3/4"$

Shear Calculation

[Sec. D.6.2]

Conc. Breakout Strength Of Anchor In Shear

*Note: Does not govern

$$V_{cb} = \frac{A_{vc}}{A_{vco}} \cdot \Psi_{ed,v} \cdot \Psi_{c,v} \cdot V_b \text{ [Eq D-21]}$$

[Sec. D.6.3]

Conc. Pryout Strength Of Anchor In Shear

$V_{cp} = K_{cp} \cdot N_{cb} \cdot$ [Eqn. D-29]

$K_{cp} = 1.0$

$N_{cp} = 1{,}968$ # (See Tension Calc.)

$V_{cp} = 1{,}968$ #

$\phi = 0.7$; $\phi_s = 0.75$

$\phi V_{cp} = 1{,}033$ # ← Governs Shear

Steel Strength Of Anchor In Shear [Sec. D.6.1]

$V_{SA} = 3{,}595$ # (Hilti Cat. Pg 319)

$\phi = 0.65$ [D.4.4]

$\phi V_{SA} = 0.75 \times 0.65 \times 3{,}595$ #

$= 1{,}753$ #

Tension

Steel Strength Of Anchor In Tension [Sec. D.5.1]

$N_{sa} = n\, A_{se}\, f_{uta}$ [Eqn. D-3]

$n = 1$; $A_{se} = 0.052\,in^2$ (Hilti Cat. Pg. 319)

$f_{uta} = 125{,}000$ #

$\phi = 0.75$

$\phi N_{sa} = 0.75 \times 0.052\,in^2 \times 125{,}000$ #

$= 4{,}875$ #

Conc. Breakout Strength Of Anchors In Tension [Sec. D.5.2]

$N_{cb} = \frac{A_{nc}}{A_{nco}} \cdot \psi_{ed,N} \cdot \psi_{c,N} \cdot \psi_{cp,N} \cdot N_b$ [Eqn. D-4]

$h_{ef} = 1\,3/4''$

$A_{nco} = A_{NC} = 9 \cdot h_{ef} = 9 \times 1.75^2$

$= 27.6\ in^2$

$\psi_{ed,N} = 1.0$

$\psi_{c,N} = 1.0$ [Eqn. D-10 or D-11]

$\psi_{cp,N} = 1.0$ [Sec. D.5.2.6]

$N_b = k_c \cdot \sqrt{f'_c} \cdot h_{ef}^{1.5}$ [Eqn. D-7]

$k_c = 17$

$N_b = 17 \cdot \sqrt{2500} \cdot 1.75^{1.5}$

$= 1{,}968$ #

$\phi = 0.65$ [D.4.4]

$\phi N_{cb} = 0.75 \times 0.65 \times 1{,}968$ #

$= 959$ #

CONC. PULLOUT STRENGTH OF ANCHOR IN TENSION [SEC. D.5.3.]

$\Phi_n N_{pn,fc} = \Psi_{c,p} \cdot N_p$

$= 0.65 \times 1,460\#$

$= 949\#$ ← GOVERNS TENSION

SIDE FACE BLOWOUT OF ANCHOR IN TENSION [SEC. D.5.4]

ANCHOR NOT CLOSE TO ANY EDGE

STEEL STRENGTH OF ANCHOR IN SHEAR [SEC. D.6.1]

$V_{sa} = n \cdot 0.6 \cdot A_{SE} \cdot f_{uta}$

$= 1.0 \times 0.6 \times 0.052 \times 125,000$

$= 3,900\#$

$\phi V_{sa} = 0.75 \times 0.65 \times 3,900\#$

$= 1,901\#$