THE VMC GROUP

Aeroflex International Isolators | Amber/Booth | Korfund Dynamics | Vibration Mountings & Controls

PROJECT: Yaskawa A1000, P1000, Z1000 VFDs
Yaskawa J1000 & V1000 Microdrives

REP:

ARCHITECT: --

ENGINEER: --

CUSTOMER: YASKAWA

P.O. NUMBER: 4200211053

COMMENTS:

Seismic Parameters:
Sds=2.0
Z/h =1.0

S/O NO.: 267486

DATE: 04/01/2015

VMA NO.: VMA-49850-1A

The VMC Group

Headquarters: 113 Main Street, Bloomingdale, NJ 07403 • Tel: 973-838-1780 • Fax: 973-492-8430

Houston: 11930 Brittmoore Park Dr Houston, TX 77041 • Tel: 713-466-0003 • Fax: 713-466-1355

www.thevmcgroup.com

REV.	DESCRIPTION	SOURCE of CHANGE	DATE
00	Initial Submittal	RJH	4/1/15

SEISMIC ANCHORAGE SUBMITTAL

CUSTOMER: YASKAWA

JOB: YASKAWA VFDS PHASE II OSP & IBCS

P.O. No: 4200211053

The following report has been performed for compliance with the applicable building codes and job specifications.

Applicable Building Code: IBC 2006,2009,2012

The VMC Group
113 Main St
Bloomingdale, NJ 07403

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CAGE CODE	SIZE	DWG NO	REV
4U931		VMA-49850-1A	00

BY	DATE:	SO NO.	SHEET:
RJH	4/1/2015	267486	2 of 76

This report reflects information received and reviewed for seismic restraint as of date shown

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Yaskawa	RJH	4/1/2015		

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Yaskawa	RJH	4/1/2015		

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CERTIFICATE OF LIABILITY INSURANCE

ACORD®

DATE (MM/DD/YYYY): 08/01/2014

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER
Marsh USA, Inc.
1166 Avenue of the Americas
New York, NY 10036

65465-Prof-S-14-15

CONTACT NAME:
PHONE (A/C, No, Ext): **FAX (A/C, No):**
E-MAIL ADDRESS:

INSURER(S) AFFORDING COVERAGE		NAIC #
INSURER A :	Lloyd's Of London	1122000
INSURER B :		
INSURER C :		
INSURER D :		
INSURER E :		
INSURER F :		

INSURED
The VMC Group
113 Main St.
Bloomingdale, NJ 07403

COVERAGES **CERTIFICATE NUMBER:** NYC-006894040-08 **REVISION NUMBER:** 6

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSR	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS	
	GENERAL LIABILITY						EACH OCCURRENCE	$
	COMMERCIAL GENERAL LIABILITY						DAMAGE TO RENTED PREMISES (Ea occurrence)	$
	CLAIMS-MADE / OCCUR						MED EXP (Any one person)	$
							PERSONAL & ADV INJURY	$
							GENERAL AGGREGATE	$
	GEN'L AGGREGATE LIMIT APPLIES PER:						PRODUCTS - COMP/OP AGG	$
	POLICY / PRO-JECT / LOC							$
	AUTOMOBILE LIABILITY						COMBINED SINGLE LIMIT (Ea accident)	$
	ANY AUTO						BODILY INJURY (Per person)	$
	ALL OWNED AUTOS / SCHEDULED AUTOS						BODILY INJURY (Per accident)	$
	HIRED AUTOS / NON-OWNED AUTOS						PROPERTY DAMAGE (Per accident)	$
								$
	UMBRELLA LIAB / OCCUR						EACH OCCURRENCE	$
	EXCESS LIAB / CLAIMS-MADE						AGGREGATE	$
	DED / RETENTION $							$
	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY Y/N						WC STATU-TORY LIMITS / OTH-ER	
	ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? N	N / A					E.L. EACH ACCIDENT	$
	(Mandatory in NH)						E.L. DISEASE - EA EMPLOYEE	$
	If yes, describe under DESCRIPTION OF OPERATIONS below						E.L. DISEASE - POLICY LIMIT	$
A	Manufacturers Engineering			B0621PVMCOO114	08/01/2014	07/01/2015	Limit	3,000,000
A	Design Errors & Omissions			B0621PVMCOO114	08/01/2014	07/01/2015	Limit	3,000,000

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (Attach ACORD 101, Additional Remarks Schedule, if more space is required)
Evidence of Coverage

CERTIFICATE HOLDER

The VMC Group
113 Main St.
Bloomingdale, NJ 07403

CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.

AUTHORIZED REPRESENTATIVE
of Marsh USA Inc.

Chris Gannon

Table 1: Schedule

Item #	Page #	Tag	Sds	Qty.	Mfr.	Model	I_P	z/h	Attachment Method	Equipment Weight (#)	Isolation System		Seismic Restraint		Attachment System	
											Qty. Per Tag	Model	Qty. Per Tag	Model	Qty. Per Tag	
1	16-21	UUT-8	2	1	Yaskawa	N/A	1.5	1.0	Wall Mounted (Steel)	150	--	None	--	As Per Anchor Calculation	4	3/8" dia SAE Grade 8/ ASTM A490 Bolts
									Wall Mounted (Concrete)						4	3/8" Dia. Hilti Kwik Bolt TZ-CS with min. embedment 2"; edge distance of 4" on a 4" thick 4000 Psi Concrete Wall
2	23-29	UUT-9	2	1	Yaskawa	N/A	1.5	1.0	Wall Mounted (Steel)	550	--	None	--	As Per Anchor Calculation	4	3/8" dia SAE Grade 8/ ASTM A490 Bolts
									Wall Mounted (Concrete)						4	3/8" Dia. Hilti Kwik Bolt TZ-CS with min. embedment 2"; edge distance of 4" on a 4" thick 4000 Psi Concrete Wall
3	30-36	UUT-10	2	1	Yaskawa	N/A	1.5	1.0	Floor Mounted (Steel)	850	--	None	--	As Per Anchor Calculation	6	1/2" dia SAE Grade 8/ ASTM A490 Bolts
									Floor Mounted (Concrete)						6	1/2" Dia. Hilti Kwik Bolt TZ-CS with min. embedment 2"; edge distance of 4" on a 4" thick 4000 Psi Concrete Wall
4	37-43	UUT-11	2	1	Yaskawa	N/A	1.5	1.0	Floor Mounted (Steel)	950	--	None	--	As Per Anchor Calculation	4	1/2" dia SAE Grade 8/ ASTM A490 Bolts
									Floor Mounted (Concrete)						4	1/2" Dia. Hilti Kwik Bolt TZ-CS with min. embedment 3.25"; edge distance of 6" on a 6" thick 4000 Psi Concrete Wall

Rev	By	Description	Date
00	RJH	Initial Submission	4/1/15

JOB: Yaskawa VFDs Phase II OSP & IBCS

S.O. No.: 267486

CUSTOMER: Yaskawa

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07403

By	Date	Checked	Date	DWG. NO.	PAGE
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Table 1: Schedule

Item #	Page #	Tag	Sds	Qty.	Mfr.	Model	I_p	z/h	Attachment Method	Equipment Weight (#)	Isolation System		Seismic Restraint		Attachment System	
											Qty. Per Tag	Model	Qty. Per Tag	Model	Qty. Per Tag	
5	44-50	UUT-12	2	1	Yaskawa	N/A	1.5	1.0	Wall Mounted (Steel)	2100	--	None	--	As Per Anchor Calculation	4	1/2" dia SAE Grade 8/ ASTM A490 Bolts
									Wall Mounted (Concrete)						4	1/2" Dia. Hilti Kwik Bolt TZ-CS with min. embedment 3.25"; edge distance of 6" on a 6" thick 4000 Psi Concrete Wall
6	51-57	UUT-13	2	1	Yaskawa	N/A	1.5	1.0	Wall Mounted (Steel)	2200	--	None	--	As Per Anchor Calculation	4	1/2" dia SAE Grade 8/ ASTM A490 Bolts
									Wall Mounted (Concrete)						4	1/2" Dia. HIT-HIY200+HIS-N B7 with min. embedment 5"; edge distance of 8" on a 8" thick 4000 Psi Concrete Wall
7	58-59	UUT-14	2	1	Yaskawa	N/A	1.5	1.0	Wall Mounted (Steel)	70	--	None	--	As Per Anchor Calculation	4	1/4" dia Screws
8	60-61	UUTs 1 & 4	2	2	Yaskawa	N/A	1.5	1.0	Wall Mounted (Steel)	5.3	--	None	--	As Per Anchor Calculation	4	#8 Screws
9	62-63	UUT 2	2	1	Yaskawa	N/A	1.5	1.0	Wall Mounted (Steel)	6.6	--	None	--	As Per Anchor Calculation	4	#8 Screws
10	64-65	UUT 3	2	1	Yaskawa	N/A	1.5	1.0	Wall Mounted (Steel)	20.2	--	None	--	As Per Anchor Calculation	4	1/4" dia Screws

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III. SUMMARY OF CRITICAL ASSUMPTIONS AND DIRECTIVE STATEMENTS:

1. This analysis does not certify that the concrete housekeeping pads, building structure, isolated or restrained equipment, or any other attached equipment, such as piping or ductwork, is capable of handling the applied seismic loads. Any non-VMC Group mounting supports, brackets, or other means of attachment must be independently certified. This calculation only certifies the seismic restraint capability of the VMC Group supplied mounting equipment and the attachment of the equipment.

2. Weight and dimensional data was provided by the customer. Information not provided for in the job specification must be verified by the building engineer. The values used in this analysis should be verified. If they vary, disregard these recommendations and notify The VMC Group of the changes.

3. All accessory attachments (pipe, conduit, etc.) to the equipment shall be attached in a manner that allows relative motion (flex, swing joint/elbow, etc.) to prevent failure due to differential movement between the equipment and attached accessory caused by seismic loading on the system.

4. Unless noted on the drawings, all drawings in this report are considered not to scale.

5. All housekeeping pads must be properly dowelled and reinforced by others to carry the seismic loads.

6. When several pieces of equipment are installed identically, the most critical one is analyzed.

7. When installing concrete expansion anchors, the anchors shall be torqued to manufacturer recommended settings to ensure maximum holding capacity in the concrete. Observe concrete edge distance and anchor spacing limitations as expressed by the anchor manufacturer or ICC-ES rating publication. For anchors installed in the underside of the slab, embedment depth must be at least one half of the slab thickness to ensure the anchor is embedded in the compression zone of the slab.

8. If isolators are supplied by The VMC Group it has been assumed that the structure supporting the isolators has a stiffness ten (10) times that of the isolator or three (3) times the natural frequency of the isolators. The equipment itself and any steel structure between the equipment and the isolators are considered rigid for calculation purposes.

IV. PURPOSE:

This report is submitted to Yaskawa for the Yaskawa VFDs Phase II OSP & IBCS project to verify that the seismic/ wind restraints provided and/or recommended by The VMC Group will safely accept loads applied from seismic forces and normal operating loads. For equipment isolated by The VMC Group, this report verifies adequate isolation per the job specification.

V. SCOPE:

This report covers only seismic restraints, isolators, and engineering recommendations provided by The VMC Group for use as listed in Table I.

This report does not cover equipment supplied by other vendors. The structural design professional must verify the adequacy of the superstructure or substructure to which The VMC Group components or specified hardware are attached. The structure must withstand the seismic loads applied at restraint locations.

The following report has been performed for compliance with the applicable building codes and job specification. If there are any specifications or information that supersede the assumptions made herein, this analysis may be invalid, and The VMC Group must be notified for review of changes.

VI. STRATEGY AND ASSUMPTIONS:

For the purposes of this analysis, it must be assumed that the building and its internal structure have been designed to perform as required by the adopted building code in response to an earthquake and remain intact and functioning after such an event. Per code the equipment must be restrained and not break away from its supports during an earthquake. The forces acting on a piece of equipment are the vertical and lateral forces resulting from the earthquake, the force of gravity, and the forces at the restraints that hold the equipment in place. The analysis assumes that the equipment does not move beyond the restraints during the earthquake. The acceleration at its center of gravity generate forces that must be balanced by reactions at the restraints. The code allows equipment to be analyzed as though it were a rigid component; however, factors (a_p, R_p) are applied within the computation to address flexibility issues for particular equipment types or flexible mounting arrangements. Given the above, the problem can be reduced to a static analysis.

The forces acting on the restraints include both shear and tensile components. The application direction of the lateral seismic acceleration can vary and is unknown. Depending on its direction, it is likely that not all of the restraints will be affected or share the load equally. This report will determine the worst case combination of forces at all restraint points for any possible direction that the acceleration can follow to ensure that the restraints are adequate.

It is assumed that the equipment is designed to be strong enough to transfer the load from its center of gravity to the restraint connection points without failure. Under some instances (particularly those relating to life support issues in hospital settings) code requirements indicate that critical equipment must be seismically qualified to ensure its continued operation after a seismic event. Special care must be taken in these situations to ensure that the equipment has been certified to meet the maximum anticipated seismic load.

VII. ALLOWABLE LOADS:

Unless otherwise specified, allowable bolt loads are per the Manual of Steel Construction - AISC 13th Edition. All concrete is assumed to be 4000 psi.

For The VMC Group products: Ratings are per test and/or analysis.
For Concrete Anchors: Ratings are per ICC ESR reports or Hilti Profis

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VIII-a-i.SEISMIC INPUT FORCES - ASD

These calculations certify that the VMC components and specified hardware, when properly installed, are capable of safely supporting a maximum seismic load based upon the ASD load combinations from ASCE – 7-05 :

1.0D(+/-) 0.7E
0.6D(+/-) 0.7E

Where:

$E= pQ_E(+/-).2S_{ds}D$
p= Reliability factor: taken as 1.0 for mechanical and electrical components
Q_E = horizontal seismic force F_p
S_{DS}= Design spectral response
D= Dead load
($0.2S_{DS}D$ is taken in the vertical direction)

Final Seismic Loading Conditions:

1: Vertical Load (P_z) = $(1.0 + 0.7*0.2*S_{DS})$ Horizontal Load (P_h) = $0.7*F_p$
2: Vertical Load (P_z) = $(0.6 - 0.7*0.2*S_{DS})$ Horizontal Load (P_h) = $0.7*F_p$

Horizontal Seismic Force per equation 13.3-1 (ASCE 7):

$$F_p = \frac{0.4*a_p*S_{DS}*(1+2(z/h))}{(R_p/I_p)} *W_p$$

Where:
a_p = The attachment amplification factor
S_{DS} = Design Spectral Response Acc. at short period
S_{MS} = Max Earthquake Spectral Response Acc. for Short Period
F_a = Site Coefficient (Use "D" if unknown)
S_s = Mapped Spectral Acc. for Short Period
z = Height of the equipment attachment to structure.
h = Average Roof Height
R_p = Component Response Modification factor
I_p = Component Importance factor
W_p = The operating weight of the system

And: $S_{DS} = (2/3)*S_{MS}$ $S_{MS} = F_a*S_s$

VIII-a-ii. SEISMIC INPUT FORCES: (ASD for use with Steel Anchor Calculation)

The building is an Occupancy Category **IV** Ss = **3.00**

Site class = **D** Therefore use Seismic Design Category **D**

From the appropriate tables: Fa = **1.00** Sds = **2.0**

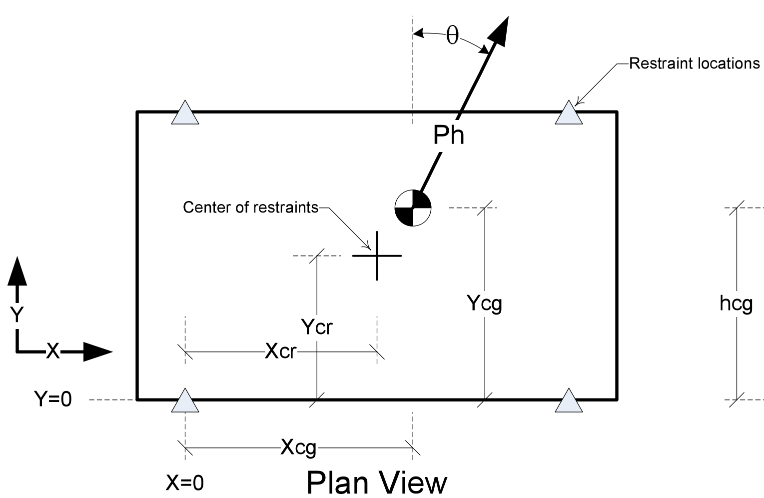
For:	**ap =**	**2.5**	ap =	2.5	ap =	2.5	ap =	2.5
	Rp =	**6**	Rp =	2	Rp =	6	Rp =	2
	Ip =	**1.5**	Ip =	1.5	Ip =	1.5	Ip =	1
At:	z/h =	Fp =	z/h =	Fp =	z/h =	Fp =	z/h =	Fp =
	0.0	0.50 g's	0.0	1.50 g's	0.0	0.50 g's	0.0	1.00 g's
	0.2	0.70 g's	0.2	2.10 g's	0.2	0.70 g's	0.2	1.40 g's
	0.4	0.90 g's	0.4	2.70 g's	0.4	0.90 g's	0.4	1.80 g's
	0.6	1.10 g's	0.6	3.30 g's	0.6	1.10 g's	0.6	2.20 g's
	0.8	1.30 g's	0.8	3.90 g's	0.8	1.30 g's	0.8	2.60 g's
	1.0	1.50 g's	1.0	4.50 g's	1.0	1.50 g's	1.0	3.00 g's

Satisfying the upper and lower bounds: At Ip = 1.5, Fp Min = 0.90 g's At Ip = 1, Fp Min = 0.60 g's

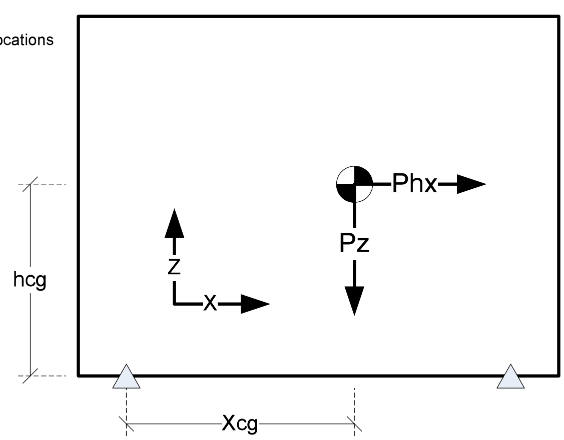
0.3*Sds*Ip*Wp < Fp < 1.6*Sds*Ip*Wp At Ip = 1.5, Fp Max = 4.80 g's At Ip = 1, Fp Max = 3.20 g's

Table 2

	At z/h =	**Ph**	**Pz**	Ph	Pz	Ph	Pz	Ph	Pz
Condition 1	0.0	0.63 g's	1.28 g's	1.05 g's	1.28 g's	0.63 g's	1.28 g's	0.70 g's	1.28 g's
	0.2	0.63 g's	1.28 g's	1.47 g's	1.28 g's	0.63 g's	1.28 g's	0.98 g's	1.28 g's
	0.4	0.63 g's	1.28 g's	1.89 g's	1.28 g's	0.63 g's	1.28 g's	1.26 g's	1.28 g's
	0.6	0.77 g's	1.28 g's	2.31 g's	1.28 g's	0.77 g's	1.28 g's	1.54 g's	1.28 g's
	0.8	0.91 g's	1.28 g's	2.73 g's	1.28 g's	0.91 g's	1.28 g's	1.82 g's	1.28 g's
	1.0	**1.05 g's**	**1.28 g's**	3.15 g's	1.28 g's	1.05 g's	1.28 g's	2.10 g's	1.28 g's
Condition 2	0.0	0.63 g's	0.32 g's	1.05 g's	0.32 g's	0.63 g's	0.32 g's	0.70 g's	0.32 g's
	0.2	0.63 g's	0.32 g's	1.47 g's	0.32 g's	0.63 g's	0.32 g's	0.98 g's	0.32 g's
	0.4	0.63 g's	0.32 g's	1.89 g's	0.32 g's	0.63 g's	0.32 g's	1.26 g's	0.32 g's
	0.6	0.77 g's	0.32 g's	2.31 g's	0.32 g's	0.77 g's	0.32 g's	1.54 g's	0.32 g's
	0.8	0.91 g's	0.32 g's	2.73 g's	0.32 g's	0.91 g's	0.32 g's	1.82 g's	0.32 g's
	1.0	**1.05 g's**	**0.32 g's**	3.15 g's	0.32 g's	1.05 g's	0.32 g's	2.10 g's	0.32 g's



Plan View



Elevation View

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VIII-b-i. SEISMIC INPUT FORCES-LRFD

These calculations certify that the VMC components and specified hardware, when properly installed, are capable of safely supporting a maximum seismic load based upon the LRFD load combinations from the building code or ASCE-7-05:

1.2D(+/-) 1.0E
0.9D(+/-) 1.0E

Where:

$E = \rho Q_E (+/-) 0.2 S_{DS} D$
ρ= Reliability factor: taken as 1.0 for mechanical and electrical components
Q_E = horizontal seismic force Fp
S_{DS}= Design spectral responce
D= Dead load
($0.2S_{DS}D$ is taken in the vertical direction)

Final Seismic Loading Conditions:

1: Vertical Load (Pz) = (1.2 + 1.0*0.2*Sds) Horizontal Load (Px) = 1.0*Fp
2: Vertical Load (Pz) = (0.9 – 1.0*0.2*Sds) Horizontal Load (Px) = 1.0*Fp

Horizontal Seismic Force per equation 13.3-1 (ASCE-7):

$$Fp = \frac{0.4 \cdot ap \cdot Sds \cdot (1+2(z/h))}{(Rp/Ip)} \cdot Wp$$

Where: ap = The attachment amplification factor
S_{DS} = Design Spectral Response Acc. at short period
S_{MS} = Max Earthquake Spectral Response Acc. for Short Period
Fa = Site Coefficient (Use "D" if unknown)
Ss = Mapped Spectral Acc. for Short Period
z = Height of the equipment attachment to structure.
h = Average Roof Height
Rp = Component Response Modification factor
Ip = Component Importance factor
Wp = The operating weight of the system

And: S_{DS} = (2/3)*Sms S_{MS} = Fa*Ss

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VIII-b-ii. SEISMIC INPUT FORCES: (LRFD for use with Concrete Anchor Calculation)

The building is an Occupancy Category IV   Ss = **3.00**

Site class = D   Therefore use Seismic Design Category D

From the appropriate tables: Fa = **1.00**   Sds = **2.00**

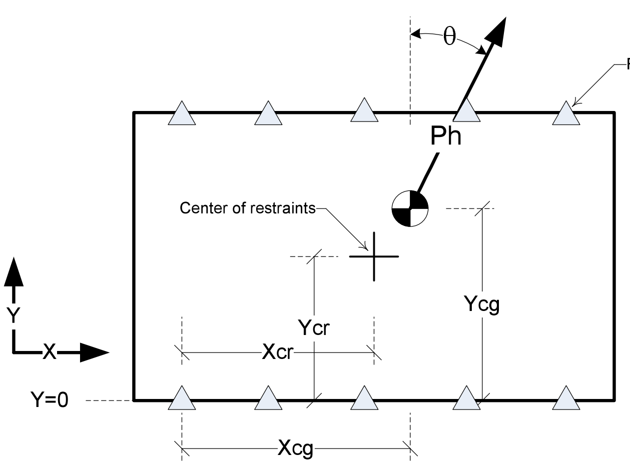
For:	**ap = 2.5**		ap = 2.5		ap = 1.0		ap = 1.0	
	Rp = 6		Rp = 6		Rp = 2.5		Rp = 2.5	
	Ip = 1.5		Ip = 1.5		Ip = 1.5		Ip = 1	
At:	z/h =	Fp =	z/h =	Fp =	z/h =	Fp =	z/h =	Fp =
	0.0	0.50 g's	0.0	0.50 g's	0.0	0.48 g's	0.0	0.32 g's
	0.2	0.70 g's	0.2	0.70 g's	0.2	0.67 g's	0.2	0.45 g's
	0.4	0.90 g's	0.4	0.90 g's	0.4	0.86 g's	0.4	0.58 g's
	0.6	1.10 g's	0.6	1.10 g's	0.6	1.06 g's	0.6	0.70 g's
	0.8	1.30 g's	0.8	1.30 g's	0.8	1.25 g's	0.8	0.83 g's
	1.0	1.50 g's	1.0	1.50 g's	1.0	1.44 g's	1.0	0.96 g's

Satisfying the upper and lower bounds: At Ip = 1.5, Fp Min = 0.90 g's   At Ip = 1, Fp Min = 0.90 g's

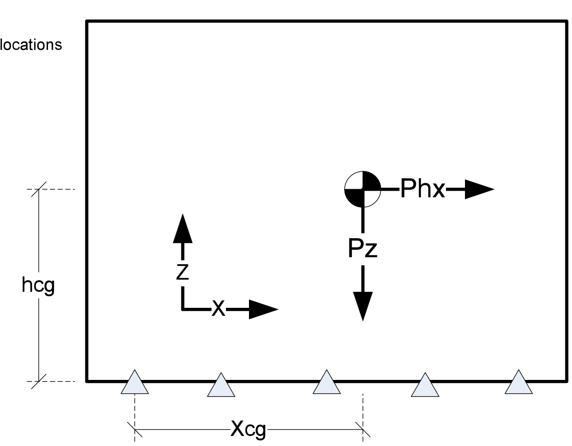
0.3*Sds*Ip*Wp < Fp < 1.6*Sds*Ip*Wp   At Ip = 1.5, Fp Max = 4.80 g's   At Ip = 1, Fp Max = 4.80 g's

Table 2

	At z/h =	Ph	Pz	Ph	Pz	Ph	Pz	Ph	Pz
Condition 1	0.0	0.90 g's	1.60 g's	0.90 g's	1.60 g's	0.90 g's	1.60 g's	0.90 g's	1.60 g's
	0.2	0.90 g's	1.60 g's	0.90 g's	1.60 g's	0.90 g's	1.60 g's	0.90 g's	1.60 g's
	0.4	0.90 g's	1.60 g's	0.90 g's	1.60 g's	0.90 g's	1.60 g's	0.90 g's	1.60 g's
	0.6	1.10 g's	1.60 g's	1.10 g's	1.60 g's	1.06 g's	1.60 g's	0.90 g's	1.60 g's
	0.8	1.30 g's	1.60 g's	1.30 g's	1.60 g's	1.25 g's	1.60 g's	0.90 g's	1.60 g's
	1.0	**1.50 g's**	**1.60 g's**	1.50 g's	1.60 g's	1.44 g's	1.60 g's	0.96 g's	1.60 g's
Condition 2	0.0	0.90 g's	0.50 g's	0.90 g's	0.50 g's	0.90 g's	0.50 g's	0.90 g's	0.50 g's
	0.2	0.90 g's	0.50 g's	0.90 g's	0.50 g's	0.90 g's	0.50 g's	0.90 g's	0.50 g's
	0.4	0.90 g's	0.50 g's	0.90 g's	0.50 g's	0.90 g's	0.50 g's	0.90 g's	0.50 g's
	0.6	1.10 g's	0.50 g's	1.10 g's	0.50 g's	1.06 g's	0.50 g's	0.90 g's	0.50 g's
	0.8	1.30 g's	0.50 g's	1.30 g's	0.50 g's	1.25 g's	0.50 g's	0.90 g's	0.50 g's
	1.0	**1.50 g's**	**0.50 g's**	1.50 g's	0.50 g's	1.44 g's	0.50 g's	0.96 g's	0.50 g's



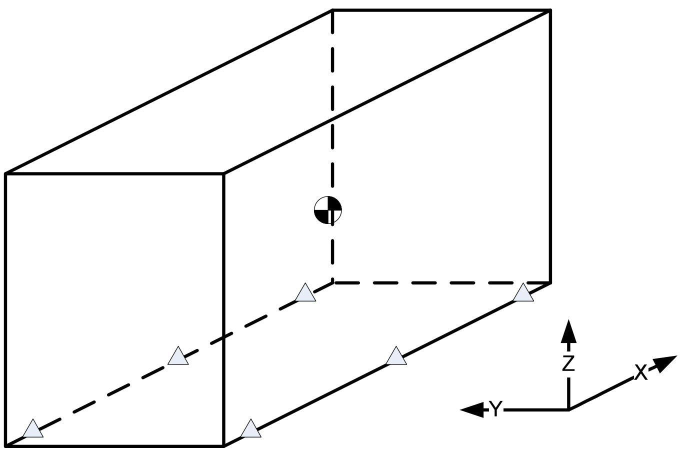
Plan View

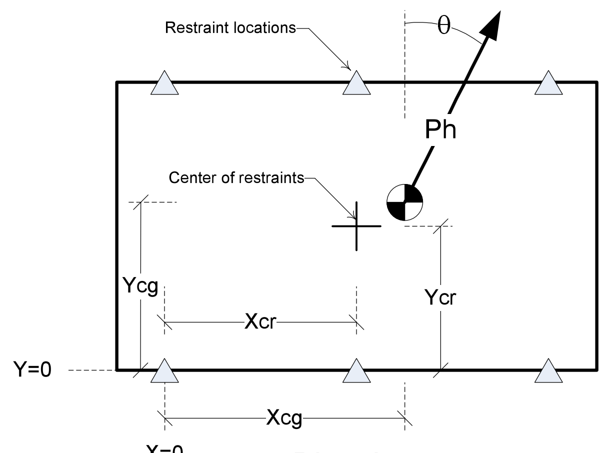


Elevation View

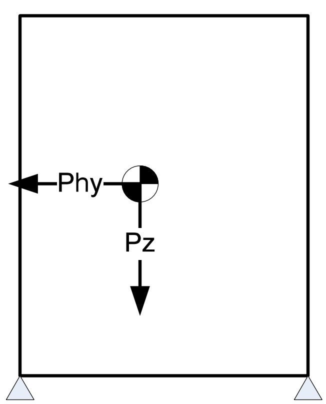
IX. ANALYSIS METHODOLOGY

These calculations follow a similar procedure as set out in ASHRAE Applications Chapter 54. Moments are taken about the center of restraints to create a free-body diagram of the restrained equipment, which is assumed to be rigid. This yields the maximum reaction loads. The calculation spreadsheet that follows uses these dimensions shown here.

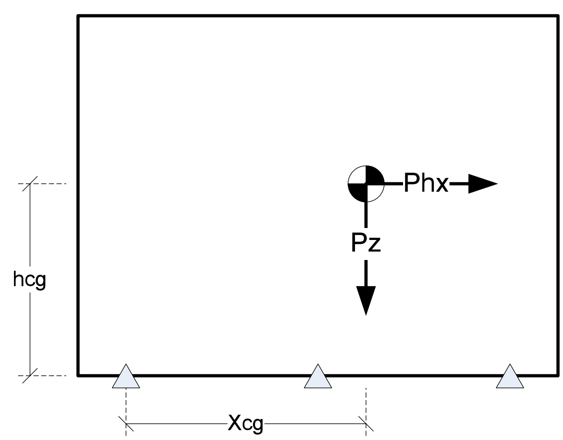




Planview



End Elevation



Side Elevation

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PROJECT	JOB / DWG NUMBER	REV. NO.	SHEET NO.
Yaskawa VFDs Phase II OSP & IBCS	VMA-49850-1A	00	16 of 76
CUSTOMER	BY / DATE	CHECKED	DATE
Yaskawa	RJH / 4/1/2015		

Equipment Tag			
UUT-8 on steel structure			
X-i-a. Seismic Restraint Load Calculation		Load Combinations are as per ASD	
Mfr	Yaskawa	Model	N/A

Input Values

Coefficient	Value	Units	Description
X	21.4	in	Equipment Depth
Y	15.5	in	Distance Between Attachment Points Along Unit Width
Z	27.34	in	Distance Between Attachment Points Along Unit Height
m	150	lbs	Equipment Mass
g_h	1.05	g	$F_{p,h} / W_p$ = Horizontal Seismic Acceleration
g_v	1.28	g	$(F_{p,v} / W_p + W_p)$ = Vertical Seismic Acceleration
X_{cg}	10.7	in	Center of Gravity Along Depth Direction
Y_{cg}	7.75	in	Center of Gravity Along Width Direction
Z_{cg}	13.67	in	Center of Gravity Along Height Direction

Critical Angle

Coefficient	Value	Units	Description
φ	27	degrees	Worst Case Angle to Apply Seismic Acceleration

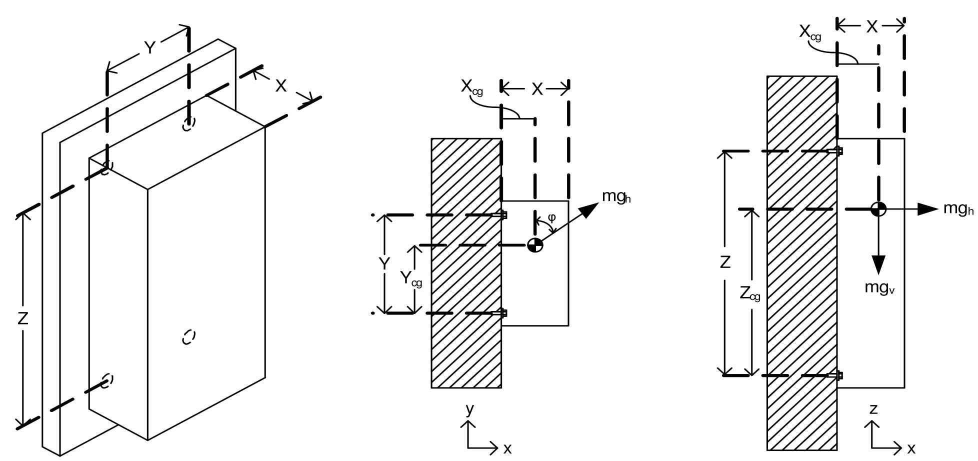
$$mg_{h,x} = (F_{p,h}/W_p)\sin(\varphi) \qquad mg_{h,y} = (F_{p,h}/W_p)\cos(\varphi)$$

$$T_{max} = \frac{mg_v X_{cg}}{2Z} + \frac{mg_{h,x}(Z_{cg} - Z/2)}{2Z} + \frac{mg_{h,x}}{4} + \frac{mg_{h,y} X_{cg}}{2Y} + \frac{mg_{h,x}(|Y_{cg} - Y/2|)}{2Y}$$

$$V_{max} = \sqrt{\left(\frac{mg_v}{4}\right)^2 + \left(\frac{mg_{h,y}}{4}\right)^2}$$

T_{max}	104 lbs

V_{max}	59 lbs



Isometric View   Plan View   Side Elevation View

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PROJECT	JOB / DWG NUMBER	REV. NO.	SHEET NO.
Yaskawa VFDs Phase II OSP & IBCS	VMA-49850-1A	00	17 of 76
CUSTOMER	BY / DATE	CHECKED	DATE
Yaskawa	RJH 4/1/2015		

X-i-b.Check Bolting of Equipment to Structural steel
Tag: UUT-8
Bolting using 3/8" diameter SAE Grade 5/ ASTM A325 bolt at each bolt location

Fastener			Loading		Fastener Stress	
Type	Diameter	Area	Tension	Shear	Tension	Shear
A325	0.375	0.110 in^2	104 #	59 #	0.94 ksi	0.53 ksi

Nominal Stress			Allowable Stress		Pass/Fail	
F_{nt}	F_{nv}	F'_{nt}	$F_{t,allow}$	$F_{v,allow}$	Tension	Shear
90 ksi	48 ksi	90 ksi	45 ksi	24 ksi	**PASS**	**PASS**

Check Bolting to Steel Structure

Stress Area = 0.110 in^2

Design Tension Stress of the Bolt = 104 # / 0.110 in^2 = 0.94 ksi

Design Shear Stress of the Bolt = 59 # / 0.110 in^2 = 0.53 ksi

F_{nt} = Nominal Tensile Stress from Table J3.2 = 90 ksi

F_{nv} = Nominal Shear Stress from Table J3.2 = 48 ksi

f_v = Design Shear Stress

Ω = 2.00 (ASD)

From AISC Manual of Steel Construction 13th Edition Section J3.6:

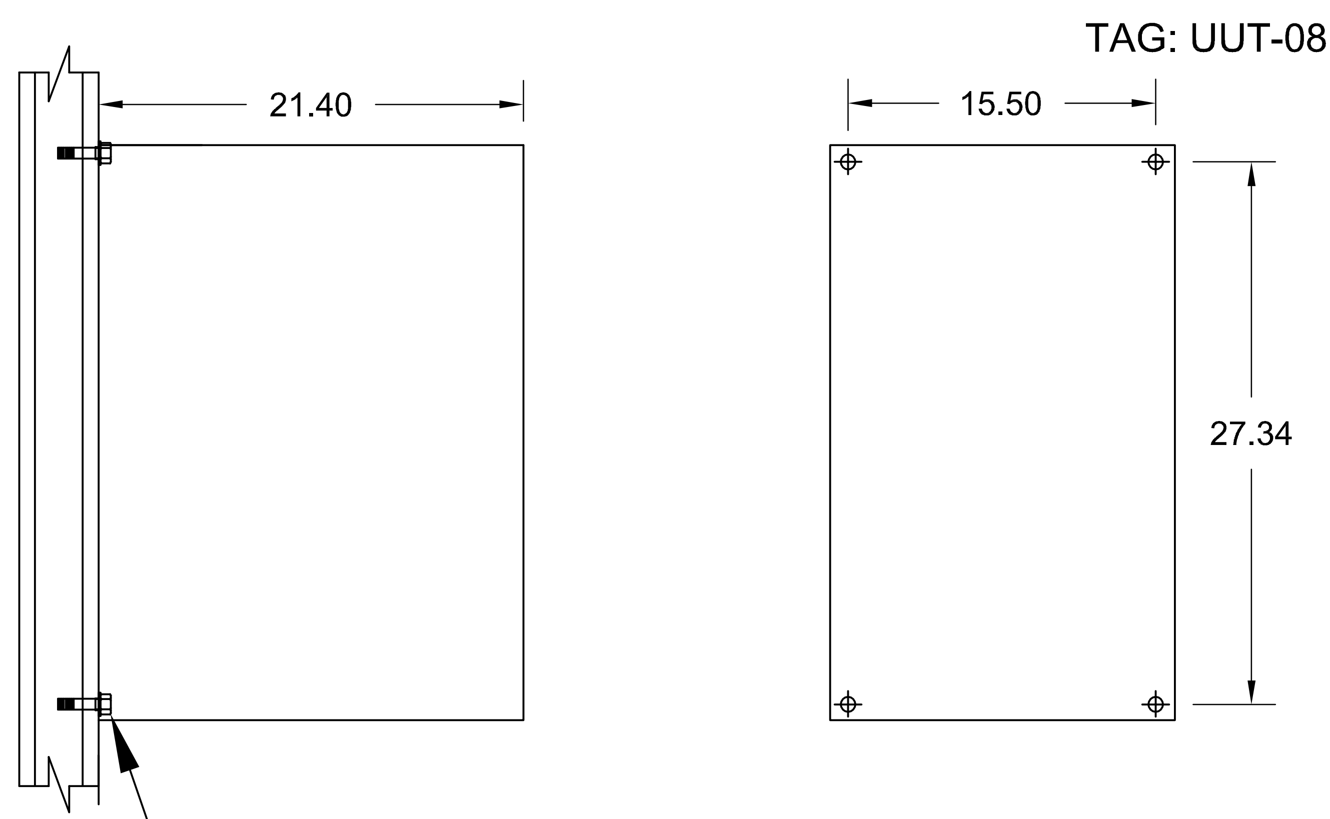
$$F'_{nt} = 1.3F_{nt} - \frac{\Omega F_{nt}}{F_{nv}} f_v \leq F_{nt}$$

Applying the equation above to find the *allowable tension* stress at this shear;

$$\frac{F'_{nt}}{\Omega} = F_{t,allowable} = 45 \text{ ksi}$$

$$\frac{F_{nv}}{\Omega} = F_{v,allowable} = 24 \text{ ksi}$$

Therefore, the 3/8" diameter A325 bolt is sufficient for this application ✓



Note:
1)All Dimensions are in Inches
2)See Yaskawa dwg# DD.Z1.3R.W1.01 for details.

CERTIFIED FOR:

JOB NAME: Pase II VFDs Seismic Anchorage

CUSTOMER : Yaskawa

CUSTOMER P.O.: 4200211053

SALES ORDER: 267486

UUT-08 STEEL ANCHORAGE LAYOUT

THE VMC GROUP
The Power of Together
Bloomingdale, NJ 07403
Houston, TX 77041

SCALE :		
NONE	Member VISCMA	
SHEET: 18 OF 76		
DRAWING NO.: VMA-49850 01A		REVISION

PROJECT	JOB / DWG NUMBER	REV. NO.	SHEET NO.
Yaskawa VFDs Phase II OSP & IBCS	VMA-49850-1A	00	19 of 76

CUSTOMER	BY	DATE	CHECKED	DATE
Yaskawa	RJH	3/31/2015		

Equipment Tag

UUT-8 mounted on concrete wall

X-i-d. Seismic Restraint Load Calculation — Load Combinations are as per LRFD

Mfr: Yaskawa — Model: N/A

Input Values

Coefficient	Value	Units	Description
X	21.4	in	Equipment Depth
Y	15.5	in	Distance Between Attachment Points Along Unit Width
Z	27.34	in	Distance Between Attachment Points Along Unit Height
m	150	lbs	Equipment Mass
g_h	1.5	g	$F_{p,h} / W_p$ = Horizontal Seismic Acceleration
g_v	1.6	g	$(F_{p,v} / W_p + W_p)$ = Vertical Seismic Acceleration
X_{cg}	10.7	in	Center of Gravity Along Depth Direction
Y_{cg}	7.75	in	Center of Gravity Along Width Direction
Z_{cg}	13.67	in	Center of Gravity Along Height Direction

Critical Angle

Coefficient	Value	Units	Description
φ	24	degrees	Worst Case Angle to Apply Seismic Acceleration

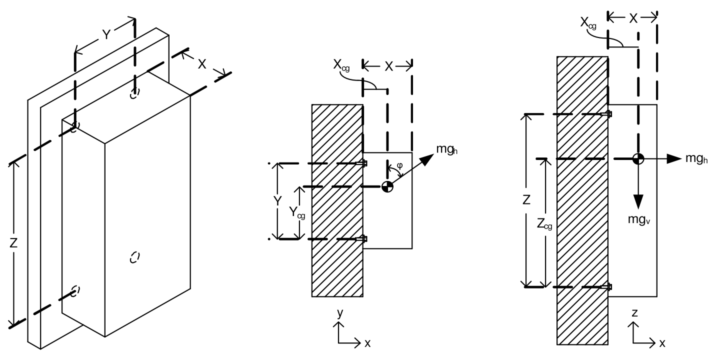
$$mg_{h,x} = (F_{p,h}/W_p)\sin(\varphi) \qquad mg_{h,y} = (F_{p,h}/W_p)\cos(\varphi)$$

$$T_{max} = \frac{mg_v X_{cg}}{2Z} + \frac{mg_{h,x}(Z_{cg} - Z/2)}{2Z} + \frac{mg_{h,x}}{4} + \frac{mg_{h,y} X_{cg}}{2Y} + \frac{mg_{h,x}(|Y_{cg} - Y/}{2Y}$$

$$V_{max} = \sqrt{\left(\frac{mg_v}{4}\right)^2 + \left(\frac{mg_{h,y}}{4}\right)^2}$$

T_{max}	282 lbs

V_{max}	142 lbs



Isometric View — Plan View — Side Elevation View

Equipment is attached to wall with **(4)3/8" Dia. Hilti Kwik Bolt TZ-CS with min. embedment 2"; edge distance of 3" on a 3" thick 4000 Psi Concrete wall**

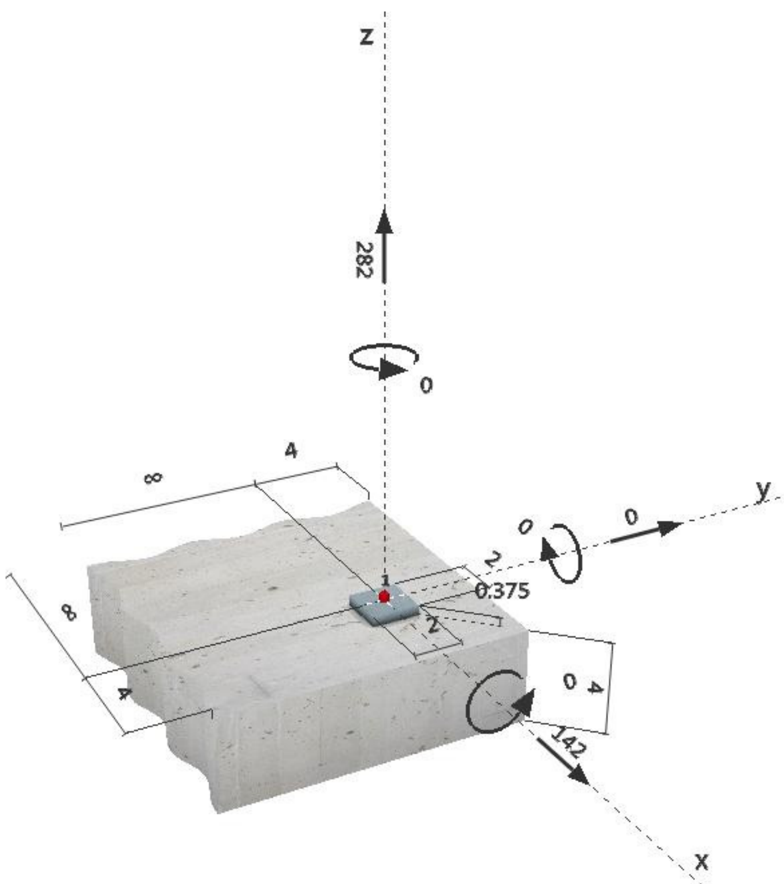
Company:		Page:	20
Specifier:		Project:	
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	4/1/2015
E-Mail:			

Specifier's comments:

1 Input data

Anchor type and diameter:	**Kwik Bolt TZ - CS 3/8 (2)**
Effective embedment depth:	$h_{ef,act}$ = 2.000 in., h_{nom} = 2.313 in.
Material:	Carbon Steel
Evaluation Service Report:	ESR-1917
Issued I Valid:	5/1/2013 | 5/1/2015
Proof:	design method ACI 318-11 / Mech.
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.375 in.
Anchor plate:	l_x x l_y x t = 2.000 in. x 2.000 in. x 0.375 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, 4000, f_c' = 4000 psi; h = 4.000 in.
Installation:	hammer drilled hole, installation condition: dry
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)	Tension load: yes (D.3.3.4.3 (d))
	Shear load: yes (D.3.3.5.3 (c))

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



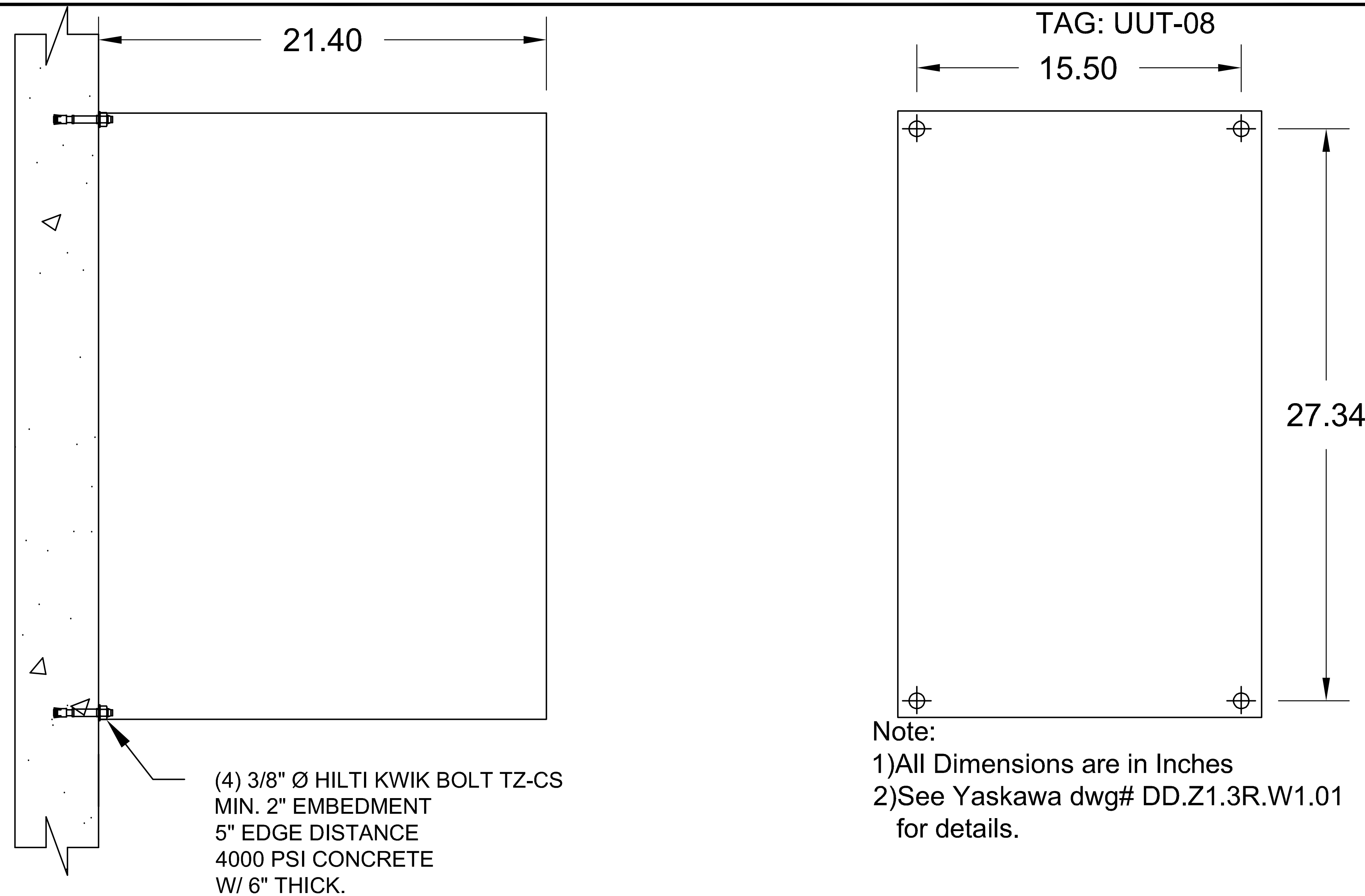
Company:		Page:	21
Specifier:		Project:	
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	4/1/2015
E-Mail:			

2 Proof I Utilization (Governing Cases)

Loading	Proof	Design values [lb] Load	Capacity	Utilization β_N / β_V [%]	Status
Tension	Pullout Strength	282	1400	21 / -	OK
Shear	Concrete edge failure in direction x+	142	1299	- / 11	OK

Loading	β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
Combined tension and shear loads	0.201	0.109	5/3	10	OK

Fastening meets the design criteria!



Note:

1)All Dimensions are in Inches

2)See Yaskawa dwg# DD.Z1.3R.W1.01 for details.

CERTIFIED FOR:

JOB NAME: Pase II VFDs Seismic Anchorage

CUSTOMER : Yaskawa

CUSTOMER P.O.: 4200211053

SALES ORDER: 267486

UUT-08 CONCRETE ANCHORAGE LAYOUT

THE VMC GROUP
The Power of Together
Bloomingdale, NJ 07403
Houston, TX 77041

SCALE : NONE

SHEET: 22 OF 76

DRAWING NO.: VMA-49850 01A

REVISION

Member VISCMA

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PROJECT	JOB / DWG NUMBER	REV. NO.	SHEET NO.
Yaskawa VFDs Phase II OSP & IBCS	VMA-49850-1A	00	23 of 76

CUSTOMER	BY	DATE	CHECKED	DATE
Yaskawa	RJH	3/31/2015		

Equipment Tag			
UUT-9 on steel structure			
X-i-a. Seismic Restraint Load Calculation			Load Combinations are as per ASD
Mfr	Yaskawa	Model	N/A
Input Values			
Coefficient	**Value**	**Units**	**Description**
X	21.47	in	Equipment Depth
Y	30.06	in	Distance Between Attachment Points Along Unit Width
Z	49.32	in	Distance Between Attachment Points Along Unit Height
m	550	lbs	Equipment Mass
g_h	1.05	g	$F_{p,h} / W_p$ = Horizontal Seismic Acceleration
g_v	1.28	g	$(F_{p,v} / W_p + W_p)$ = Vertical Seismic Acceleration
X_{cg}	10.735	in	Center of Gravity Along Depth Direction
Y_{cg}	15.03	in	Center of Gravity Along Width Direction
Z_{cg}	24.66	in	Center of Gravity Along Height Direction

Critical Angle			
Coefficient	**Value**	**Units**	**Description**
φ	39	degrees	Worst Case Angle to Apply Seismic Acceleration

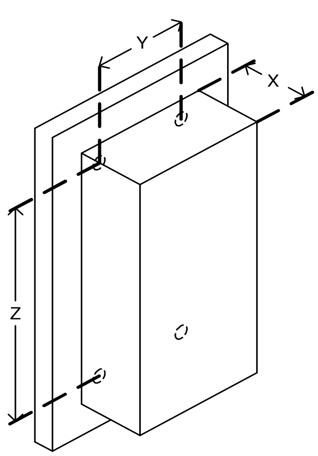
$$mg_{h,x} = (F_{p,h}/W_p)\sin(\varphi) \qquad mg_{h,y} = (F_{p,h}/W_p)\cos(\varphi)$$

$$T_{max} = \frac{mg_v X_{cg}}{2Z} + \frac{mg_{h,x}(Z_{cg} - Z/2)}{2Z} + \frac{mg_{h,x}}{4} + \frac{mg_{h,y} X_{cg}}{2Y} + \frac{mg_{h,x}(|Y_{cg} - Y/2|)}{2Y}$$

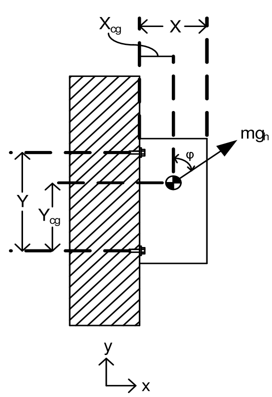
$$V_{max} = \sqrt{\left(\frac{mg_v}{4}\right)^2 + \left(\frac{mg_{h,y}}{4}\right)^2}$$

T_{max}	248 lbs

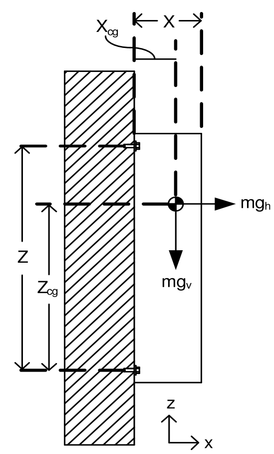
V_{max}	209 lbs



Isometric View



Plan View



Side Elevation View

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PROJECT	JOB / DWG NUMBER	REV. NO.	SHEET NO.
Yaskawa VFDs Phase II OSP & IBCS	VMA-49850-1A	00	24 of 76

CUSTOMER	BY	DATE	CHECKED	DATE
Yaskawa	RJH	3/31/2015		

X-ii-b.Check Bolting of Equipment to Structural steel

Tag: UUT-9

Bolting using 3/8" diameter SAE Grade 5/ ASTM A325 bolt at each bolt location

Fastener			Loading		Fastener Stress	
Type	Diameter	Area	Tension	Shear	Tension	Shear
A325	0.375	0.110 in^2	248 #	209 #	2.25 ksi	1.89 ksi

Nominal Stress			Allowable Stress		Pass/Fail	
F_{nt}	F_{nv}	F'_{nt}	$F_{t,allow}$	$F_{v,allow}$	Tension	Shear
90 ksi	48 ksi	90 ksi	45 ksi	24 ksi	**PASS**	**PASS**

Check Bolting to Steel Structure

Stress Area = 0.110 in^2

Design Tension Stress of the Bolt = 248 # / 0.110 in^2 = 2.25 ksi

Design Shear Stress of the Bolt = 209 # / 0.110 in^2 = 1.89 ksi

F_{nt} = Nominal Tensile Stress from Table J3.2 = 90 ksi

F_{nv} = Nominal Shear Stress from Table J3.2 = 48 ksi

f_v = Design Shear Stress

Ω = 2.00 (ASD)

From AISC Manual of Steel Construction 13th Edition Section J3.6:

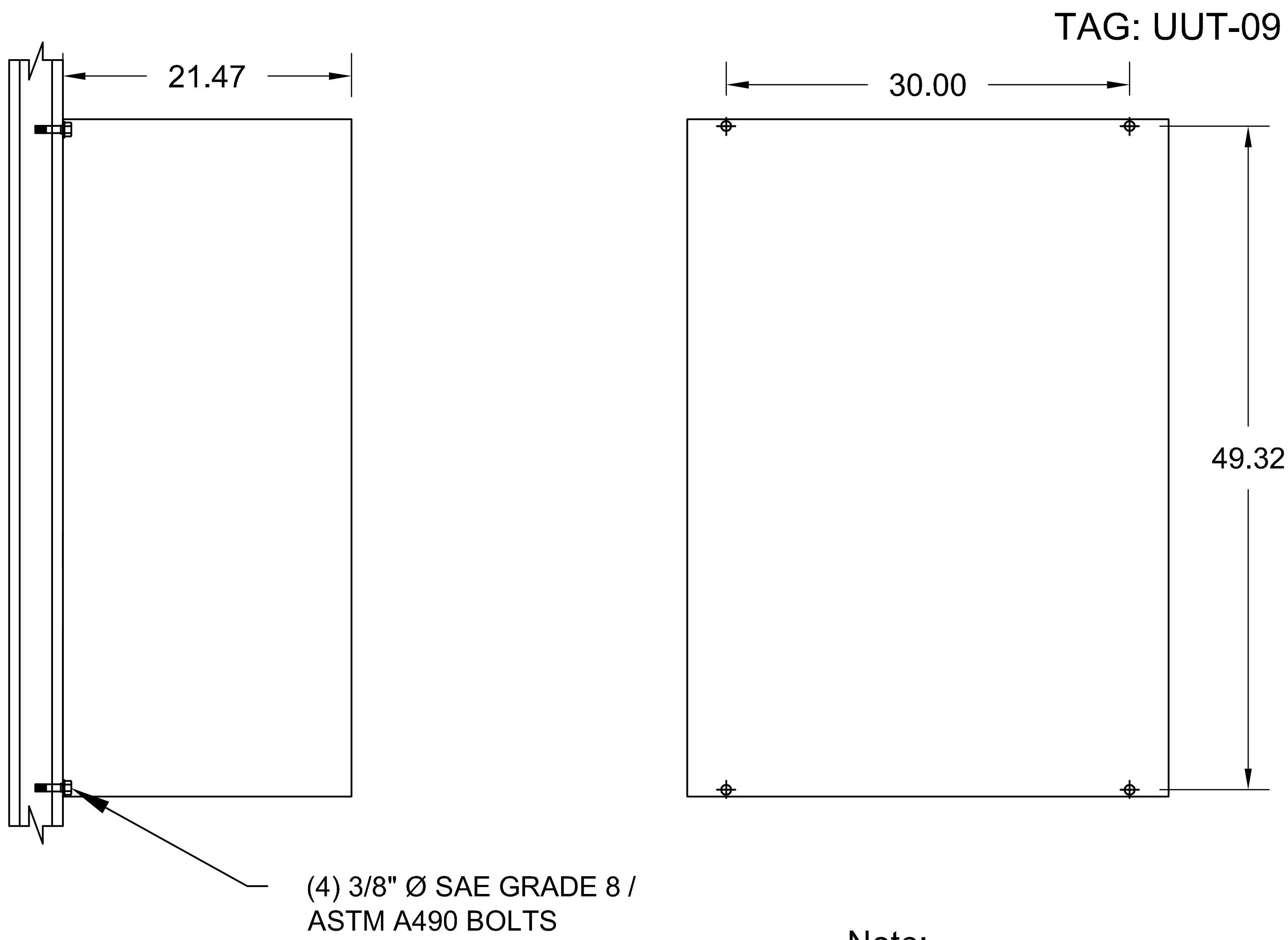
$$F'_{nt} = 1.3F_{nt} - \frac{\Omega F_{nt}}{F_{nv}} f_v \leq F_{nt}$$

Applying the equation above to find the *allowable tension* stress at this shear;

$$\frac{F'_{nt}}{\Omega} = F_{t,allowable} = 45 \text{ ksi}$$

$$\frac{F_{nv}}{\Omega} = F_{v,allowable} = 24 \text{ ksi}$$

Therefore, the 3/8" diameter A325 bolt is sufficient for this application ✓



Note:
1)All Dimensions are in Inches
2)See Yaskawa dwg# DD.Z1.3R.W4.01 for details.

CERTIFIED FOR:

JOB NAME: Pase II VFDs Seismic Anchorage

CUSTOMER : Yaskawa

CUSTOMER P.O.: 4200211053

SALES ORDER: 267486

UUT-09 STEEL ANCHORAGE LAYOUT

THE VMC GROUP
The Power of Together
Bloomingdale, NJ 07403
Houston, TX 77041

SCALE : NONE	Member VISCMA
SHEET: 25 OF 76	
DRAWING NO.: VMA-49850 01A	REVISION

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PROJECT	JOB / DWG NUMBER	REV. NO.	SHEET NO.
Yaskawa VFDs Phase II OSP & IBCS	VMA-49850-1A	00	26 of 76

CUSTOMER	BY	DATE	CHECKED	DATE
Yaskawa	RJH	3/31/2015		

Equipment Tag

UUT-9 mounted on concrete wall

X-ii-d. Seismic Restraint Load Calculation — Load Combinations are as per LRFD

Mfr: Yaskawa — Model: N/A

Input Values

Coefficient	Value	Units	Description
X	21.47	in	Equipment Depth
Y	30.06	in	Distance Between Attachment Points Along Unit Width
Z	49.32	in	Distance Between Attachment Points Along Unit Height
m	550	lbs	Equipment Mass
g_h	1.5	g	$F_{p,h} / W_p$ = Horizontal Seismic Acceleration
g_v	1.6	g	$(F_{p,v} / W_p + W_p)$ = Vertical Seismic Acceleration
X_{cg}	10.735	in	Center of Gravity Along Depth Direction
Y_{cg}	15.03	in	Center of Gravity Along Width Direction
Z_{cg}	24.66	in	Center of Gravity Along Height Direction

Critical Angle

Coefficient	Value	Units	Description
φ	37	degrees	Worst Case Angle to Apply Seismic Acceleration

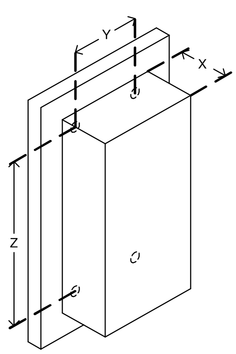
$$mg_{h,x} = (F_{p,h}/W_p)\sin(\varphi) \qquad mg_{h,y} = (F_{p,h}/W_p)\cos(\varphi)$$

$$T_{max} = \frac{mg_v X_{cg}}{2Z} + \frac{mg_{h,x}(Z_{cg} - Z/2)}{2Z} + \frac{mg_{h,x}}{4} + \frac{mg_{h,y} X_{cg}}{2Y} + \frac{mg_{h,x}(|Y_{cg} - Y/}{2Y}$$

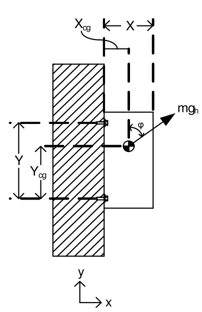
$$V_{max} = \sqrt{\left(\frac{mg_v}{4}\right)^2 + \left(\frac{mg_{h,y}}{4}\right)^2}$$

T_{max}	338 lbs

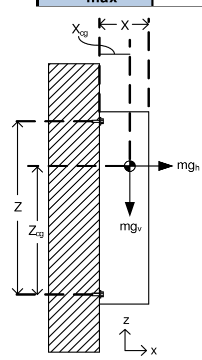
V_{max}	357 lbs



Isometric View



Plan View



Side Elevation View

Equipment is attached to wall with **(4)3/8" Dia. Hilti Kwik Bolt TZ-CS with min. embedment 2"; edge distance of 3" on a 3" thick 4000 Psi Concrete wall**

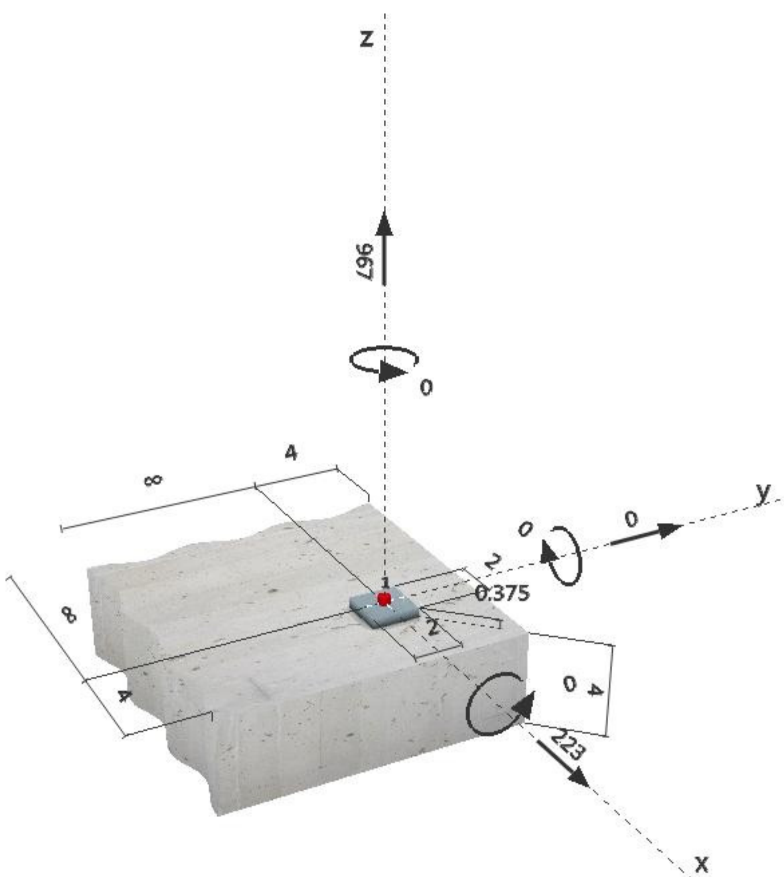
Company:		Page:	34
Specifier:		Project:	
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	4/1/2015
E-Mail:			

Specifier's comments:

1 Input data

Anchor type and diameter:	**Kwik Bolt TZ - CS 1/2 (2)**
Effective embedment depth:	$h_{ef,act}$ = 2.000 in., h_{nom} = 2.375 in.
Material:	Carbon Steel
Evaluation Service Report:	ESR-1917
Issued I Valid:	5/1/2013 | 5/1/2015
Proof:	design method ACI 318-11 / Mech.
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.375 in.
Anchor plate:	l_x x l_y x t = 2.000 in. x 2.000 in. x 0.375 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, 4000, f_c' = 4000 psi; h = 4.000 in.
Installation:	hammer drilled hole, installation condition: dry
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)	Tension load: yes (D.3.3.4.3 (d))
	Shear load: yes (D.3.3.5.3 (c))

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



Company:		Page:	35
Specifier:		Project:	
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	4/1/2015
E-Mail:			

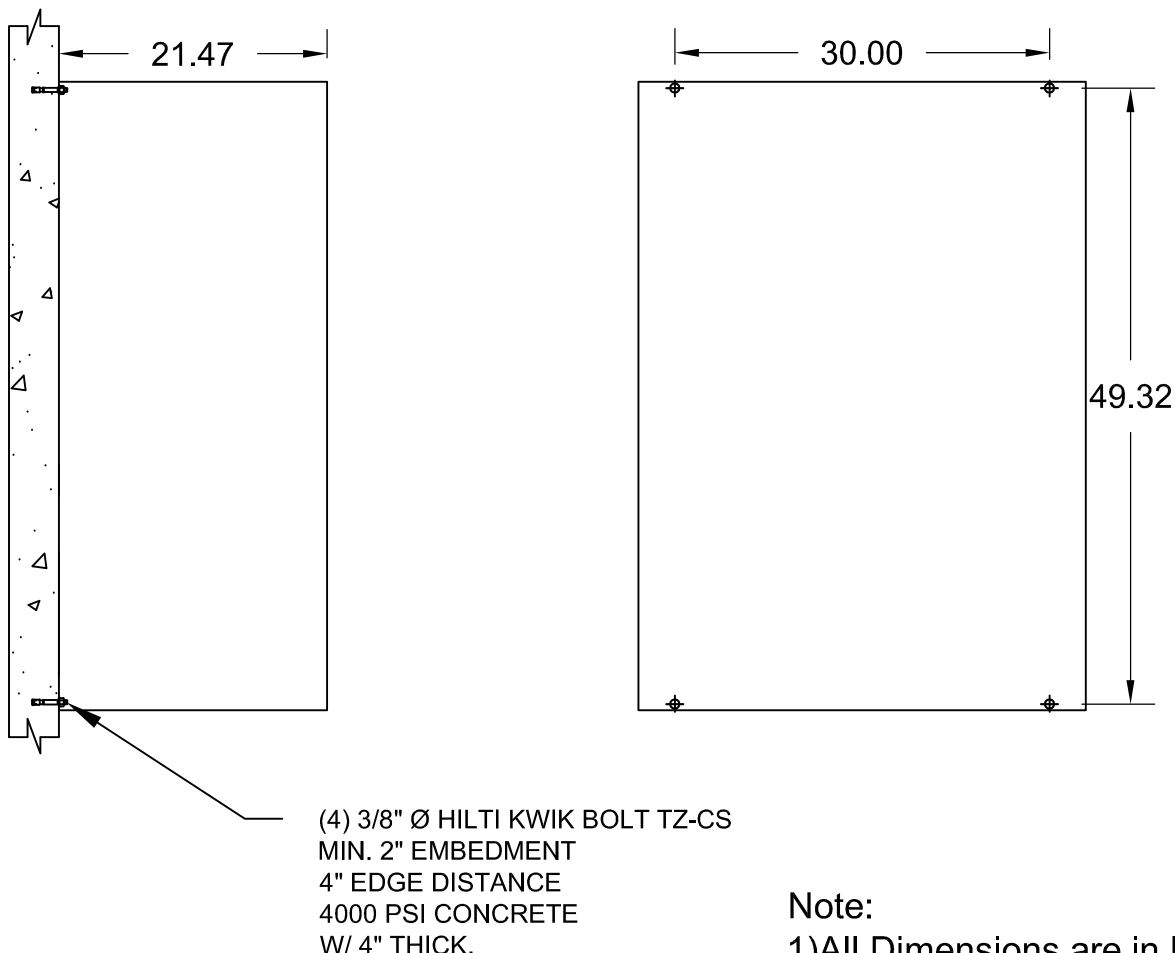
2 Proof I Utilization (Governing Cases)

		Design values [lb]		Utilization	
Loading	**Proof**	**Load**	**Capacity**	**β_N / β_V [%]**	**Status**
Tension	Concrete Breakout Strength	967	1483	66 / -	OK
Shear	Concrete edge failure in direction x+	223	1417	- / 16	OK

Loading	β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
Combined tension and shear loads	0.652	0.157	5/3	54	OK

Fastening meets the design criteria!

TAG: UUT-09



Note:
1)All Dimensions are in Inches
2)See Yaskawa dwg# DD.Z1.3R.W4.01 for details.

CERTIFIED FOR: JOB NAME: Pase II VFDs Seismic Anchorage CUSTOMER : Yaskawa CUSTOMER P.O.: 4200211053 SALES ORDER: 267486	UUT-09 CONCRETE ANCHORAGE LAYOUT	THE VMC GROUP *The Power of Together* Bloomingdale, NJ 07403 Houston, TX 77041	SCALE : NONE SHEET: 29 OF 76 DRAWING NO.: VMA-49850 01A	Member VISCMA REVISION

THE VMC GROUP

Aeroflex International Isolators | Amber/Booth | Korfund Dynamics | Vibration Mountings & Controls

PROJECT	JOB / DWG NUMBER	REV. NO.	SHEET NO.
Yaskawa VFDs Phase II OSP & IBCS	VMA-49850-1A	00	

CUSTOMER	BY	DATE	CHECKED	DATE
Yaskawa	RJH	3/31/2015		

X-iii-a. Seismic Force Calculation: UUT-10

○ LRFD ◉ ASD ○ AC-156

Ss =	3.00	ap =	2.5	From the tables:				
z/h =	1.0	Rp =	6	Fa =	1.00		Min. limit	Actual	Max. limit
Site Class	D	Ip =	1.5	S_{DS} =	2.000	Fp/Wp =	0.90 g's	1.50 g's	4.80 g's
Occupancy Category	IV	Calculated Seismic Design Category			D			DL	E
Mfr	Yaskawa	Model	N/A			Load Combination 1		1	0.7
Calculate the maximum loading at the most critical anchor location.						Load Combination 2		0.6	

Principal Axis Calculation

Input Data							Calculated Loads		
W	horz g's	vert g's		Hcg	Xcg	Ycg	Phx	Pz Max	Pz Min
850 #	1.050	0.320	1.280	40.14"	17.95"	14.58"	893 #	1088 #	272 #

	Restraint Locations		Iy1	Ix1	Ixy	J1	Overturning Loads (Fp Only)	Rigid Weight Distribution	Seismic Vertical Distribution	
	X	Y	$(X-Xcr)^2$	$(Y-Ycr)^2$	(X-Xcr)*(Y-Ycr)	r^2	P ot (Tens = -)	Static 1.0 g Vert	Max Vert	Min Vert
1	1.00"	1.00"	319	196	250	515	722 #	155 #	921	771
2	1.00"	15.00"	319	0	0	319	155 #	149 #	345	202
3	1.00"	29.00"	319	196	-250	515	-412 #	143 #	-230	-367
4	36.73"	1.00"	319	196	-250	515	412 #	141 #	592	457
5	36.73"	15.00"	319	0	0	319	-155 #	134 #	17	-112
6	36.73"	29.00"	319	196	250	515	-722 #	128 #	-558	-681
	Center of Restraints		Iy total	Ix total	Ixy total	J total	0 #	850 #	1088	272
	18.9"	15.0"	1915	784	0	2699		0	0	0

Cx	Cy	# Vertical Restraints	# Horizontal Restraints	Theta		Tanθ	r max
17.9"	14.0"	6	6	207.6 deg	0.481 rad	0.522	22.7"

	Mx	My	MxIy-MyIxy	MyIx-MxIxy	$IxIy-Ixy^2$
Fp Only	-31753	-16589	-6.08E+07	-1.30E+07	1.50E+06
					Mz
Static Vert	-357	-778	-6.84E+05	-6.10E+05	899

Max Loads per Location	
Comp (Max Vert)	921 #
Tens. (Min Vert)	681 #
Shear	156 #

THE VMC GROUP
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PROJECT	JOB / DWG NUMBER	REV. NO.	SHEET NO.
Yaskawa VFDs Phase II OSP & IBCS	VMA-49850-1A	00	31 of 76
CUSTOMER	BY / DATE	CHECKED	DATE
Yaskawa	RJH 3/31/2015		

X-iii-b. Check Bolting of Equipment to Structural steel
Tag: UUT-10
Bolting using 1/2" diameter SAE Grade 8/ ASTM A490 bolt at each bolt location

Fastener			Loading		Fastener Stress	
Type	Diameter	Area	Tension	Shear	Tension	Shear
A325	0.500	0.196 in^2	681 #	156 #	3.47 ksi	0.79 ksi

Nominal Stress			Allowable Stress		Pass/Fail	
F_{nt}	F_{nv}	F'_{nt}	$F_{t,allow}$	$F_{v,allow}$	Tension	Shear
90 ksi	48 ksi	90 ksi	45 ksi	24 ksi	**PASS**	**PASS**

Check Bolting to Steel Structure
Stress Area = 0.196 in^2

Design Tension Stress of the Bolt = 681 # / 0.196 in^2 = 3.47 ksi
Design Shear Stress of the Bolt = 156 # / 0.196 in^2 = 0.79 ksi

F_{nt} = Nominal Tensile Stress from Table J3.2 = 90 ksi
F_{nv} = Nominal Shear Stress from Table J3.2 = 48 ksi
f_v = Design Shear Stress
Ω = 2.00 (ASD)

From AISC Manual of Steel Construction 13th Edition Section J3.6:

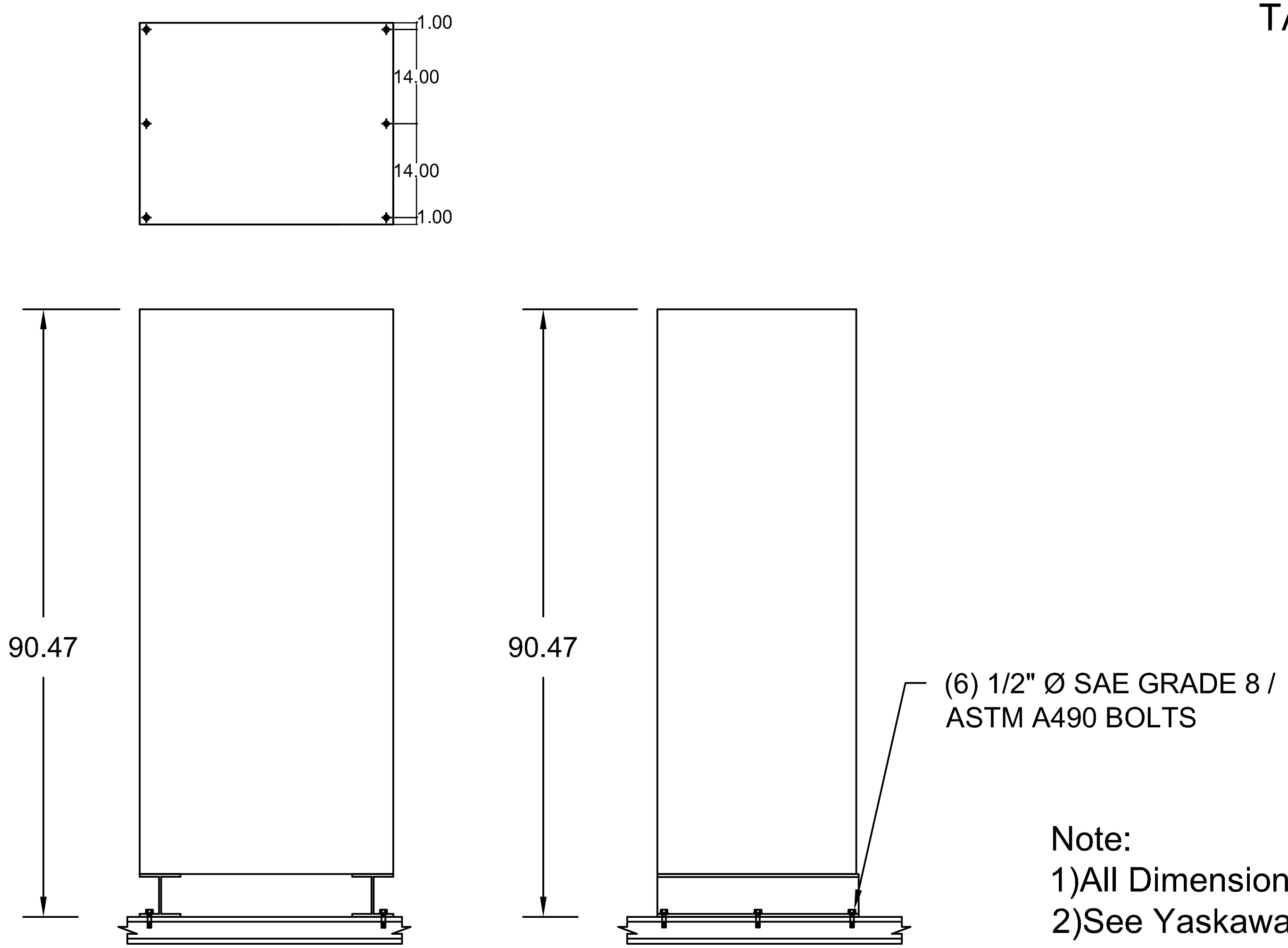
$$F'_{nt} = 1.3F_{nt} - \frac{\Omega F_{nt}}{F_{nv}} f_v \leq F_{nt}$$

Applying the equation above to find the *allowable tension stress* at this shear;

$$\frac{F'_{nt}}{\Omega} = F_{t,allowable} = 45 \text{ ksi}$$

$$\frac{F_{nv}}{\Omega} = F_{v,allowable} = 24 \text{ ksi}$$

Therefore, the 1/2" diameter A325 bolt is sufficient for this application ✓



TAG: UUT-10

Note:
1)All Dimensions are in Inches
2)See Yaskawa dwg# DD.Z1.3R.F1.02 for details.
3) See Yaskawa dwg # USP03233 for mounting foot details

CERTIFIED FOR:

JOB NAME: Pase II VFDs Seismic Anchorage

CUSTOMER : Yaskawa

CUSTOMER P.O.: 4200211053

SALES ORDER: 267486

UUT-10 STEEL ANCHORAGE LAYOUT

THE VMC GROUP
The Power of Together
Bloomingdale, NJ 07403
Houston, TX 77041

SCALE : NONE	Member VISCMA
SHEET: 32 OF 76	
DRAWING NO.: VMA-49850 01A	REVISION

PROJECT	JOB / DWG NUMBER	REV. NO.	SHEET NO.
Yaskawa VFDs Phase II OSP & IBCS	VMA-49850-1A	00	33 of 76

CUSTOMER	BY	DATE	CHECKED	DATE
Yaskawa	RJH	3/31/2015		

X-iii-d. Seismic Force Calculation: UUT-10

◉ LRFD ○ ASD ○ AC-156

Ss =	3.00	ap =	2.5	From the tables:				
z/h =	1.0	Rp =	6	Fa =	1.00		Min. limit	Actual	Max. limit
Site Class	D	Ip =	1.5	S_{DS} =	2.000	Fp/Wp =	0.90 g's	1.50 g's	4.80 g's
Occupancy Category	IV	Calculated Seismic Design Category		D			DL	E
Mfr	Yaskawa	Model	N/A			Load Combination 1	1.2	1
Calculate the maximum loading at the most critical anchor location.						Load Combination 2	0.9	

Principal Axis Calculation

Input Data							Calculated Loads		
W	horz g's	vert g's		Hcg	Xcg	Ycg	Phx	Pz Max	Pz Min
850 #	1.500	0.500	1.600	40.14"	17.95"	14.58"	1275 #	1360 #	425 #

	Restraint Locations		Iy1	Ix1	Ixy	J1	Overturning Loads (Fp Only)	Rigid Weight Distribution	Seismic Vertical Distribution	
	X	Y	$(X\text{-}Xcr)^2$	$(Y\text{-}Ycr)^2$	(X-Xcr)*(Y-Ycr)	r^2	P ot (Tens = -)	Static 1.0 g Vert	Max Vert	Min Vert
1	1.00"	1.00"	319	196	250	515	1031 #	155 #	1280	1109
2	1.00"	15.00"	319	0	0	319	221 #	149 #	459	296
3	1.00"	29.00"	319	196	-250	515	-589 #	143 #	-361	-518
4	36.73"	1.00"	319	196	-250	515	589 #	141 #	814	659
5	36.73"	15.00"	319	0	0	319	-221 #	134 #	-6	-154
6	36.73"	29.00"	319	196	250	515	-1031 #	128 #	-826	-967
	Center of Restraints		Iy total	Ix total	Ixy total	J total	0 #	850 #	1360	425
	18.9"	15.0"	1915	784	0	2699		0	0	0

Cx	Cy	# Vertical Restraints	# Horizontal Restraints	Theta		Tanθ	r max
17.9"	14.0"	6	6	207.6 deg	0.481 rad	0.522	22.7"

	Mx	My	MxIy-MyIxy	MyIx-MxIxy	$IxIy\text{-}Ixy^2$
Fp Only	-45361	-23698	-8.69E+07	-1.86E+07	1.50E+06
					Mz
Static Vert	-357	-778	-6.84E+05	-6.10E+05	1284

Max Loads per Location	
Comp (Max Vert)	1280 #
Tens. (Min Vert)	967 #
Shear	223 #

Design Tension =	967#

Design Shear =	223#

Equipment is attached to concrete with (4) Hilti Kwik Bolt TZ-CS, 1/2" Dia. with 3.25" min. embedment

Edge distance of 6" on a 6" thick concrete pad of 4000Psi

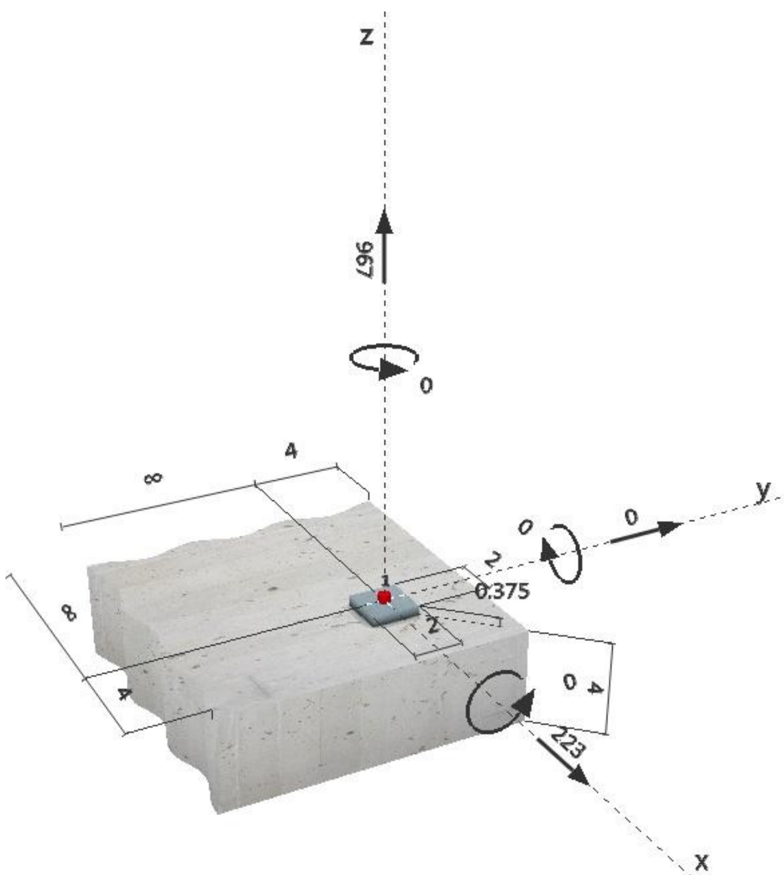
Company:		Page:	34
Specifier:		Project:	
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	4/1/2015
E-Mail:			

Specifier's comments:

1 Input data

Anchor type and diameter:	**Kwik Bolt TZ - CS 1/2 (2)**
Effective embedment depth:	$h_{ef,act}$ = 2.000 in., h_{nom} = 2.375 in.
Material:	Carbon Steel
Evaluation Service Report:	ESR-1917
Issued I Valid:	5/1/2013 | 5/1/2015
Proof:	design method ACI 318-11 / Mech.
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.375 in.
Anchor plate:	l_x x l_y x t = 2.000 in. x 2.000 in. x 0.375 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, 4000, f_c' = 4000 psi; h = 4.000 in.
Installation:	hammer drilled hole, installation condition: dry
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)	Tension load: yes (D.3.3.4.3 (d))
	Shear load: yes (D.3.3.5.3 (c))

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



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Specifier:		Project:	
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	4/1/2015
E-Mail:			

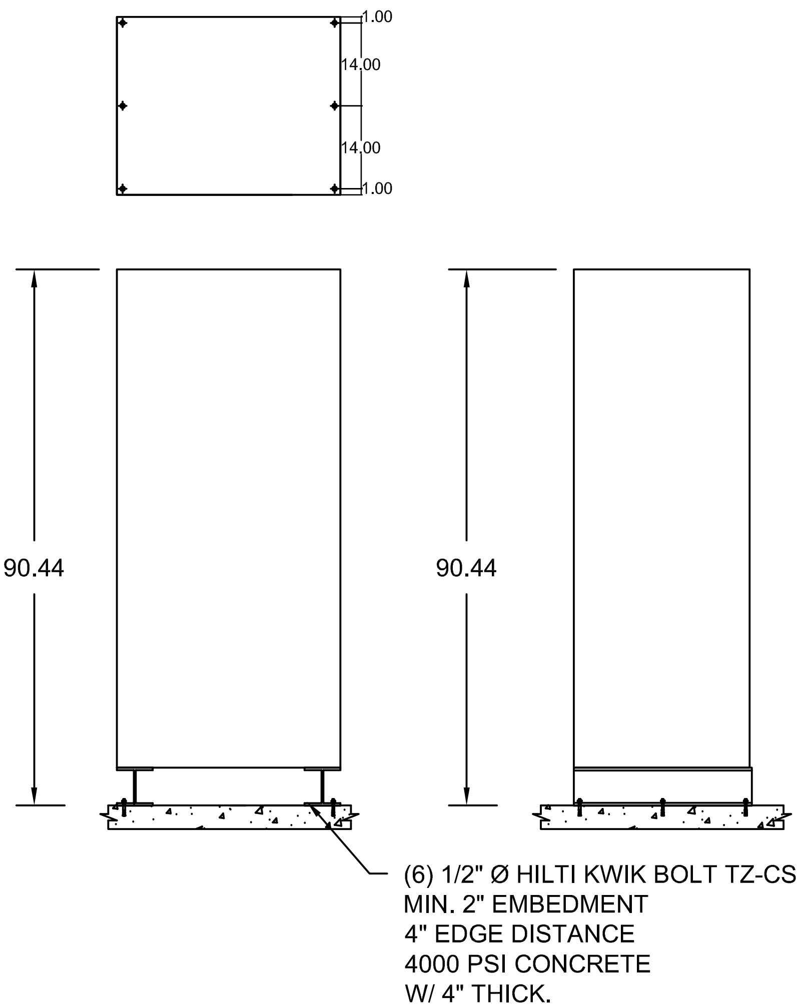
2 Proof I Utilization (Governing Cases)

		Design values [lb]		Utilization	
Loading	**Proof**	**Load**	**Capacity**	**β_N / β_V [%]**	**Status**
Tension	Concrete Breakout Strength	967	1483	66 / -	OK
Shear	Concrete edge failure in direction x+	223	1417	- / 16	OK

Loading	**β_N**	**β_V**	**ζ**	**Utilization $\beta_{N,V}$ [%]**	**Status**
Combined tension and shear loads	0.652	0.157	5/3	54	OK

Fastening meets the design criteria!

TAG: UUT-10



Note:
1)All Dimensions are in Inches
2)See Yaskawa dwg# DD.Z1.3R.F1.02 for details.
3) See Yaskawa dwg # USP03233 for mounting foot details

CERTIFIED FOR:

JOB NAME: Pase II VFDs Seismic Anchorage

CUSTOMER : Yaskawa

CUSTOMER P.O.: 4200211053

SALES ORDER: 267486

UUT-10 CONCRETE ANCHORAGE LAYOUT

THE VMC GROUP
The Power of Together
Bloomingdale, NJ 07403
Houston, TX 77041

SCALE : NONE

SHEET: 36 OF 76

Member VISCMA

DRAWING NO.: VMA-49850 01A

REVISION

THE VMC GROUP

Aeroflex International Isolators | Amber/Booth | Korfund Dynamics | Vibration Mountings & Controls

PROJECT	JOB / DWG NUMBER	REV. NO.	SHEET NO.
Yaskawa VFDs Phase II OSP & IBCS	VMA-49850-1A	00	37 of 76

CUSTOMER	BY	DATE	CHECKED	DATE
Yaskawa	RJH	3/31/2015		

X-iv-a. Seismic Force Calculation: UUT-11

○ LRFD ◉ ASD ○ AC-156

Ss =	3.00	ap =	2.5	From the tables:				
z/h =	1.0	Rp =	6	Fa =	1.00		Min. limit	Actual	Max. limit
Site Class	D	Ip =	1.5	S_{DS} =	2.000	Fp/Wp =	0.90 g's	1.50 g's	4.80 g's
Occupancy Category	IV	Calculated Seismic Design Category			D			DL	E
Mfr	Yaskawa	Model	N/A			Load Combination 1		1	0.7
Calculate the maximum loading at the most critical anchor location.						Load Combination 2		0.6	

Principal Axis Calculation

Input Data							Calculated Loads		
W	horz g's	vert g's		Hcg	Xcg	Ycg	Phx	Pz Max	Pz Min
850 #	1.050	0.320	1.280	40.14"	17.95"	14.58"	893 #	1088 #	272 #

	Restraint Locations		Iy1	Ix1	Ixy	J1	Overturning Loads (Fp Only)	Rigid Weight Distribution	Seismic Vertical Distribution	
	X	Y	$(X\text{-}Xcr)^2$	$(Y\text{-}Ycr)^2$	(X-Xcr)* (Y-Ycr)	r^2	P ot (Tens = -)	Static 1.0 g Vert	Max Vert	Min Vert
1	1.00"	1.00"	319	196	250	515	722 #	155 #	921	771
2	1.00"	15.00"	319	0	0	319	155 #	149 #	345	202
3	1.00"	29.00"	319	196	-250	515	-412 #	143 #	-230	-367
4	36.73"	1.00"	319	196	-250	515	412 #	141 #	592	457
5	36.73"	15.00"	319	0	0	319	-155 #	134 #	17	-112
6	36.73"	29.00"	319	196	250	515	-722 #	128 #	-558	-681
	Center of Restraints		Iy total	Ix total	Ixy total	J total	0 #	850 #	1088	272
	18.9"	15.0"	1915	784	0	2699		0	0	0

Cx	Cy	# Vertical Restraints	# Horizontal Restraints	Theta		Tanθ	r max
17.9"	14.0"	6	6	207.6 deg	0.481 rad	0.522	22.7"

	Mx	My	MxIy-MyIxy	MyIx-MxIxy	$IxIy\text{-}Ixy^2$
Fp Only	-31753	-16589	-6.08E+07	-1.30E+07	1.50E+06
					Mz
Static Vert	-357	-778	-6.84E+05	-6.10E+05	899

Max Loads per Location	
Comp (Max Vert)	921 #
Tens. (Min Vert)	681 #
Shear	156 #

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PROJECT	JOB / DWG NUMBER	REV. NO.	SHEET NO.
Yaskawa VFDs Phase II OSP & IBCS	VMA-49850-1A	00	38 of 76

CUSTOMER	BY	DATE	CHECKED	DATE
Yaskawa	RJH	3/31/2015		

X-iv-b. Check Bolting of Equipment to Structural steel

Tag: UUT-11

Bolting using 1/2" diameter SAE Grade 8/ ASTM A490 bolt at each bolt location

Fastener			Loading		Fastener Stress	
Type	Diameter	Area	Tension	Shear	Tension	Shear
A325	0.500	0.196 in^2	681 #	156 #	3.47 ksi	0.79 ksi

Nominal Stress			Allowable Stress		Pass/Fail	
F_{nt}	F_{nv}	F'_{nt}	$F_{t,allow}$	$F_{v,allow}$	Tension	Shear
90 ksi	48 ksi	90 ksi	45 ksi	24 ksi	**PASS**	**PASS**

Check Bolting to Steel Structure

Stress Area = 0.196 in^2

Design Tension Stress of the Bolt = 681 # / 0.196 in^2 = 3.47 ksi

Design Shear Stress of the Bolt = 156 # / 0.196 in^2 = 0.79 ksi

F_{nt} = Nominal Tensile Stress from Table J3.2 = 90 ksi

F_{nv} = Nominal Shear Stress from Table J3.2 = 48 ksi

f_v = Design Shear Stress

Ω = 2.00 (ASD)

From AISC Manual of Steel Construction 13th Edition Section J3.6:

$$F'_{nt} = 1.3F_{nt} - \frac{\Omega F_{nt}}{F_{nv}} f_v \leq F_{nt}$$

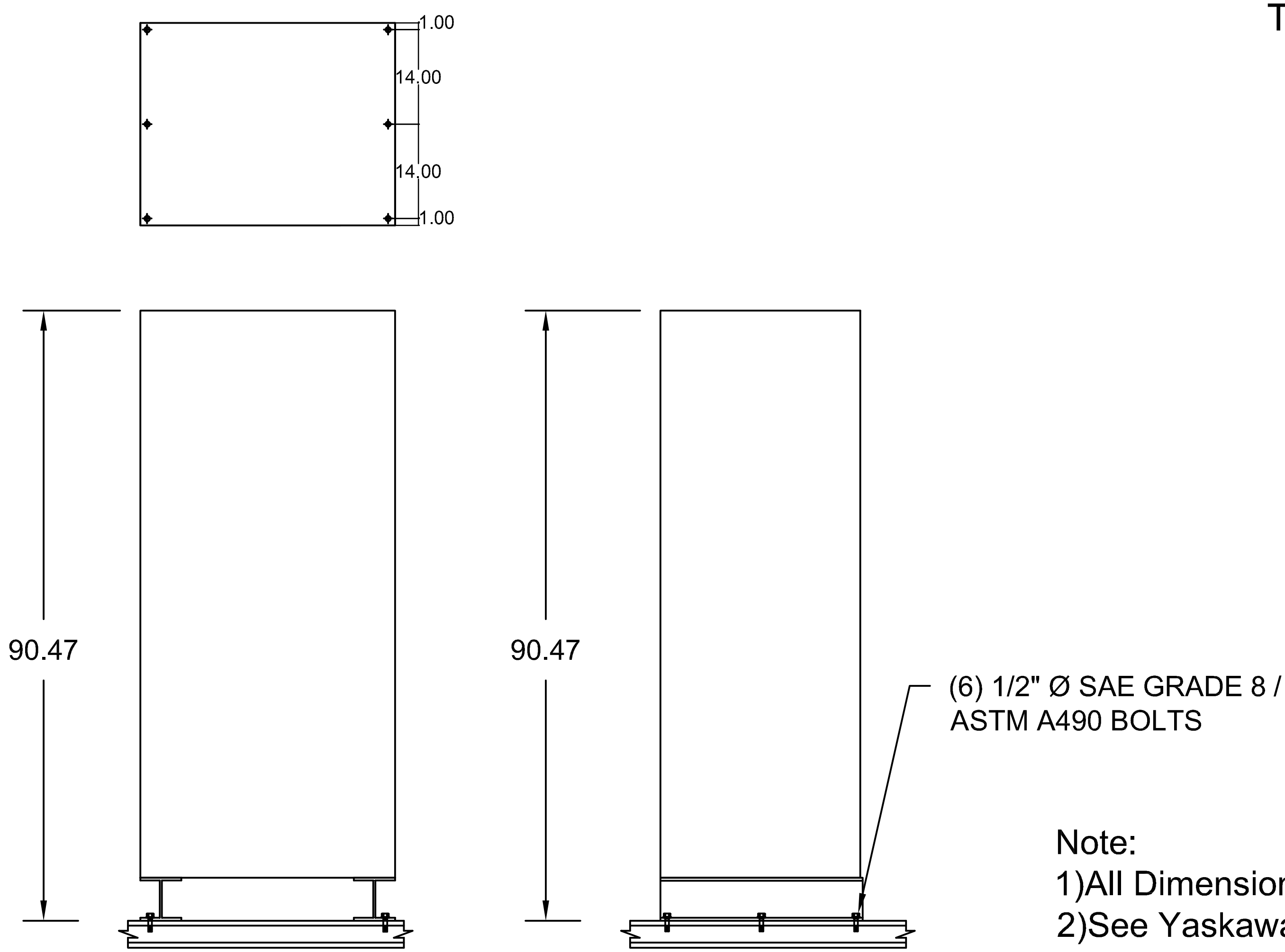
Applying the equation above to find the *allowable tension* stress at this shear;

$$\frac{F'_{nt}}{\Omega} = F_{t,allowable} = 45 \text{ ksi}$$

$$\frac{F_{nv}}{\Omega} = F_{v,allowable} = 24 \text{ ksi}$$

Therefore, the 1/2" diameter A325 bolt is sufficient for this application ✓

TAG: UUT-11



Note:
1)All Dimensions are in Inches
2)See Yaskawa dwg# DD.Z1.1.F1.02 for details.

CERTIFIED FOR:

JOB NAME: Pase II VFDs Seismic Anchorage

CUSTOMER : Yaskawa

CUSTOMER P.O.: 4200211053

SALES ORDER: 267486

UUT-11 STEEL ANCHORAGE LAYOUT

THE VMC GROUP
The Power of Together
Bloomingdale, NJ 07403
Houston, TX 77041

SCALE : NONE	Member VISCMA
SHEET: 39 OF 76	
DRAWING NO.: VMA-49850 01A	REVISION

THE VMC GROUP

Aeroflex International Isolators | Amber/Booth | Korfund Dynamics | Vibration Mountings & Controls

PROJECT	JOB / DWG NUMBER		REV. NO.	SHEET NO.
Yaskawa VFDs Phase II OSP & IBCS	VMA-49850-1A		00	40 of 76
CUSTOMER	BY	DATE	CHECKED	DATE
Yaskawa	RJH	3/31/2015		

X-iv-d. Seismic Force Calculation: UUT-11

◉ LRFD ◯ ASD ◯ AC-156

Ss =	3.00	ap =	2.5	From the tables:				
z/h =	1.0	Rp =	6	Fa =	1.00		Min. limit	Actual	Max. limit
Site Class	D	Ip =	1.5	S_{DS} =	2.000	Fp/Wp =	0.90 g's	1.50 g's	4.80 g's
Occupancy Category	IV	Calculated Seismic Design Category		D			DL	E
Mfr	Yaskawa	Model	N/A			Load Combination 1	1.2	1
Calculate the maximum loading at the most critical anchor location.						Load Combination 2	0.9	

Principal Axis Calculation

Input Data							Calculated Loads		
W	horz g's	vert g's		Hcg	Xcg	Ycg	Phx	Pz Max	Pz Min
950 #	1.500	0.500	1.600	47.58"	19.27"	13.57"	1425 #	1520 #	475 #

	Restraint Locations		Iy1	Ix1	Ixy	J1	Overturning Loads (Fp Only)	Rigid Weight Distribution	Seismic Vertical Distribution	
	X	Y	$(X\text{-}Xcr)^2$	$(Y\text{-}Ycr)^2$	(X-Xcr)* (Y-Ycr)	r^2	P ot (Tens = -)	Static 1.0 g Vert	Max Vert	Min Vert
1	1.05"	1.05"	313	87	165	400	-2056 #	149 #	-1818	-1982
2	1.05"	19.68"	313	87	-165	400	1164 #	312 #	1664	1320
3	36.45"	1.05"	313	87	-165	400	-1164 #	163 #	-904	-1083
4	36.45"	19.68"	313	87	165	400	2056 #	326 #	2578	2219
	Center of Restraints		Iy total	Ix total	Ixy total	J total	0 #	950 #	1520	475
	18.8"	10.4"	1253	347	0	1600		0	0	0

Cx	Cy	# Vertical Restraints	# Horizontal Restraints	Theta		Tanθ	r max
17.7"	9.3"	4	4	27.8 deg	0.484 rad	0.526	20.0"

	Mx	My	MxIy-MyIxy	MyIx-MxIxy	$IxIy\text{-}Ixy^2$	Max Loads per Location	
Fp Only	60000	31576	7.52E+07	1.10E+07	4.35E+05	Comp (Max Vert)	2578 #
					Mz	Tens. (Min Vert)	1982 #
Static Vert	3045	494	3.82E+06	1.71E+05	4627	Shear	414 #

Design Tension =	1982#	Design Shear =	414#

Equipment is attached to concrete with (4) Hilti Kwik Bolt TZ-CS, 1/2" Dia. with 3.25" min. embedment

Edge distance of 6" on a 6" thick concrete pad of 4000Psi

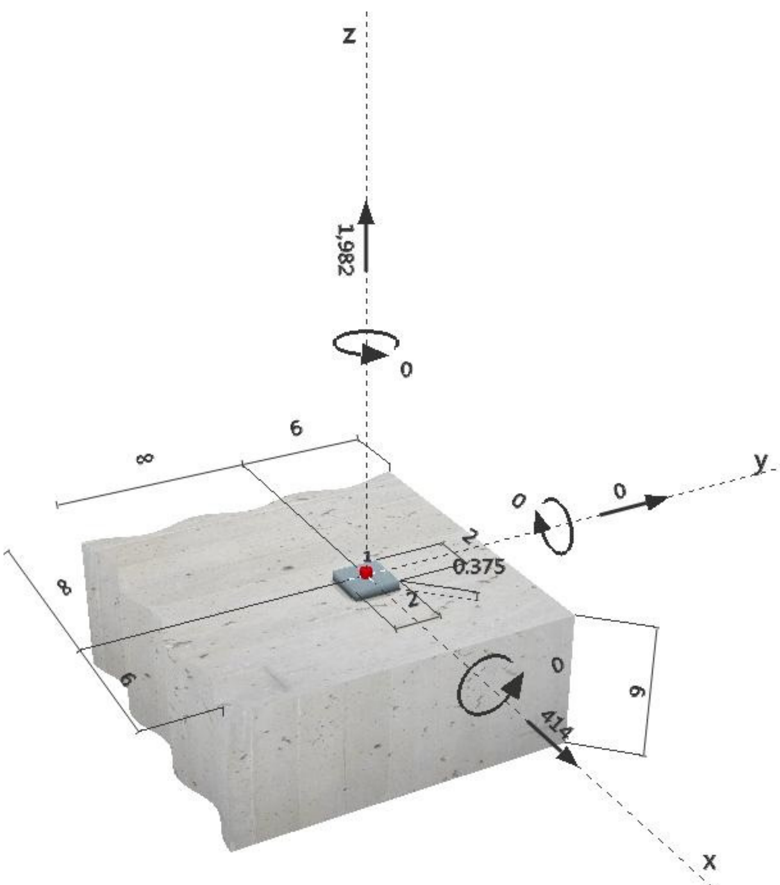
Company:		Page:	41
Specifier:		Project:	
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	4/1/2015
E-Mail:			

Specifier's comments:

1 Input data

Anchor type and diameter:	**Kwik Bolt TZ - CS 1/2 (3 1/4)**
Effective embedment depth:	$h_{ef,act}$ = 3.250 in., h_{nom} = 3.625 in.
Material:	Carbon Steel
Evaluation Service Report:	ESR-1917
Issued I Valid:	5/1/2013 | 5/1/2015
Proof:	design method ACI 318-11 / Mech.
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.375 in.
Anchor plate:	l_x x l_y x t = 2.000 in. x 2.000 in. x 0.375 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, 4000, f_c' = 4000 psi; h = 6.000 in.
Installation:	hammer drilled hole, installation condition: dry
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)	Tension load: yes (D.3.3.4.3 (d))
	Shear load: yes (D.3.3.5.3 (c))

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



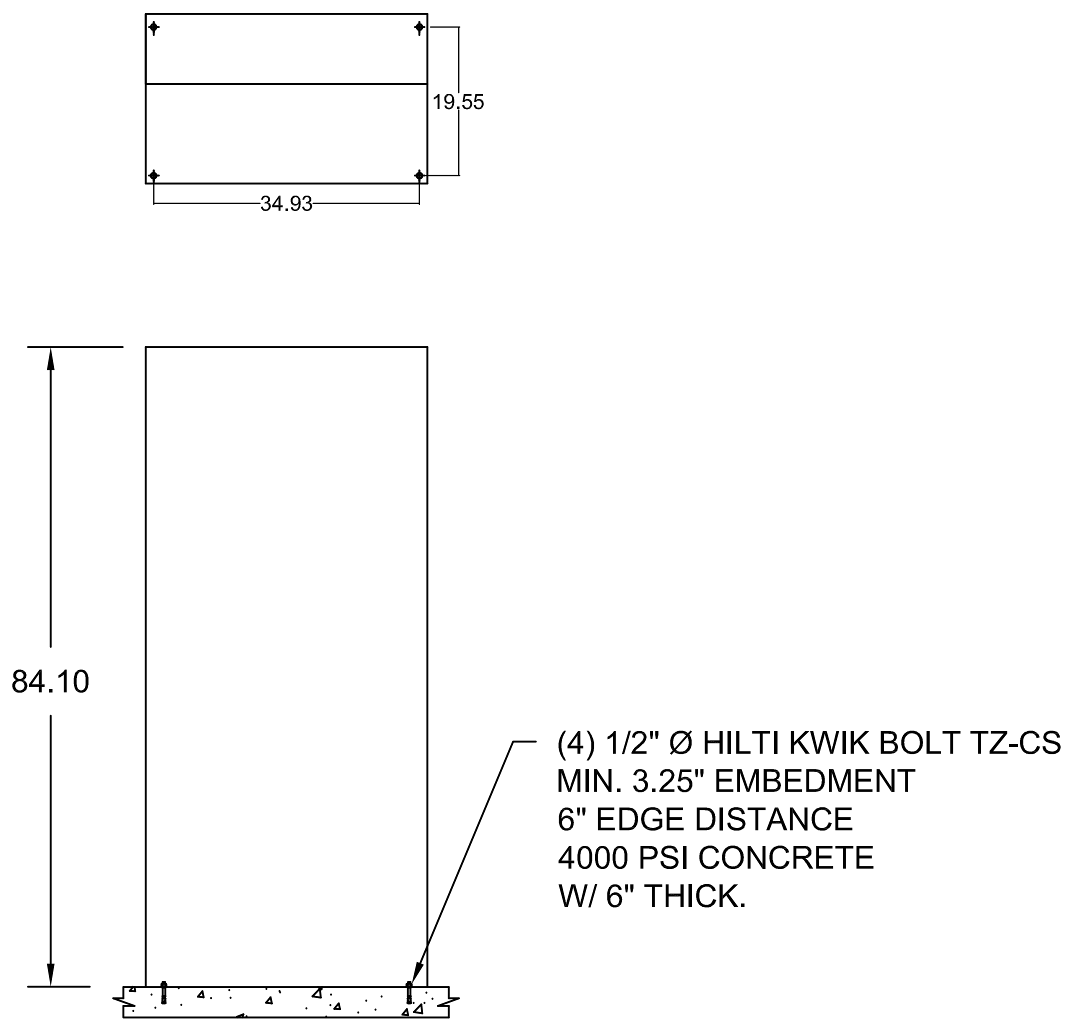
2 Proof I Utilization (Governing Cases)

		Design values [lb]		Utilization	
Loading	**Proof**	**Load**	**Capacity**	β_N / β_V [%]	**Status**
Tension	Pullout Strength	1982	3031	66 / -	OK
Shear	Concrete edge failure in direction x+	414	2868	- / 15	OK

Loading	β_N	β_V	ζ	**Utilization** $\beta_{N,V}$ [%]	**Status**
Combined tension and shear loads	0.654	0.144	5/3	54	OK

Fastening meets the design criteria!

TAG: UUT-11



Note:
1)All Dimensions are in Inches
2)See Yaskawa dwg# DD.Z1.1.F1.02 for details.

CERTIFIED FOR: JOB NAME: Pase II VFDs Seismic Anchorage CUSTOMER : Yaskawa CUSTOMER P.O.: 4200211053 SALES ORDER: 267486	UUT-11 CONCRETE ANCHORAGE LAYOUT	THE VMC GROUP *The Power of Together* Bloomingdale, NJ 07403 Houston, TX 77041	SCALE : NONE SHEET: 43 OF 76 Member VISCMA DRAWING NO.: VMA-49850 01A REVISION

THE VMC GROUP

Aeroflex International Isolators | Amber/Booth | Korfund Dynamics | Vibration Mountings & Controls

PROJECT	JOB / DWG NUMBER	REV. NO.	SHEET NO.
Yaskawa VFDs Phase II OSP & IBCS	VMA-49850-1A	00	44 of 76

CUSTOMER	BY	DATE	CHECKED	DATE
Yaskawa	RJH	4/1/2015		

X-v-a. Seismic Force Calculation: UUT-12

○ LRFD ● ASD ○ AC-156

Ss =	3.00	ap =	2.5	From the tables:				
z/h =	1.0	Rp =	6	Fa =	1.00		Min. limit	Actual	Max. limit
Site Class	D	Ip =	1.5	S_{DS} =	2.000	Fp/Wp =	0.90 g's	1.50 g's	4.80 g's
Occupancy Category	IV	Calculated Seismic Design Category			D			DL	E
Mfr	Yaskawa	Model	N/A			Load Combination 1		1	0.7
Calculate the maximum loading at the most critical anchor location.						Load Combination 2		0.6	

Principal Axis Calculation

Input Data							Calculated Loads		
W	horz g's	vert g's		Hcg	Xcg	Ycg	Phx	Pz Max	Pz Min
2100 #	1.050	0.320	1.280	42.74"	33.96"	12.57"	2205 #	2688 #	672 #

	Restraint Locations		Iy1	Ix1	Ixy	J1	Overturning Loads (Fp Only)	Rigid Weight Distribution	Seismic Vertical Distribution	
	X	Y	$(X-Xcr)^2$	$(Y-Ycr)^2$	(X-Xcr)*(Y-Ycr)	r^2	P ot (Tens = -)	Static 1.0 g Vert	Max Vert	Min Vert
1	1.00"	1.00"	1032	196	450	1228	1480 #	432 #	2033	1618
2	1.00"	15.00"	1032	0	0	1032	-136 #	341 #	300	-27
3	1.00"	29.00"	1032	196	-450	1228	-1752 #	250 #	-1433	-1673
4	65.25"	1.00"	1032	196	-450	1228	1752 #	450 #	2329	1897
5	65.25"	15.00"	1032	0	0	1032	136 #	359 #	596	251
6	65.25"	29.00"	1032	196	450	1228	-1480 #	268 #	-1137	-1394
	Center of Restraints		Iy total	Ix total	Ixy total	J total	0 #	2100 #	2688	672
	33.1"	15.0"	6192	784	0	6976		0	0	0

Cx	Cy	# Vertical Restraints	# Horizontal Restraints	Theta		Tanθ	r max
32.1"	14.0"	6	6	163.8 deg	0.283 rad	-0.291	35.0"

	Mx	My	MxIy-MyIxy	MyIx-MxIxy	$IxIy-Ixy^2$
Fp Only	-90500	26293	-5.60E+08	2.06E+07	4.85E+06
					Mz
Static Vert	-5103	1754	-3.16E+07	1.37E+06	5666

Max Loads per Location	
Comp (Max Vert)	2329 #
Tens. (Min Vert)	1673 #
Shear	396 #

THE VMC GROUP
Aeroflex International Isolators | Amber/Booth | Korfund Dynamics | Vibration Mountings & Controls

PROJECT	JOB / DWG NUMBER	REV. NO.	SHEET NO.
Yaskawa VFDs Phase II OSP & IBCS	VMA-49850-1A	00	
CUSTOMER	BY / DATE	CHECKED	DATE
Yaskawa	RJH 4/1/2015		

X-v-b. Check Bolting of Equipment to Structural steel

Tag: UUT-12

Bolting using 1/2" diameter SAE Grade 8/ ASTM A490 bolt at each bolt location

Fastener			Loading		Fastener Stress	
Type	Diameter	Area	Tension	Shear	Tension	Shear
A325	0.500	0.196 in^2	1673 #	396 #	8.52 ksi	2.02 ksi

Nominal Stress			Allowable Stress		Pass/Fail	
F_{nt}	F_{nv}	F'_{nt}	$F_{t,allow}$	$F_{v,allow}$	Tension	Shear
90 ksi	48 ksi	90 ksi	45 ksi	24 ksi	**PASS**	**PASS**

Check Bolting to Steel Structure

Stress Area = 0.196 in^2

Design Tension Stress of the Bolt = 1673 # / 0.196 in^2 = 8.52 ksi

Design Shear Stress of the Bolt = 396 # / 0.196 in^2 = 2.02 ksi

F_{nt} = Nominal Tensile Stress from Table J3.2 = 90 ksi

F_{nv} = Nominal Shear Stress from Table J3.2 = 48 ksi

f_v = Design Shear Stress

Ω = 2.00 (ASD)

From AISC Manual of Steel Construction 13th Edition Section J3.6:

$$F'_{nt} = 1.3F_{nt} - \frac{\Omega F_{nt}}{F_{nv}} f_v \leq F_{nt}$$

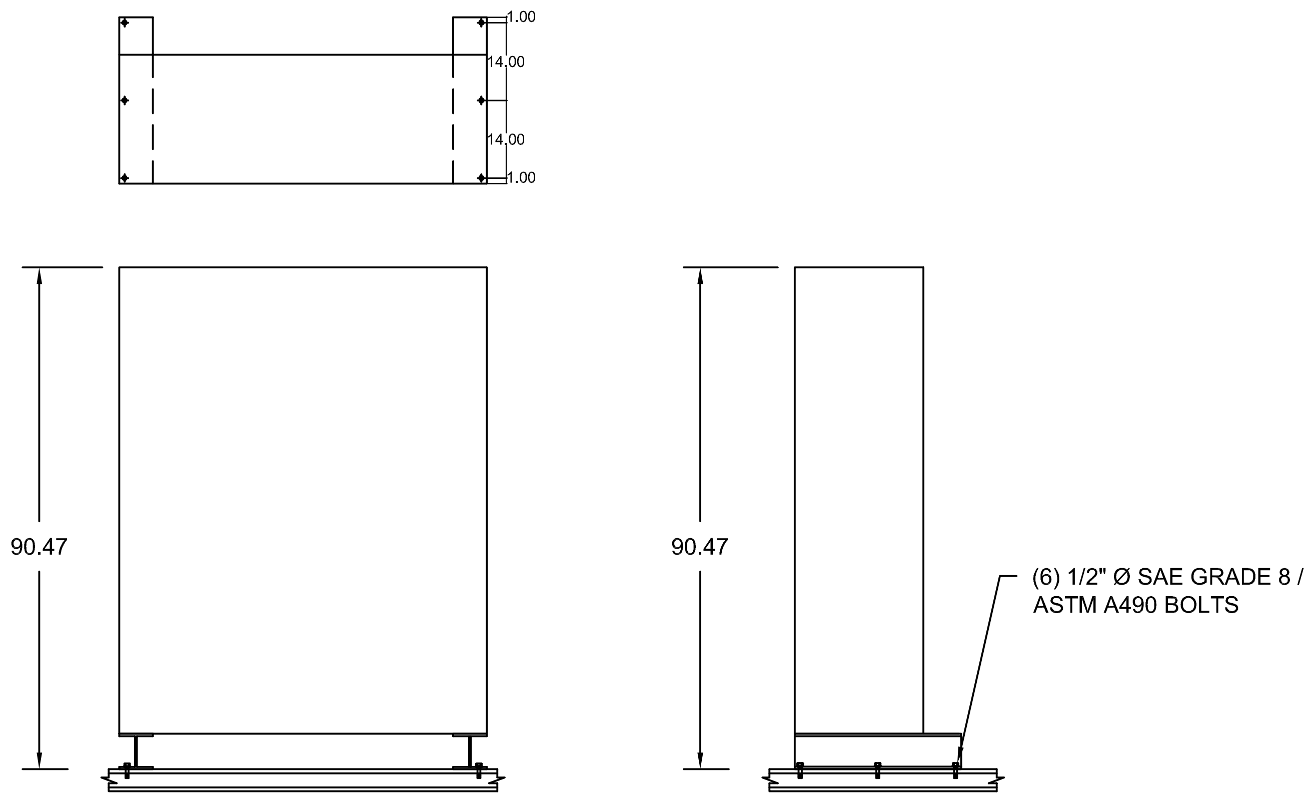
Applying the equation above to find the *allowable tension* stress at this shear;

$$\frac{F'_{nt}}{\Omega} = F_{t,allowable} = 45 \text{ ksi}$$

$$\frac{F_{nv}}{\Omega} = F_{v,allowable} = 24 \text{ ksi}$$

Therefore, the 1/2" diameter A325 bolt is sufficient for this application ✓

TAG: UUT-12



Note:
1)All Dimensions are in Inches
2)See Yaskawa dwg# DD.Z1.3R.F2.02 for details.
3) See Yaskawa dwg # USP03233 for mounting foot details

CERTIFIED FOR:

JOB NAME: Pase II VFDs Seismic Anchorage

CUSTOMER : Yaskawa

CUSTOMER P.O.: 4200211053

SALES ORDER: 267486

UUT-12 STEEL ANCHORAGE LAYOUT

THE VMC GROUP
The Power of Together
Bloomingdale, NJ 07403
Houston, TX 77041

SCALE :	NONE
SHEET:	46 OF 76
DRAWING NO.:	VMA-49850 01A
REVISION	

Member VISCMA

PROJECT	JOB / DWG NUMBER	REV. NO.	SHEET NO.
Yaskawa VFDs Phase II OSP & IBCS	VMA-49850-1A	00	47 of 76
CUSTOMER	BY / DATE	CHECKED	DATE
Yaskawa	RJH 4/1/2015		

X-v-d. Seismic Force Calculation: UUT-12

◉ LRFD ○ ASD ○ AC-156

Ss =	3.00	ap =	2.5	From the tables:				
z/h =	1.0	Rp =	6	Fa =	1.00		Min. limit	Actual	Max. limit
Site Class	D	Ip =	1.5	S_{DS} =	2.000	Fp/Wp =	0.90 g's	1.50 g's	4.80 g's
Occupancy Category	IV	Calculated Seismic Design Category		D			DL	E
Mfr	Yaskawa	Model	N/A			Load Combination 1	1.2	1
Calculate the maximum loading at the most critical anchor location.						Load Combination 2	0.9	

Principal Axis Calculation

Input Data							Calculated Loads		
W	horz g's	vert g's		Hcg	Xcg	Ycg	Phx	Pz Max	Pz Min
2100 #	1.500	0.500	1.600	42.74"	33.96"	12.57"	3150 #	3360 #	1050 #

	Restraint Locations		Iy1	Ix1	Ixy	J1	Overturning Loads (Fp Only)	Rigid Weight Distribution	Seismic Vertical Distribution	
	X	Y	$(X\text{-}Xcr)^2$	$(Y\text{-}Ycr)^2$	(X-Xcr)* (Y-Ycr)	r^2	P ot (Tens = -)	Static 1.0 g Vert	Max Vert	Min Vert
1	1.00"	1.00"	1032	196	450	1228	2114 #	432 #	2805	2330
2	1.00"	15.00"	1032	0	0	1032	-195 #	341 #	351	-24
3	1.00"	29.00"	1032	196	-450	1228	-2504 #	250 #	-2104	-2379
4	65.25"	1.00"	1032	196	-450	1228	2504 #	450 #	3224	2729
5	65.25"	15.00"	1032	0	0	1032	195 #	359 #	769	374
6	65.25"	29.00"	1032	196	450	1228	-2114 #	268 #	-1685	-1980
	Center of Restraints		Iy total	Ix total	Ixy total	J total	0 #	2100 #	3360	1050
	33.1"	15.0"	6192	784	0	6976		0	0	0

Cx	Cy	# Vertical Restraints	# Horizontal Restraints	Theta		Tanθ	r max
32.1"	14.0"	6	6	163.8 deg	0.283 rad	-0.291	35.0"

	Mx	My	MxIy-MyIxy	MyIx-MxIxy	$IxIy\text{-}Ixy^2$
Fp Only	-129285	37561	-8.01E+08	2.94E+07	4.85E+06
					Mz
Static Vert	-5103	1754	-3.16E+07	1.37E+06	8094

Max Loads per Location	
Comp (Max Vert)	3224 #
Tens. (Min Vert)	2379 #
Shear	566 #

Design Tension =	2379#	Design Shear =	566#

Equipment is attached to concrete with (4) Hilti Kwik Bolt TZ-CS, 1/2" Dia. with 3.25" min. embedment
Edge distance of 6" on a 6" thick concrete pad of 4000Psi

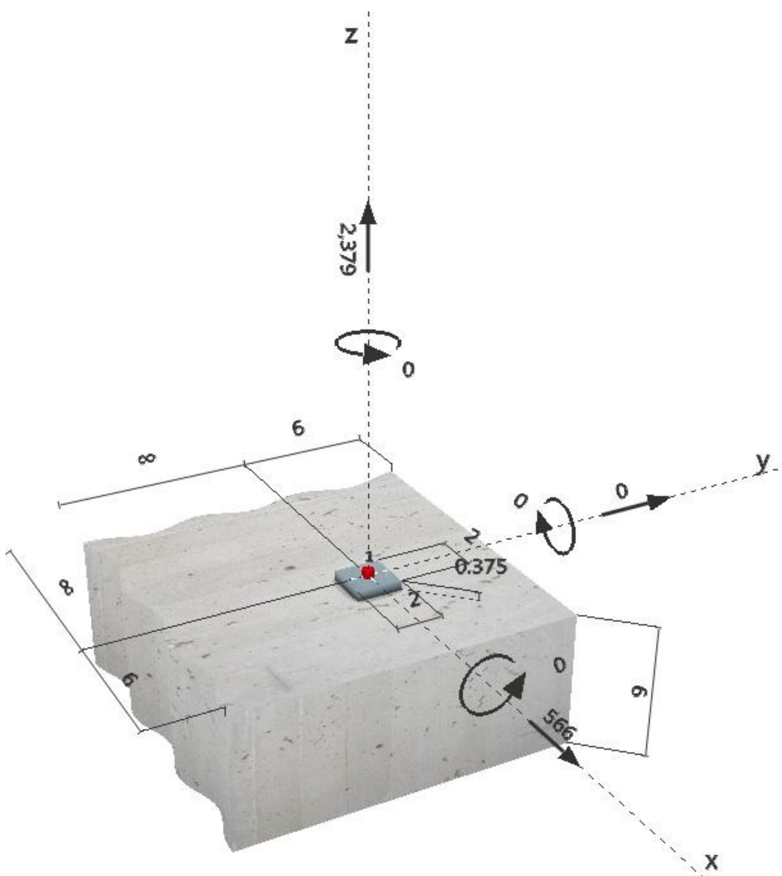
Company:		Page:	48
Specifier:		Project:	
Address:		Sub-Project I Pos. No.:	
Phone I Fax: |		Date:	4/1/2015
E-Mail:			

Specifier's comments:

1 Input data

Anchor type and diameter:	**Kwik Bolt TZ - CS 1/2 (3 1/4)**
Effective embedment depth:	$h_{ef,act}$ = 3.250 in., h_{nom} = 3.625 in.
Material:	Carbon Steel
Evaluation Service Report:	ESR-1917
Issued I Valid:	5/1/2013 | 5/1/2015
Proof:	design method ACI 318-11 / Mech.
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.375 in.
Anchor plate:	l_x x l_y x t = 2.000 in. x 2.000 in. x 0.375 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, 4000, f_c' = 4000 psi; h = 6.000 in.
Installation:	hammer drilled hole, installation condition: dry
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)	Tension load: yes (D.3.3.4.3 (d))
	Shear load: yes (D.3.3.5.3 (c))

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



Company:
Specifier:
Address:
Phone I Fax: |
E-Mail:

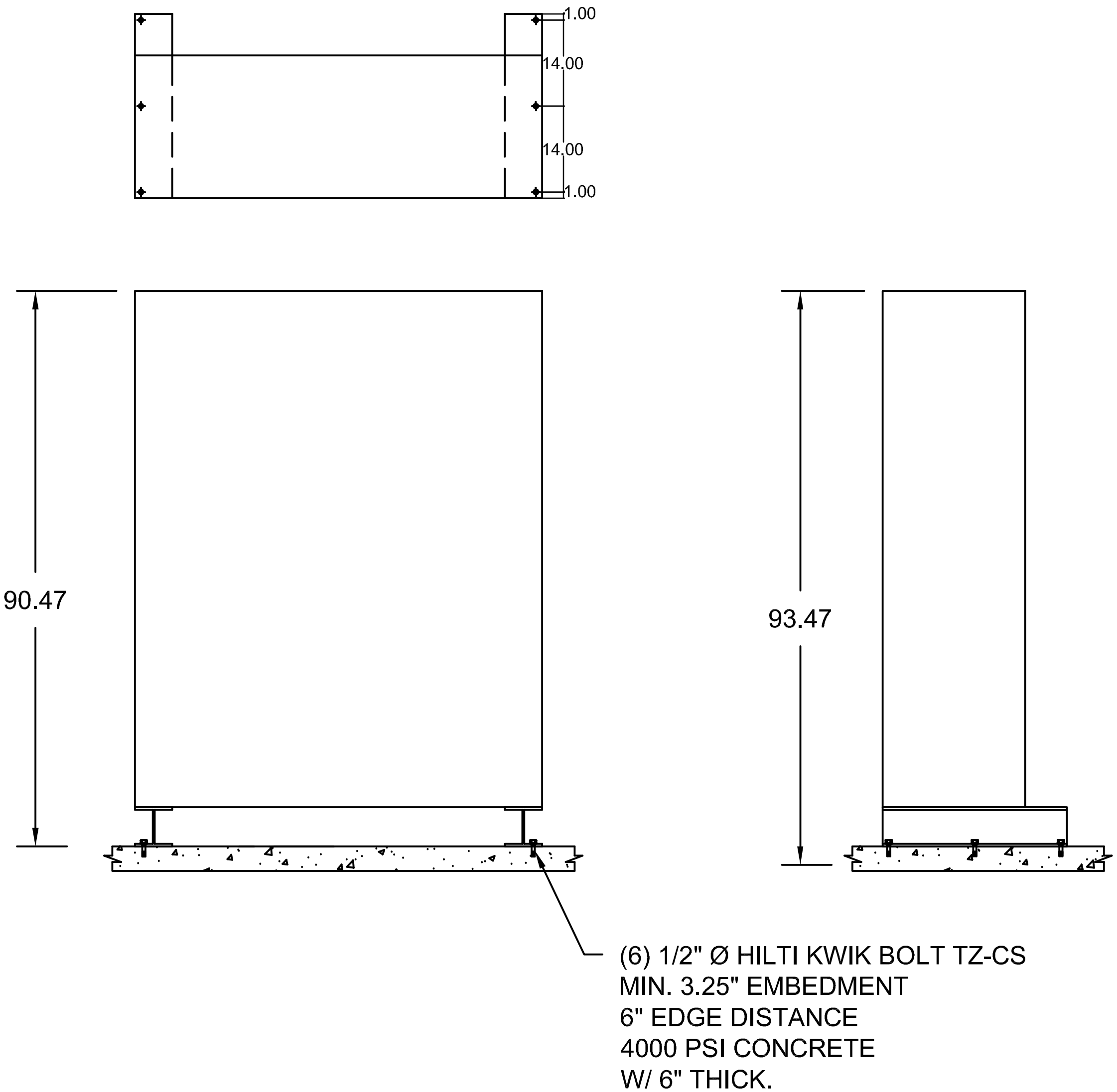
2 Proof I Utilization (Governing Cases)

		Design values [lb]		Utilization	
Loading	**Proof**	**Load**	**Capacity**	β_N / β_V **[%]**	**Status**
Tension	Pullout Strength	2379	3031	79 / -	OK
Shear	Concrete edge failure in direction x+	566	2868	- / 20	OK

Loading	β_N	β_V	ζ	**Utilization** $\beta_{N,V}$ **[%]**	**Status**
Combined tension and shear loads	0.785	0.197	5/3	74	OK

Fastening meets the design criteria!

TAG: UUT-12



Note:

1)All Dimensions are in Inches

2)See Yaskawa dwg# DD.Z1.3R.F2.02 for details.

3) See Yaskawa dwg # USP03233 for mounting foot details

CERTIFIED FOR:

JOB NAME: Pase II VFDs Seismic Anchorage

CUSTOMER : Yaskawa

CUSTOMER P.O.: 4200211053

SALES ORDER: 267486

UUT-12 CONCRETE ANCHORAGE LAYOUT

THE VMC GROUP
The Power of Together
Bloomingdale, NJ 07403
Houston, TX 77041

SCALE : NONE

SHEET: 50 OF 76

DRAWING NO.: VMA-49850 01A

REVISION

Member VISCMA

THE VMC GROUP

Aeroflex International Isolators | Amber/Booth | Korfund Dynamics | Vibration Mountings & Controls

PROJECT	JOB / DWG NUMBER	REV. NO.	SHEET NO.
Yaskawa VFDs Phase II OSP & IBCS	VMA-49850-1A	00	51 of 76
CUSTOMER	BY / DATE	CHECKED	DATE
Yaskawa	RJH 4/1/2015		

X-vi-a. Seismic Force Calculation: UUT-13

○ LRFD ◉ ASD ○ AC-156

Ss =	3.00	ap =	2.5	From the tables:				
z/h =	1.0	Rp =	6	Fa =	1.00		Min. limit	Actual	Max. limit
Site Class	D	Ip =	1.5	S_{DS} =	2.000	Fp/Wp =	0.90 g's	1.50 g's	4.80 g's
Occupancy Category	IV	Calculated Seismic Design Category		D				DL	E
Mfr	Yaskawa	Model	N/A			Load Combination 1		1	0.7
Calculate the maximum loading at the most critical anchor location.						Load Combination 2		0.6	

Principal Axis Calculation

Input Data							Calculated Loads		
W	horz g's	vert g's		Hcg	Xcg	Ycg	Phx	Pz Max	Pz Min
2200 #	1.050	0.320	1.280	39.40"	36.53"	12.23"	2310 #	2816 #	704 #

	Restraint Locations		Iy1	Ix1	Ixy	J1	Overturning Loads (Fp Only)	Rigid Weight Distribution	Seismic Vertical Distribution	
	X	Y	$(X\text{-}Xcr)^2$	$(Y\text{-}Ycr)^2$	(X-Xcr)*(Y-Ycr)	r^2	P ot (Tens = -)	Static 1.0 g Vert	Max Vert	Min Vert
1	1.05"	1.05"	1006	87	295	1093	-2546 #	375 #	-2066	-2426
2	1.05"	19.68"	1006	87	-295	1093	2141 #	595 #	2903	2332
3	64.48"	1.05"	1006	87	-295	1093	-2141 #	505 #	-1495	-1980
4	64.48"	19.68"	1006	87	295	1093	2546 #	725 #	3474	2778
	Center of Restraints		Iy total	Ix total	Ixy total	J total	0 #	2200 #	2816	704
	32.8"	10.4"	4023	347	0	4370		0	0	0

Cx	Cy	# Vertical Restraints	# Horizontal Restraints	Theta		Tanθ	r max
31.7"	9.3"	4	4	16.4 deg	0.286 rad	0.294	33.1"

	Mx	My	MxIy-MyIxy	MyIx-MxIxy	$IxIy\text{-}Ixy^2$
Fp Only	87325	25648	3.51E+08	8.90E+06	1.40E+06
					Mz
Static Vert	4103	8283	1.65E+07	2.87E+06	9706

Max Loads per Location	
Comp (Max Vert)	3474 #
Tens. (Min Vert)	2426 #
Shear	651 #

PROJECT	JOB / DWG NUMBER	REV. NO.	SHEET NO.
Yaskawa VFDs Phase II OSP & IBCS	VMA-49850-1A	00	52 of 76
CUSTOMER	BY / DATE	CHECKED	DATE
Yaskawa	RJH 4/1/2015		

X-vi-b. Check Bolting of Equipment to Structural steel
Tag: UUT-13
Bolting using 1/2" diameter SAE Grade 8/ ASTM A490 bolt at each bolt location

Fastener			Loading		Fastener Stress	
Type	Diameter	Area	Tension	Shear	Tension	Shear
A325	0.500	0.196 in^2	2426 #	651 #	12.36 ksi	3.32 ksi

Nominal Stress			Allowable Stress		Pass/Fail	
F_{nt}	F_{nv}	F'_{nt}	$F_{t,allow}$	$F_{v,allow}$	Tension	Shear
90 ksi	48 ksi	90 ksi	45 ksi	24 ksi	**PASS**	**PASS**

<u>Check Bolting to Steel Structure</u>
Stress Area = 0.196 in^2

Design Tension Stress of the Bolt = 2426 # / 0.196 in^2 = 12.36 ksi
Design Shear Stress of the Bolt = 651 # / 0.196 in^2 = 3.32 ksi

F_{nt} = Nominal Tensile Stress from Table J3.2 = 90 ksi
F_{nv} = Nominal Shear Stress from Table J3.2 = 48 ksi
f_v = Design Shear Stress
Ω = 2.00 (ASD)

From AISC Manual of Steel Construction 13th Edition Section J3.6:

$$F'_{nt} = 1.3F_{nt} - \frac{\Omega F_{nt}}{F_{nv}} f_v \leq F_{nt}$$

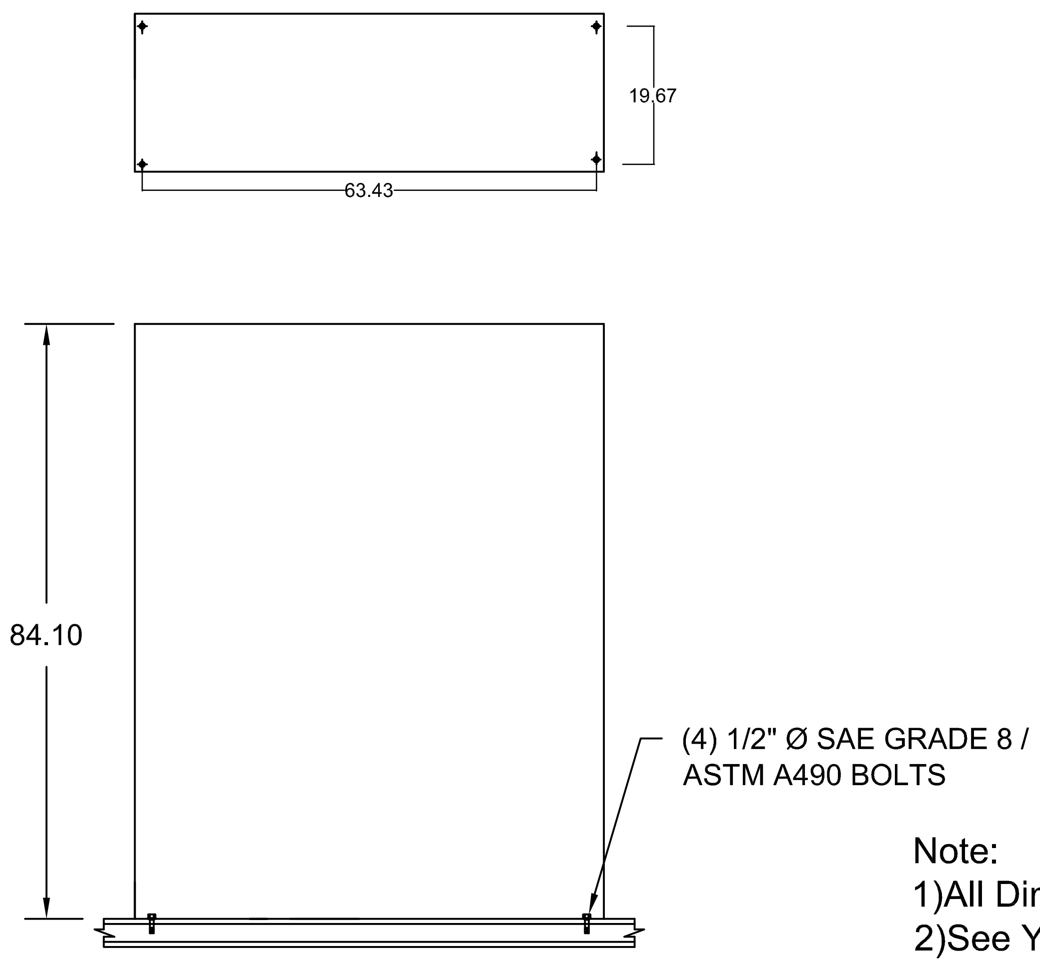
Applying the equation above to find the *allowable tension* <u>*stress*</u> at this shear;

$$\frac{F'_{nt}}{\Omega} = F_{t,allowable} = 45 \text{ ksi}$$

$$\frac{F_{nv}}{\Omega} = F_{v,allowable} = 24 \text{ ksi}$$

Therefore, the 1/2" diameter A325 bolt is sufficient for this application ✓

TAG: UUT-11



Note:
1)All Dimensions are in Inches
2)See Yaskawa dwg# DD.Z1.1.F2.02 for details.

CERTIFIED FOR:

JOB NAME: Pase II VFDs Seismic Anchorage

CUSTOMER : Yaskawa

CUSTOMER P.O.: 4200211053

SALES ORDER: 267486

UUT-11 STEEL ANCHORAGE LAYOUT

THE VMC GROUP
The Power of Together
Bloomingdale, NJ 07403
Houston, TX 77041

SCALE : NONE

SHEET: 53 OF 76

Member VISCMA

DRAWING NO.: VMA-49850 01A

REVISION

THE VMC GROUP

Aeroflex International Isolators | Amber/Booth | Korfund Dynamics | Vibration Mountings & Controls

PROJECT	JOB / DWG NUMBER	REV. NO.	SHEET NO.
Yaskawa VFDs Phase II OSP & IBCS	VMA-49850-1A	00	54 of 76
CUSTOMER	BY / DATE	CHECKED	DATE
Yaskawa	RJH 4/1/2015		

X-vi-a. Seismic Force Calculation: UUT-13

(◉) LRFD ( ) ASD ( ) AC-156

Ss =	3.00	ap =	2.5	From the tables:				
z/h =	1.0	Rp =	6	Fa =	1.00		Min. limit	Actual	Max. limit
Site Class	D	Ip =	1.5	S_{DS} =	2.000	Fp/Wp =	0.90 g's	1.50 g's	4.80 g's
Occupancy Category	IV	Calculated Seismic Design Category		D			DL	E
Mfr	Yaskawa	Model	N/A			Load Combination 1	1.2	1
Calculate the maximum loading at the most critical anchor location.						Load Combination 2	0.9	

Principal Axis Calculation

	Input Data							Calculated Loads		
	W	horz g's	vert g's		Hcg	Xcg	Ycg	Phx	Pz Max	Pz Min
	2200 #	1.500	0.500	1.600	39.40"	36.53"	12.23"	3300 #	3520 #	1100 #
	Restraint Locations		Iy1	Ix1	Ixy	J1	Overturning Loads (Fp Only)	Rigid Weight Distribution	Seismic Vertical Distribution	
	X	Y	$(X-Xcr)^2$	$(Y-Ycr)^2$	(X-Xcr)*(Y-Ycr)	r^2	P ot (Tens = -)	Static 1.0 g Vert	Max Vert	Min Vert
1	1.05"	1.05"	1006	87	295	1093	-3637 #	375 #	-3038	-3450
2	1.05"	19.68"	1006	87	-295	1093	3059 #	595 #	4011	3357
3	64.48"	1.05"	1006	87	-295	1093	-3059 #	505 #	-2251	-2807
4	64.48"	19.68"	1006	87	295	1093	3637 #	725 #	4798	4000
	Center of Restraints		Iy total	Ix total	Ixy total	J total	0 #	2200 #	3520	1100
	32.8"	10.4"	4023	347	0	4370		0	0	0
	Cx	Cy	# Vertical Restraints		# Horizontal Restraints		Theta		Tanθ	r max
	31.7"	9.3"	4		4		16.4 deg	0.286 rad	0.294	33.1"
		Mx	My	MxIy-MyIxy	MyIx-MxIxy	$IxIy-Ixy^2$	Max Loads per Location			
	Fp Only	124750	36640	5.02E+08	1.27E+07	1.40E+06	Comp (Max Vert)		4798 #	
						Mz	Tens. (Min Vert)		3450 #	
	Static Vert	4103	8283	1.65E+07	2.87E+06	13865	Shear		930 #	

Design Tension =	3450#

Design Shear =	930#

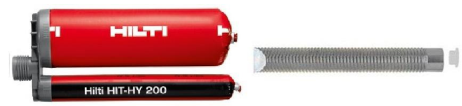
Equipment is attached to concrete with (4) HIT-HY 200 + HIS-N B7, 1/2" Dia. with 5" min. embedment

Edge distance of 8" on a 8" thick concrete pad of 4000Psi

Company:		Page:	55
Specifier:		Project:	
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	4/1/2015
E-Mail:			

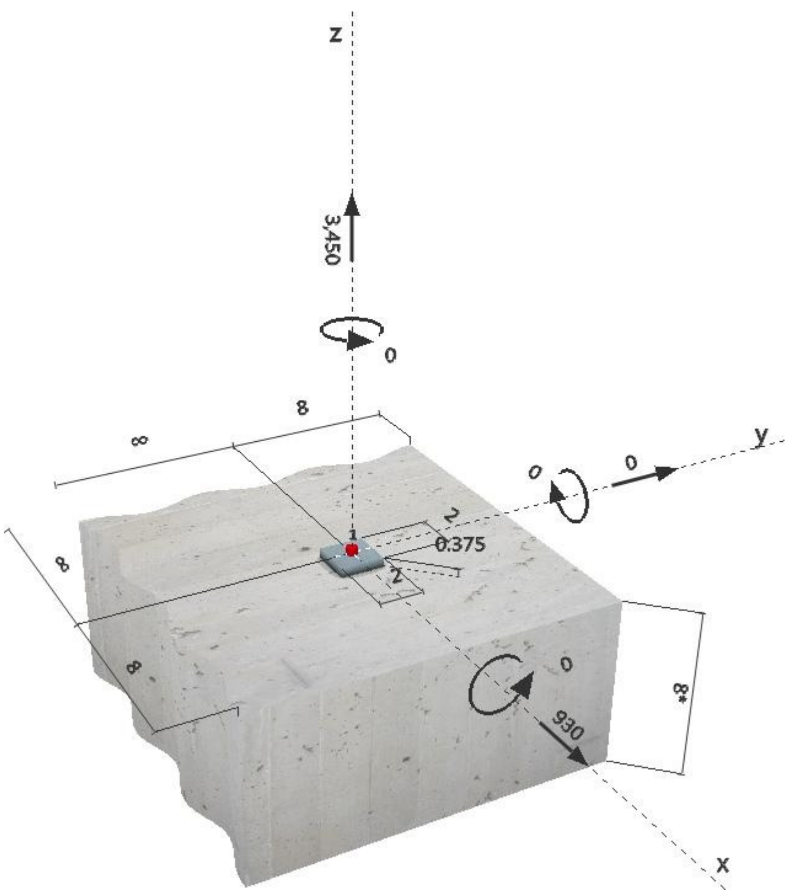
Specifier's comments:

1 Input data



Anchor type and diameter:	**HIT-HY 200 + HIS-N B7 1/2**
Effective embedment depth:	$h_{ef,act}$ = 5.000 in., h_{nom} = 5.000 in.
Material:	ASTM A 193 Grade B7
Evaluation Service Report:	ESR-3187
Issued I Valid:	5/1/2014 | 3/1/2016
Proof:	design method ACI 318-11 / Chem
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.375 in.
Anchor plate:	l_x x l_y x t = 2.000 in. x 2.000 in. x 0.375 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, 4000, f_c' = 4000 psi; h = 8.000 in., Temp. short/long: 32/32 °F
Installation:	hammer drilled hole, installation condition: dry
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)	Tension load: yes (D.3.3.4.3 (d))
	Shear load: yes (D.3.3.5.3 (c))

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



Company:
Specifier:
Address:
Phone I Fax: |
E-Mail:

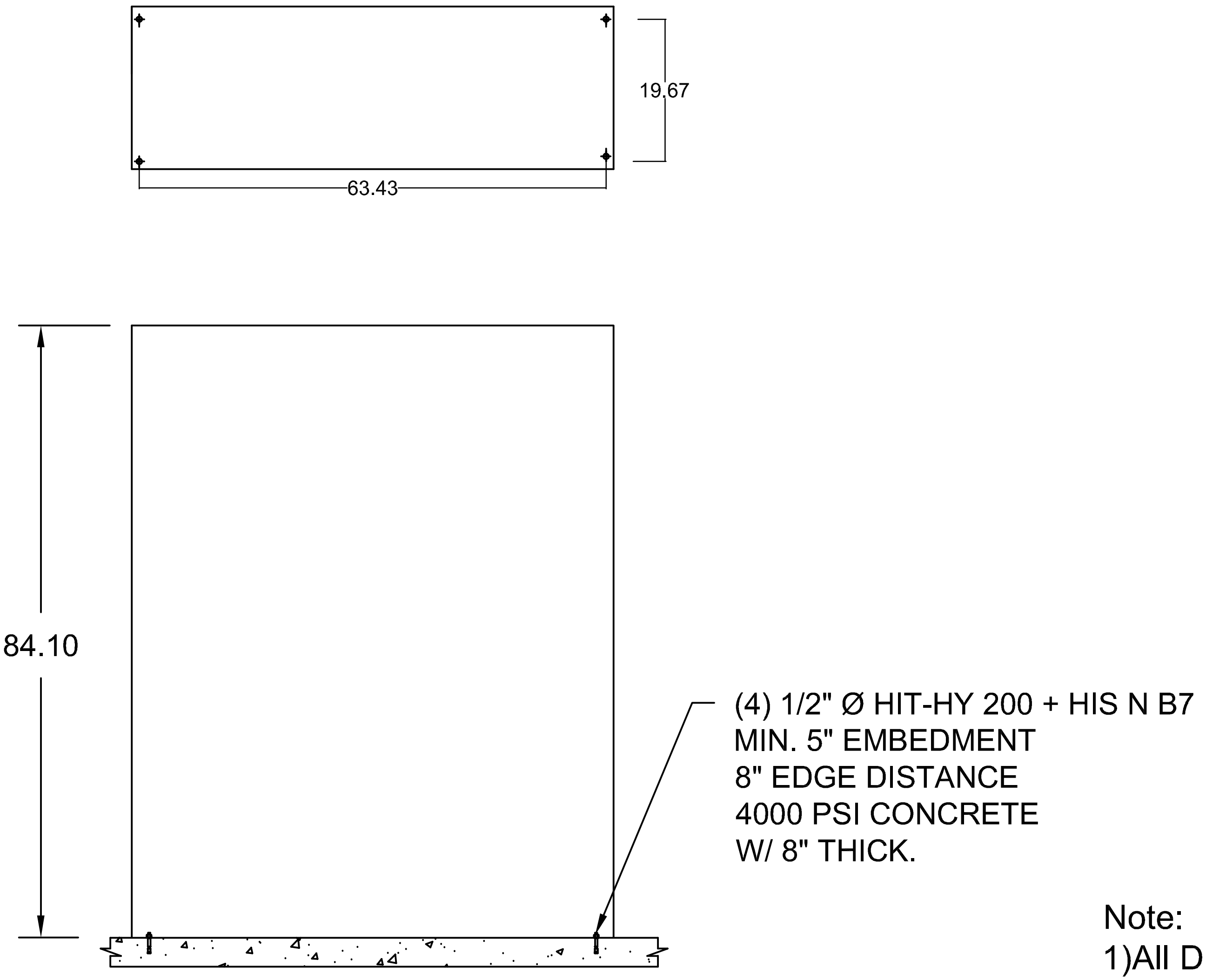
2 Proof I Utilization (Governing Cases)

		Design values [lb]		Utilization	
Loading	**Proof**	**Load**	**Capacity**	β_N / β_V [%]	**Status**
Tension	Bond Strength	3450	3793	91 / -	OK
Shear	Steel Strength	930	4471	- / 21	OK

Loading	β_N	β_V	ζ	**Utilization** $\beta_{N,V}$ **[%]**	**Status**
Combined tension and shear loads	0.909	0.208	5/3	93	OK

Fastening meets the design criteria!

TAG: UUT-11



Note:
1)All Dimensions are in Inches
2)See Yaskawa dwg# DD.Z1.1.F2.02 for details.

CERTIFIED FOR:

JOB NAME: Pase II VFDs Seismic Anchorage

CUSTOMER : Yaskawa

CUSTOMER P.O.: 4200211053

SALES ORDER: 267486

UUT-11 CONCRETE ANCHORAGE LAYOUT

THE VMC GROUP
The Power of Together
Bloomingdale, NJ 07403
Houston, TX 77041

SCALE : NONE	Member VISCMA
SHEET: 57 OF 76	
DRAWING NO.: VMA-49850 01A	REVISION

PROJECT	JOB / DWG NUMBER	REV. NO.	SHEET NO.
Yaskawa VFDs Phase II OSP & IBCS	VMA-49850-1A	00	58 of 76
CUSTOMER	BY / DATE	CHECKED	DATE
Yaskawa	RJH 4/1/2015		

Equipment Tag			
UUT-14 on steel structure			
X-vii-a. Seismic Restraint Load Calculation		Load Combinations are as per ASD	
Mfr	Yaskawa	Model	N/A

Input Values

Coefficient	Value	Units	Description
X	10.55	in	Equipment Depth
Y	8.7	in	Distance Between Attachment Points Along Unit Width
Z	20.76	in	Distance Between Attachment Points Along Unit Height
m	70	lbs	Equipment Mass
g_h	1.05	g	$F_{p,h} / W_p$ = Horizontal Seismic Acceleration
g_v	1.28	g	$(F_{p,v} / W_p + W_p)$ = Vertical Seismic Acceleration
X_{cg}	5.275	in	Center of Gravity Along Depth Direction
Y_{cg}	4.35	in	Center of Gravity Along Width Direction
Z_{cg}	10.38	in	Center of Gravity Along Height Direction

Critical Angle

Coefficient	Value	Units	Description
φ	29	degrees	Worst Case Angle to Apply Seismic Acceleration

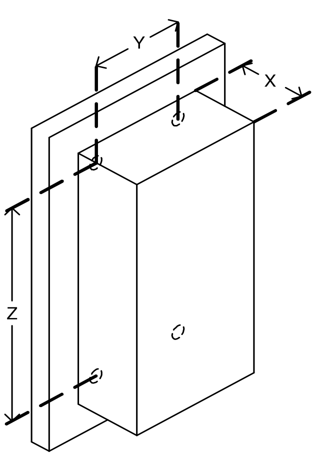
$mg_{h,x} = (F_{p,h}/W_p)\sin(\varphi)$ $mg_{h,y} = (F_{p,h}/W_p)\cos(\varphi)$

$$T_{max} = \frac{mg_v X_{cg}}{2Z} + \frac{mg_{h,x}(Z_{cg} - Z/2)}{2Z} + \frac{mg_{h,x}}{4} + \frac{mg_{h,y} X_{cg}}{2Y} + \frac{mg_{h,x}(|Y_{cg} - Y/2|)}{2Y}$$

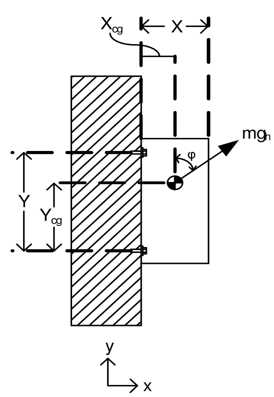
$$V_{max} = \sqrt{\left(\frac{mg_v}{4}\right)^2 + \left(\frac{mg_{h,y}}{4}\right)^2}$$

T_{max}	40 lbs

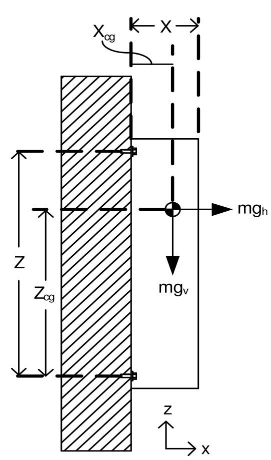
V_{max}	28 lbs



Isometric View



Plan View



Side Elevation View

THE VMC GROUP
Aeroflex International Isolators | Amber/Booth | Korfund Dynamics | Vibration Mountings & Controls

PROJECT	JOB / DWG NUMBER	REV. NO.	SHEET NO.
Yaskawa VFDs Phase II OSP & IBCS	VMA-49850-1A	00	59 of 76
CUSTOMER	BY / DATE	CHECKED	DATE
Yaskawa	RJH 4/1/2015		

X-vii-b. Check screw of Equipment to Structural steel
Tag: UUT-14 using 1/4" diameter screws

Check 1/4" ϕ screw to Steel Structure

Stress Area = 0.0491 in²

Design Tension of the Bolt = 40 lbs.
Design Shear of the Bolt = 28 lbs.

From ICC-ES Report, ESR-2196, Table 2 (page 6 of 10) and Table 4A (page 8 of 10),
Attachment to minimum of gauge 20 steel where the screw head is not in contact,

Allowable tension load is **115 lbs** (Table 2).
Allowable Shear load is **215 lbs** (Table 4A).

Allowable Pullout load 115 lbs > Design Tension load 40 lbs.

Allowable Shear load 215 lbs > Design Shear load 28 lbs.

Therefore, the 1/4"ϕ screw is sufficient for this application ✓

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PROJECT	JOB / DWG NUMBER	REV. NO.	SHEET NO.
Yaskawa VFDs Phase II OSP & IBCS	VMA-49850-1A	00	60 of 76

CUSTOMER	BY	DATE	CHECKED	DATE
Yaskawa	RJH	4/1/2015		

Equipment Tag			
UUT-1 Microdrive on steel structure			
X-viii-a. Seismic Restraint Load Calculation			Load Combinations are as per ASD
Mfr	Yaskawa	Model	N/A
Input Values			
Coefficient	**Value**	**Units**	**Description**
X	5.6	in	Equipment Depth
Y	4.05	in	Distance Between Attachment Points Along Unit Width
Z	4.65	in	Distance Between Attachment Points Along Unit Height
m	5.3	lbs	Equipment Mass
g_h	1.05	g	$F_{p,h} / W_p$ = Horizontal Seismic Acceleration
g_v	1.28	g	$(F_{p,v} / W_p + W_p)$ = Vertical Seismic Acceleration
X_{cg}	2.8	in	Center of Gravity Along Depth Direction
Y_{cg}	2.025	in	Center of Gravity Along Width Direction
Z_{cg}	2.325	in	Center of Gravity Along Height Direction

Critical Angle			
Coefficient	**Value**	**Units**	**Description**
φ	27	degrees	Worst Case Angle to Apply Seismic Acceleration

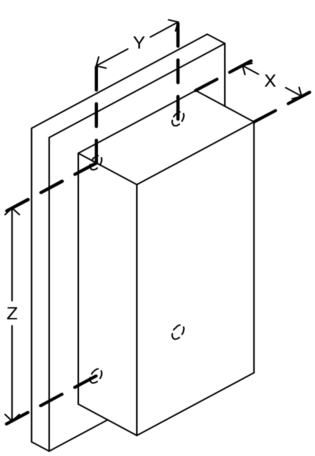
$$mg_{h,x} = (F_{p,h}/W_p)\sin(\varphi) \qquad mg_{h,y} = (F_{p,h}/W_p)\cos(\varphi)$$

$$T_{max} = \frac{mg_v X_{cg}}{2Z} + \frac{mg_{h,x}(Z_{cg} - Z/2)}{2Z} + \frac{mg_{h,x}}{4} + \frac{mg_{h,y} X_{cg}}{2Y} + \frac{mg_{h,x}(|Y_{cg} - Y/2|)}{2Y}$$

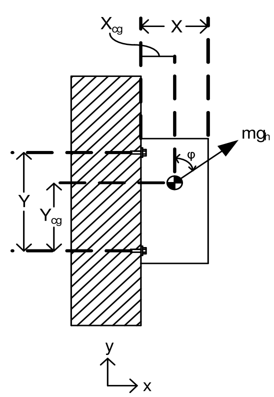
$$V_{max} = \sqrt{\left(\frac{mg_v}{4}\right)^2 + \left(\frac{mg_{h,y}}{4}\right)^2}$$

T_{max}	4 lbs

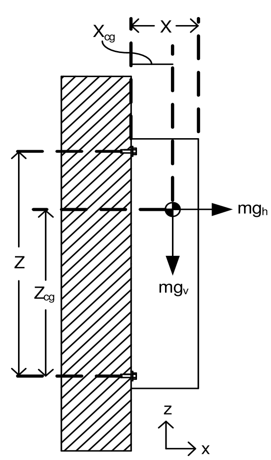
V_{max}	2 lbs



Isometric View



Plan View



Side Elevation View

PROJECT	JOB / DWG NUMBER	REV. NO.	SHEET NO.
Yaskawa VFDs Phase II OSP & IBCS	VMA-49850-1A	00	61 of 76
CUSTOMER	BY / DATE	CHECKED	DATE
Yaskawa	RJH 4/1/2015		

X-viii-b. Check screw of Equipment to Structural steel
Tag: UUTs-1& 4 (Micro drives) using #8 screws

Check 0.164" ϕ screw to Steel Structure
Stress Area = 0.0211 in²

Design Tension of the Bolt = 4 lbs.
Design Shear of the Bolt = 2 lbs.

From ICC-ES Report, ESR-2196, Table 2 (page 6 of 10) and Table 4A (page 8 of 10), Attachment to minimum of gauge 20 steel where the screw head is not in contact,

Allowable tension load is **75 lbs** (Table 2).
Allowable Shear load is **174 lbs** (Table 4A).

Allowable Pullout load 75 lbs > Design Tension load 4 lbs.

Allowable Shear load 174 lbs > Design Shear load 2 lbs.

Therefore, the #8 screw is sufficient for this application ✓

Please refer to Yaskawa drawing DD.J1K.FR11.IP20 for mounting

PROJECT	JOB / DWG NUMBER	REV. NO.	SHEET NO.
Yaskawa VFDs Phase II OSP & IBCS	VMA-49850-1A	00	62 of 76

CUSTOMER	BY	DATE	CHECKED	DATE
Yaskawa	RJH	4/1/2015		

Equipment Tag			
UUT-2 Microdrive on steel structure			
X-ix-a. Seismic Restraint Load Calculation		Load Combinations are as per ASD	
Mfr	Yaskawa	Model	N/A

Input Values

Coefficient	Value	Units	Description
X	7	in	Equipment Depth
Y	6.22	in	Distance Between Attachment Points Along Unit Width
Z	4.65	in	Distance Between Attachment Points Along Unit Height
m	6.6	lbs	Equipment Mass
g_h	1.05	g	$F_{p,h} / W_p$ = Horizontal Seismic Acceleration
g_v	1.28	g	$(F_{p,v} / W_p + W_p)$ = Vertical Seismic Acceleration
X_{cg}	3.5	in	Center of Gravity Along Depth Direction
Y_{cg}	3.11	in	Center of Gravity Along Width Direction
Z_{cg}	2.325	in	Center of Gravity Along Height Direction

Critical Angle

Coefficient	Value	Units	Description
φ	30	degrees	Worst Case Angle to Apply Seismic Acceleration

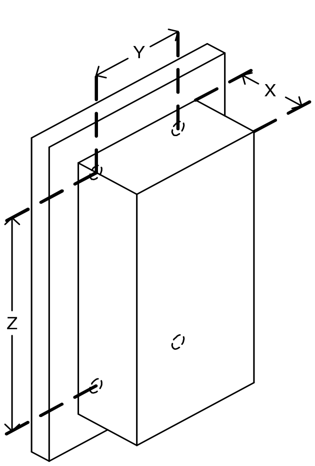
$$mg_{h,x} = (F_{p,h}/W_p)\sin(\varphi) \qquad mg_{h,y} = (F_{p,h}/W_p)\cos(\varphi)$$

$$T_{max} = \frac{mg_v X_{cg}}{2Z} + \frac{mg_{h,x}(Z_{cg} - Z/2)}{2Z} + \frac{mg_{h,x}}{4} + \frac{mg_{h,y} X_{cg}}{2Y} + \frac{mg_{h,x}(|Y_{cg} - Y/2|)}{2Y}$$

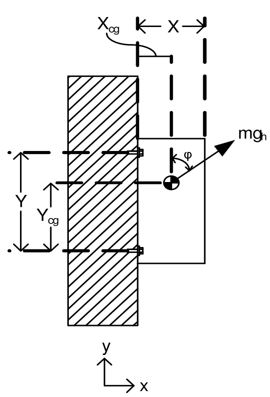
$$V_{max} = \sqrt{\left(\frac{mg_v}{4}\right)^2 + \left(\frac{mg_{h,y}}{4}\right)^2}$$

T_{max}	6 lbs

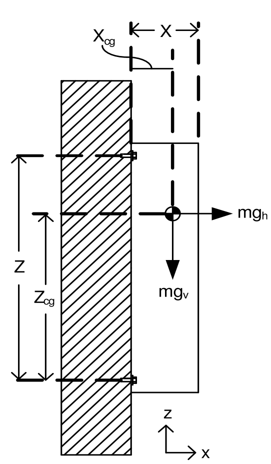
V_{max}	3 lbs



Isometric View



Plan View



Side Elevation View

X-ix-b. Check screw of Equipment to Structural steel
Tag: UUT-2(Micro drive) using #8 screws

Check 0.164" ϕ screw to Steel Structure

Stress Area = 0.0211 in²

Design Tension of the Bolt = 6 lbs.
Design Shear of the Bolt = 3 lbs.

From ICC-ES Report, ESR-2196, Table 2 (page 6 of 10) and Table 4A (page 8 of 10),
Attachment to minimum of gauge 20 steel where the screw head is not in contact,

Allowable tension load is **75 lbs** (Table 2).
Allowable Shear load is **174 lbs** (Table 4A).

Allowable Pullout load 75 lbs > Design Tension load 6 lbs.

Allowable Shear load 174 lbs > Design Shear load 3 lbs.

Therefore, the #8 screw is sufficient for this application ✓

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PROJECT	JOB / DWG NUMBER	REV. NO.	SHEET NO.
Yaskawa VFDs Phase II OSP & IBCS	VMA-49850-1A	00	64 of 76

CUSTOMER	BY	DATE	CHECKED	DATE
Yaskawa	RJH	4/1/2015		

Equipment Tag			
UUT-3 Microdrive on steel structure			
X-x-a. Seismic Restraint Load Calculation			Load Combinations are as per ASD
Mfr	Yaskawa	Model	N/A

Input Values

Coefficient	Value	Units	Description
X	7.36	in	Equipment Depth
Y	7.56	in	Distance Between Attachment Points Along Unit Width
Z	13.23	in	Distance Between Attachment Points Along Unit Height
m	20.2	lbs	Equipment Mass
g_h	1.05	g	$F_{p,h} / W_p$ = Horizontal Seismic Acceleration
g_v	1.28	g	$(F_{p,v} / W_p + W_p)$ = Vertical Seismic Acceleration
X_{cg}	3.68	in	Center of Gravity Along Depth Direction
Y_{cg}	3.78	in	Center of Gravity Along Width Direction
Z_{cg}	6.615	in	Center of Gravity Along Height Direction

Critical Angle

Coefficient	Value	Units	Description
φ	33	degrees	Worst Case Angle to Apply Seismic Acceleration

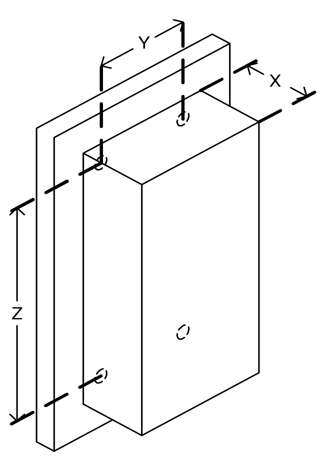
$$mg_{h,x} = (F_{p,h}/W_p)\sin(\varphi) \qquad mg_{h,y} = (F_{p,h}/W_p)\cos(\varphi)$$

$$T_{max} = \frac{mg_v X_{cg}}{2Z} + \frac{mg_{h,x}(Z_{cg} - Z/2)}{2Z} + \frac{mg_{h,x}}{4} + \frac{mg_{h,y} X_{cg}}{2Y} + \frac{mg_{h,x}(|Y_{cg} - Y/2|)}{2Y}$$

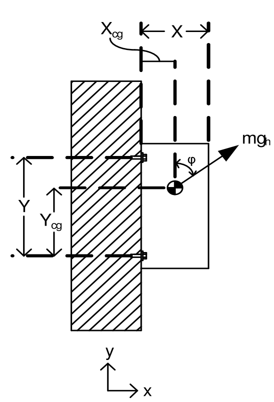
$$V_{max} = \sqrt{\left(\frac{mg_v}{4}\right)^2 + \left(\frac{mg_{h,y}}{4}\right)^2}$$

T_{max}	11 lbs

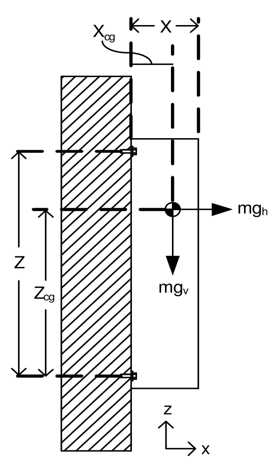
V_{max}	8 lbs



Isometric View



Plan View



Side Elevation View

PROJECT	JOB / DWG NUMBER		REV. NO.	SHEET NO.
Yaskawa VFDs Phase II OSP & IBCS	VMA-49850-1A		00	65 of 76
CUSTOMER	BY	DATE	CHECKED	DATE
Yaskawa	RJH	4/1/2015		

X-x-b. Check screw of Equipment to Structural steel
Tag: UUT-3 (Micro drive) using 1/4 diameter screws

Check 1/4" ϕ screw to Steel Structure

Stress Area = 0.0491 in^2

Design Tension of the Bolt = 11 lbs.
Design Shear of the Bolt = 8 lbs.

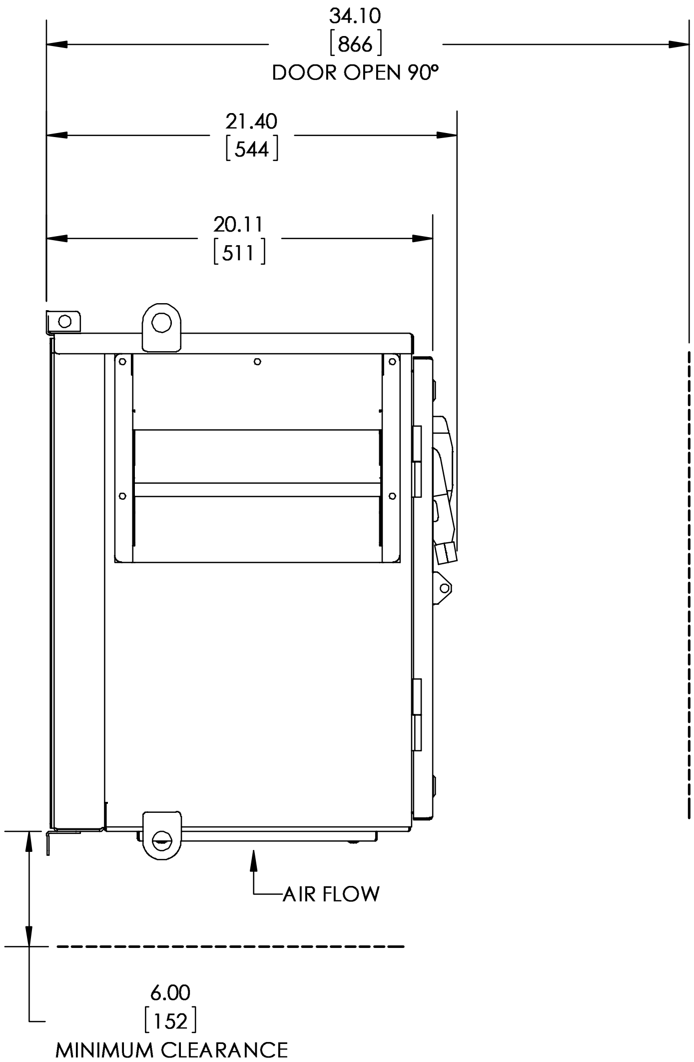
From ICC-ES Report, ESR-2196, Table 2 (page 6 of 10) and Table 4A (page 8 of 10), Attachment to minimum of gauge 20 steel where the screw head is not in contact,

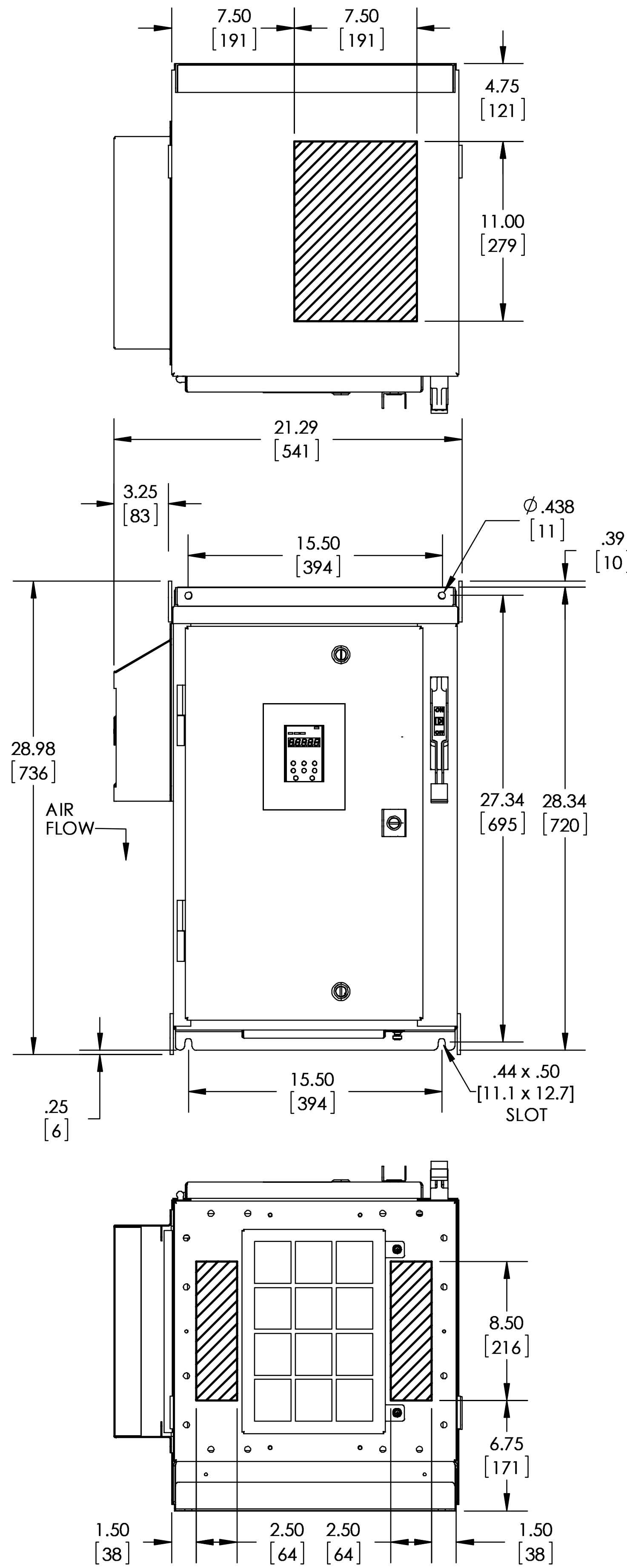
Allowable tension load is **115 lbs** (Table 2).
Allowable Shear load is **215 lbs** (Table 4A).

Allowable Pullout load 115 lbs > Design Tension load 11 lbs.

Allowable Shear load 215 lbs > Design Shear load 8 lbs.

Therefore, the 1/4"ϕ screw is sufficient for this application ✓





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C. HATCHED AREA INDICATES PERMISSIBLE CONDUIT ENTRANCE AREA.
D. FANS, FILTERS, LEG STANDS OR CLOSING PLATES ARE SUPPLIED WHEN OPTION MIX NECESSITATES.
E. USE APPROPRIATE TYPE RATED HUBS OR FITTINGS TO MAINTAIN ENCLOSURE RATING.

REVISIONS

REV.	DESCRIPTION	DRAWN BY	ECO	DATE
02	ADDED NEW 12" AND 30" LEG STANDS	JDE	4526	9/11/13
01	ADDED NEW 12" AND 30" LEG STANDS	JDE	4462	8/14/13
00	INITIAL RELEASE	JDE	-	4/25/13

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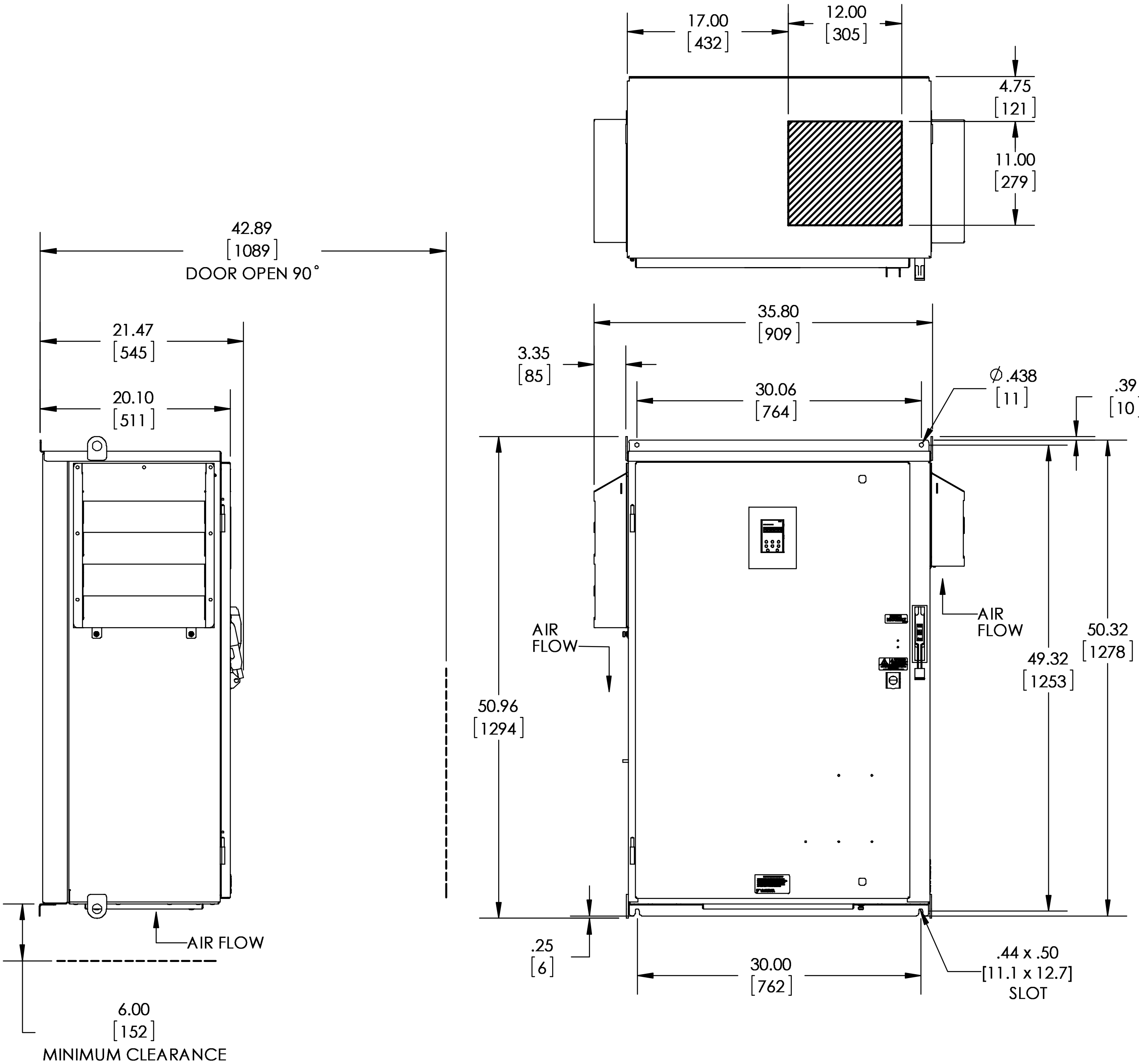
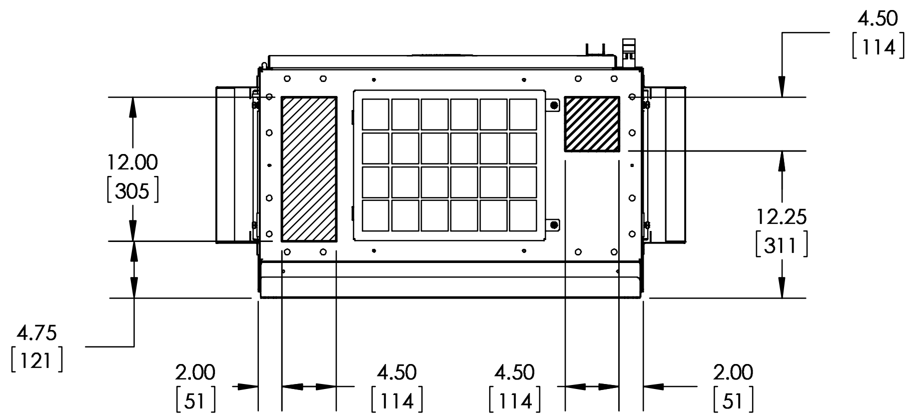
DRAWN: JDE	DATE 04/25/13	TITLE: DIMENSION DRAWING, Z1000 TYPE 3R, W1
CHECKED: RKM	DATE 04/25/13	
TECH:	DATE	MATERIAL# ---
APPROVED: BJJ	DATE 05/02/13	SIZE A · REVISION 02 · PAGE 1 OF 2
ORIGINAL DESIGN: JDE	DATE 04/19/13	DRAWING #: DD.Z1.3R.W1.01





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C. HATCHED AREA INDICATES PERMISSIBLE CONDUIT ENTRANCE AREA.
D. FANS, FILTERS, LEG STANDS OR CLOSING PLATES ARE SUPPLIED WHEN OPTION MIX NECESSITATES.
E. USE APPROPRIATE TYPE RATED HUBS OR FITTINGS TO MAINTAIN ENCLOSURE RATING.

REVISIONS

REV.	DESCRIPTION	DRAWN BY	ECO	DATE
02	ADDED NEW 12" AND 30" LEG STANDS	JDE	4526	9/11/13
01	ADDED NEW 12" AND 30" LEG STANDS	JDE	4462	8/19/13
00	INITIAL RELEASE	JDE	-	4/25/13

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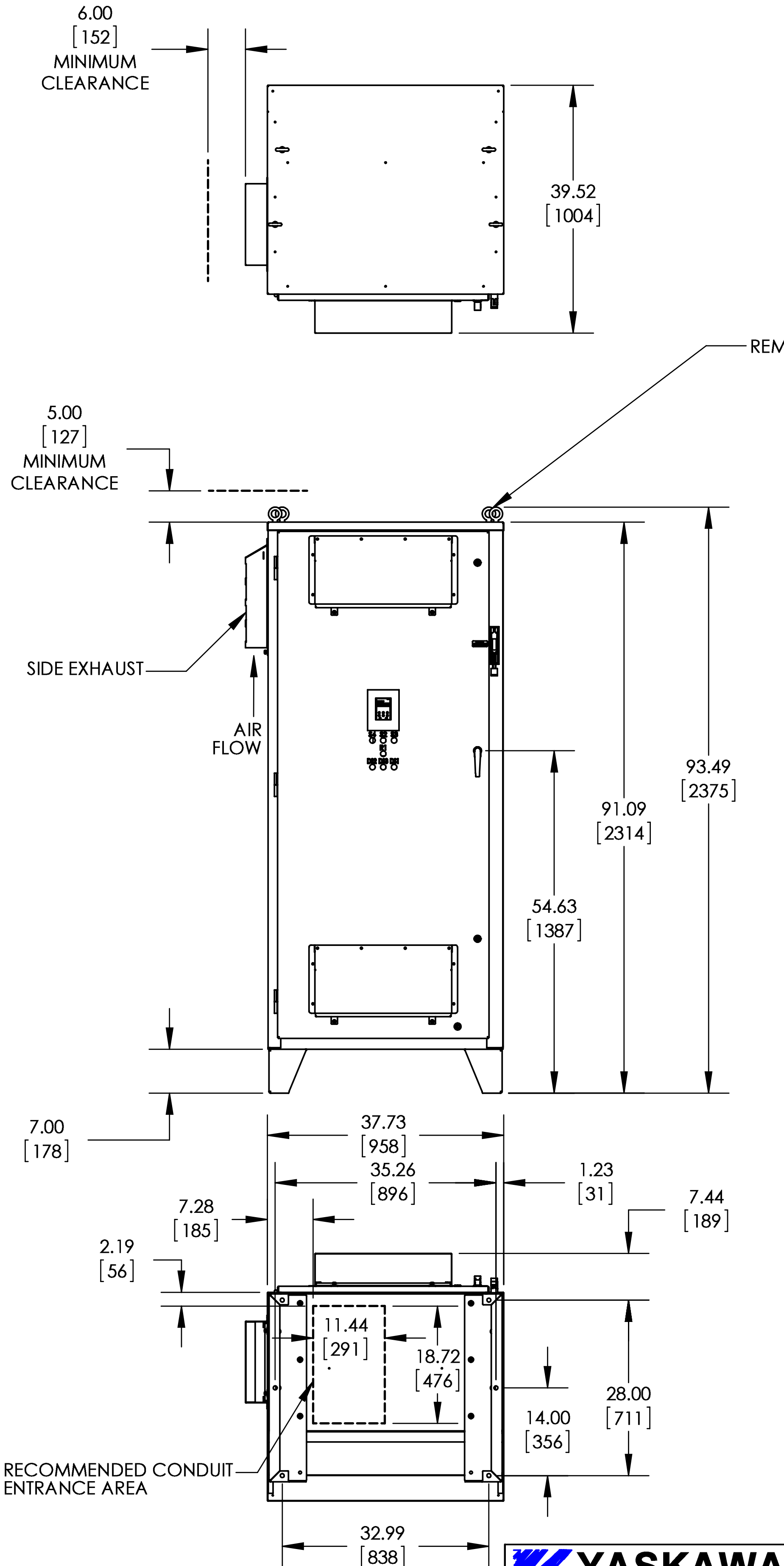
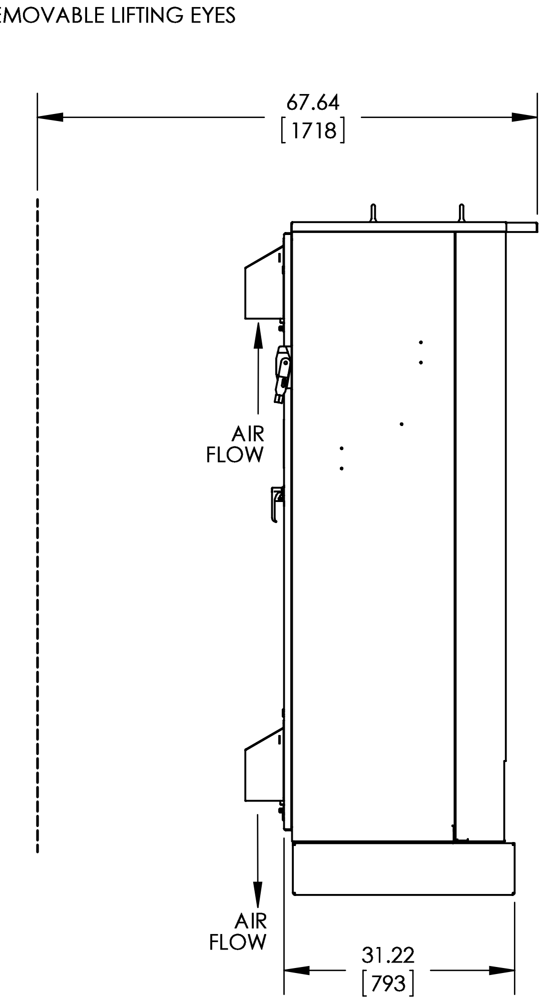
CHECKED: RKM	DATE 04/25/13	
TECH:	DATE	MATERIAL# ---
APPROVED: BJJ	DATE 05/02/13	SIZE A / REVISION 02 / PAGE 1 OF 2
ORIGINAL DESIGN: JDE	DATE 04/19/13	DRAWING #: DD.Z1.3R.W4.01





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B. DIMENSIONS ARE IN INCHES [MILLIMETERS].
C. FANS, FILTERS, OR CLOSING PLATES ARE SUPPLIED WHEN OPTION MIX NECESSITATES.
D. USE APPROPRIATE TYPE RATED HUBS OR FITTINGS TO MAINTAIN ENCLOSURE RATING.

REVISIONS

REV.	DESCRIPTION	ECO #	DRAWN BY	DATE
00	INITIAL RELEASE	-	JDE	4/26/13

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DRAWN: JDE	DATE 04/26/13	TITLE: DIMENSION DRAWING Z1000,F1,TYPE 3R
CHECKED: RKM	DATE 04/26/13	
TECH:	DATE	MATERIAL# ---
APPROVED: BJJ	DATE 05/03/13	SIZE A / REVISION 00 / PAGE 1 OF 1
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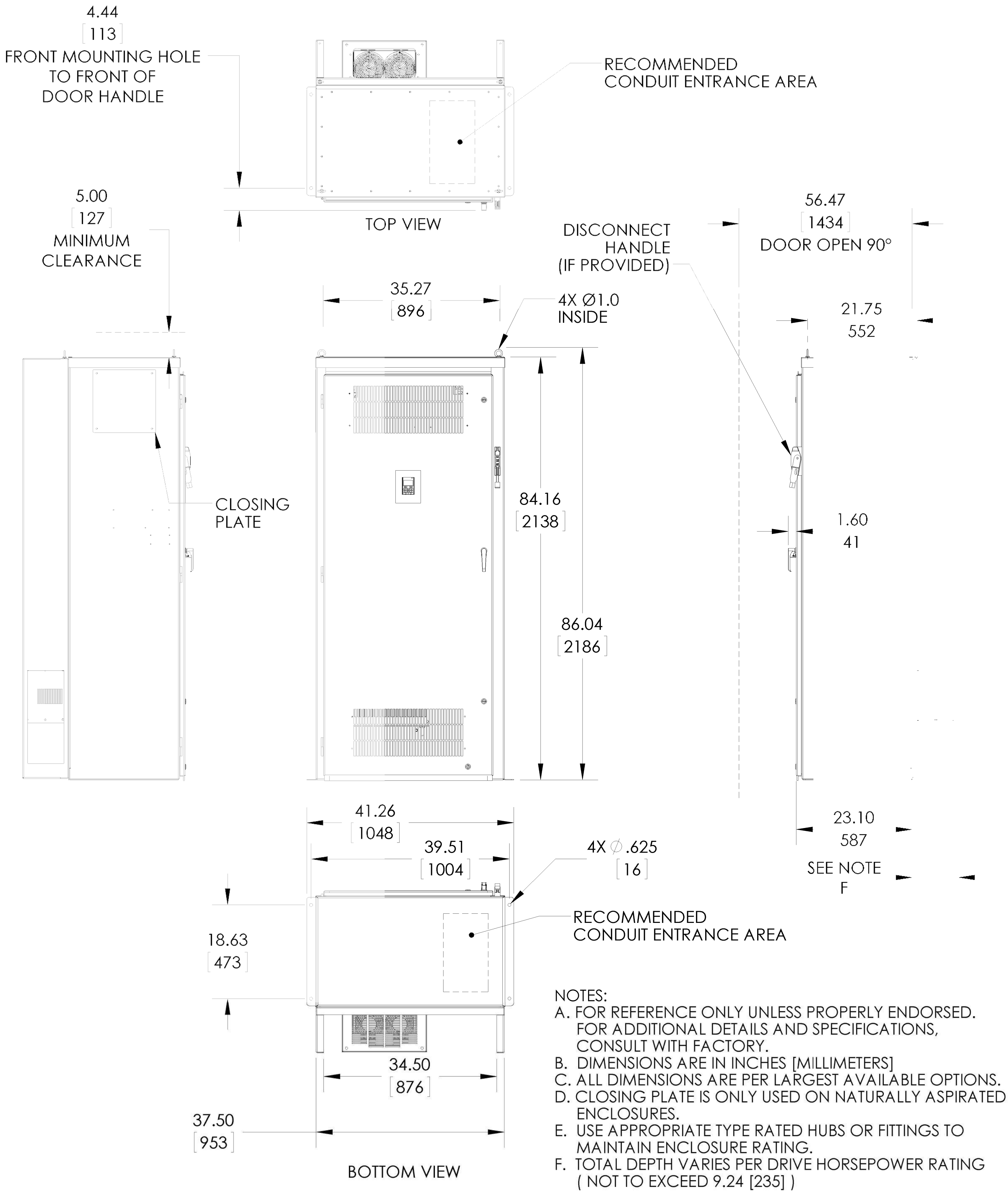

NOTES:

A. FOR REFERENCE ONLY UNLESS PROPERLY ENDORSED. FOR ADDITIONAL DETAILS AND SPECIFICATIONS, CONSULT WITH FACTORY.

B. DIMENSIONS ARE IN INCHES [MILLIMETERS]

C. ALL DIMENSIONS ARE PER LARGEST AVAILABLE OPTIONS.

D. CLOSING PLATE IS ONLY USED ON NATURALLY ASPIRATED ENCLOSURES.

E. USE APPROPRIATE TYPE RATED HUBS OR FITTINGS TO MAINTAIN ENCLOSURE RATING.

F. TOTAL DEPTH VARIES PER DRIVE HORSEPOWER RATING (NOT TO EXCEED 9.24 [235])

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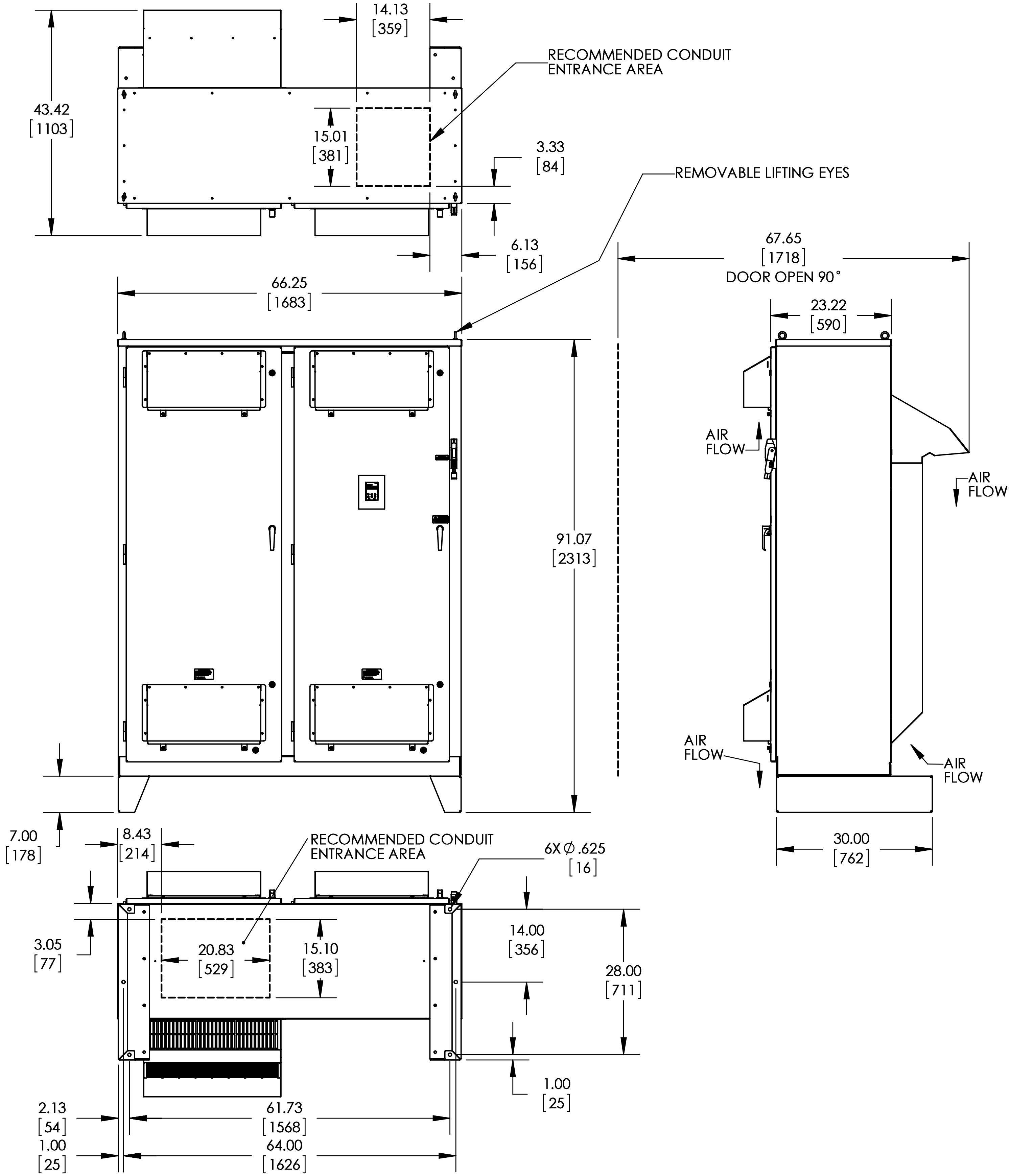
DRAWN: DDG	DATE 11/1/11	TITLE: DIMENSION DRAWING Z1000, F1, TYPE 1
CHECKED: KF	DATE 11/2/11	
TECH:	DATE	MATERIAL#
APPROVED: JZ	DATE 11/2/11	SIZE A / REVISION 02 / PAGE 1 OF 2
ORIGINAL DESIGN: DDG	DATE 11/1/11	DRAWING #: DD.Z1.1.F1.02

Prepared by matthew dewey 6/25/2013 1:07:21 PM



NOTES:

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B. DIMENSIONS ARE IN INCHES [MILLIMETERS].
C. FANS, FILTERS, OR CLOSING PLATES ARE SUPPLIED WHEN OPTION MIX NECESSITATES.
D. USE APPROPRIATE TYPE RATED HUBS OR FITTINGS TO MAINTAIN ENCLOSURE RATING.

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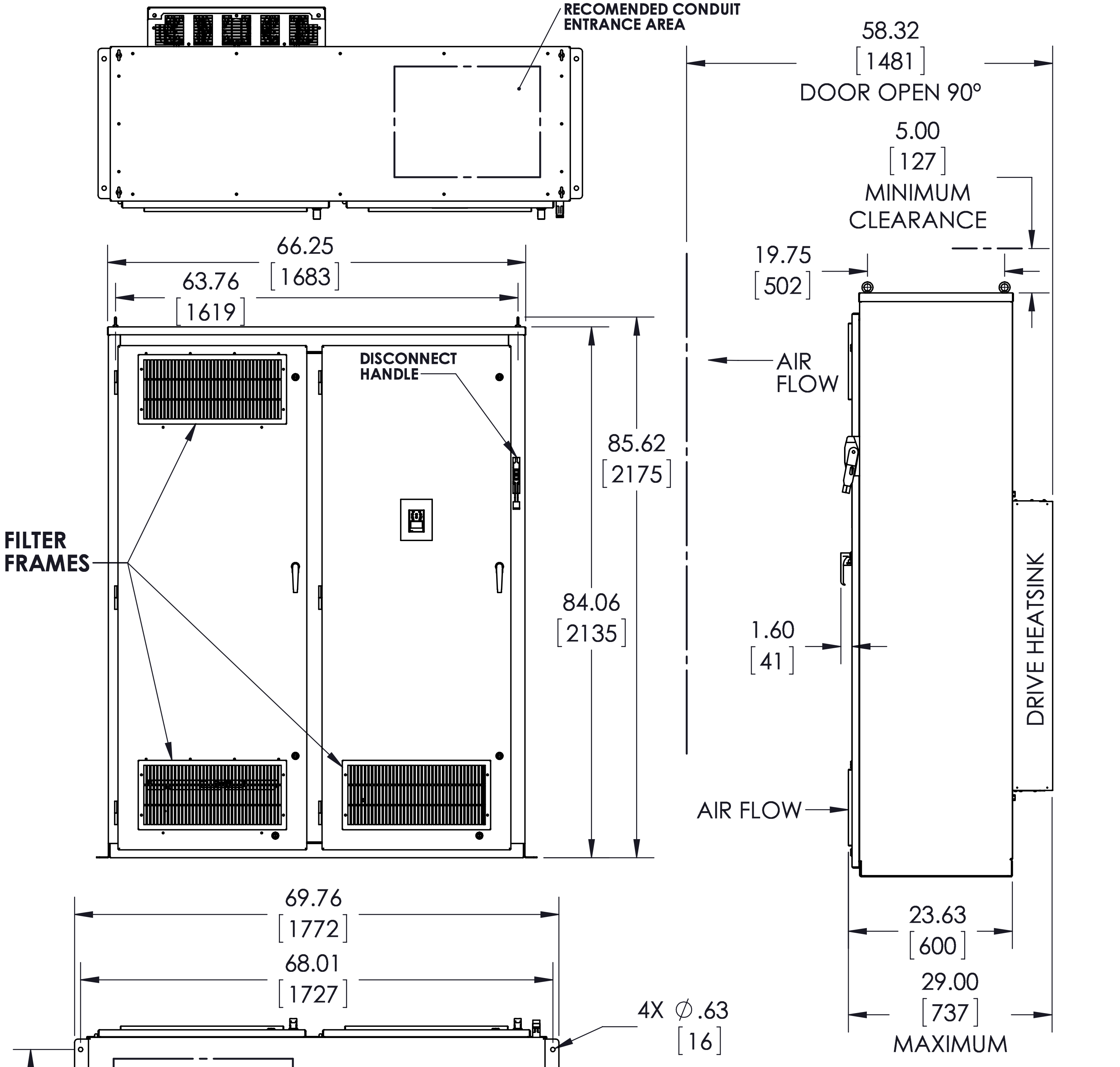
	DATE
DRAWN: JDE	04/26/13
CHECKED: RKM	04/26/13
TECH:	
APPROVED: BJJ	05/03/13
ORIGINAL DESIGN: JDE	04/19/13

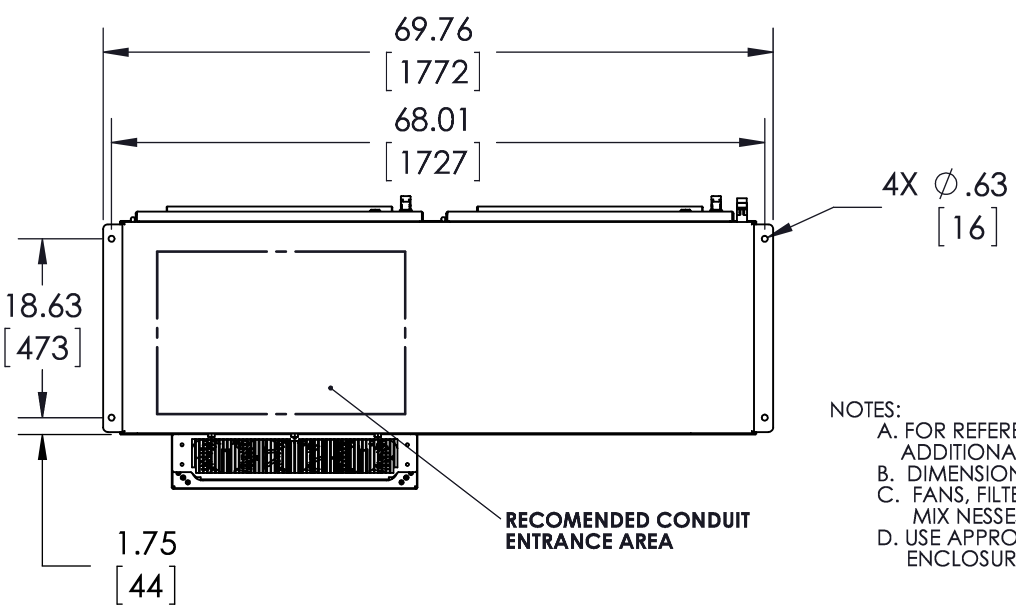
TITLE:
DIMENSION DRAWING
Z1000 F2, TYPE 3R

MATERIAL# ---

SIZE	REVISION	PAGE
A	00	1 OF 1

DRAWING #: DD.Z1.3R.F2.01





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B. DIMENSIONS ARE IN INCHES [MILLIMETERS]
C. FANS, FILTERS, OR CLOSING PLATES ARE SUPPLIED WHEN OPTION MIX NESSESITATES.
D. USE APPROPIATE TYPE RATED HUBS OR FITTINGS TO MAINTAIN ENCLOSURE RATING.

YASKAWA

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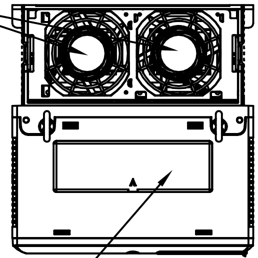
DRAWN:	M. DEWEY	DATE 06/05/13
CHECKED:	B. JOHNSON	DATE 06/06/13
TECH:		DATE
APPROVED:	K. FLIERL	DATE 06/06/13
ORIGINAL DESIGN:	D. PACKER	DATE 01/23/13

TITLE: OUTLINE DRAWING Z1000 F2, TYPE 1

MATERIAL#

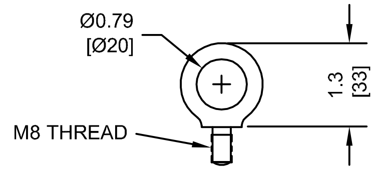
SIZE	REVISION	PAGE
A	00	1 OF 1

DRAWING #: DD.Z1.1.F2.01

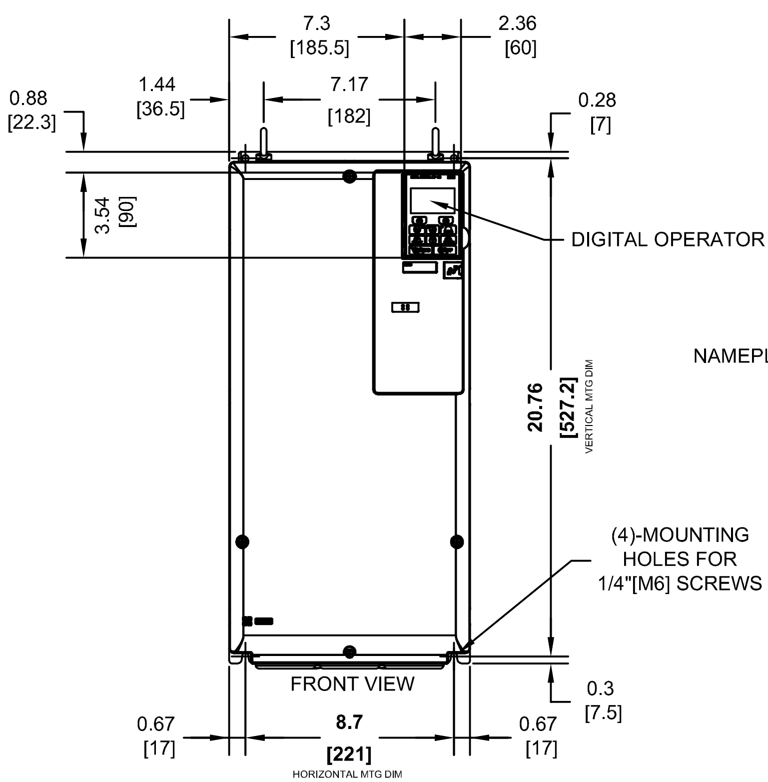


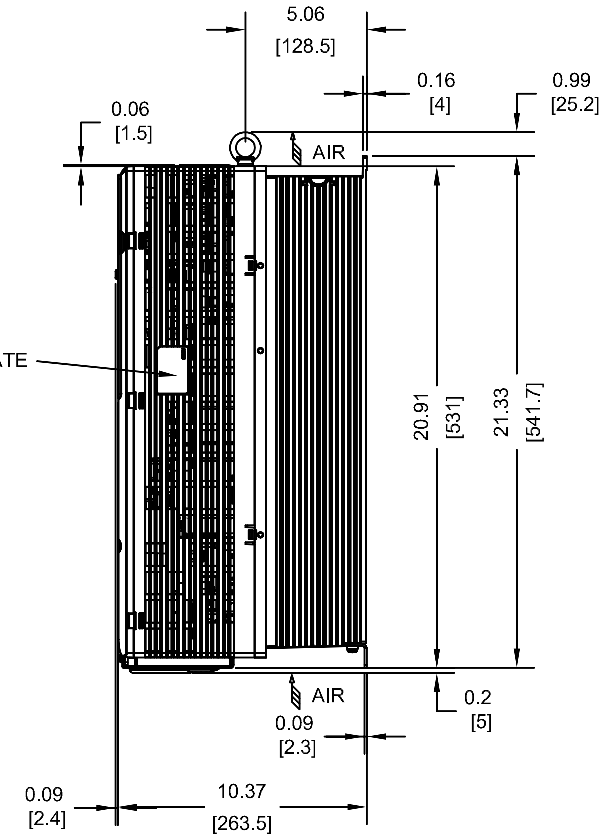
NOTE:
PROTECTIVE COVERS ARE FACTORY INSTALLED TO THE TOP AND BOTTOM OF THE DRIVE TO MEET IP20 & NEMA TYPE 1 REQUIREMENTS, RESULTING IN AN AMBIENT TEMPERATURE RATING OF 104F(40C). REMOVE THESE COVERS WHEN OPERATING THE DRIVE WITHIN A PANEL TO OBTAIN THE MAXIMUM SURROUNDING AIR TEMPERATURE RATING OF 122F(50C). REMOVING THESE COVERS RESULTS IN AN ENCLOSURE RATING OF IP00.

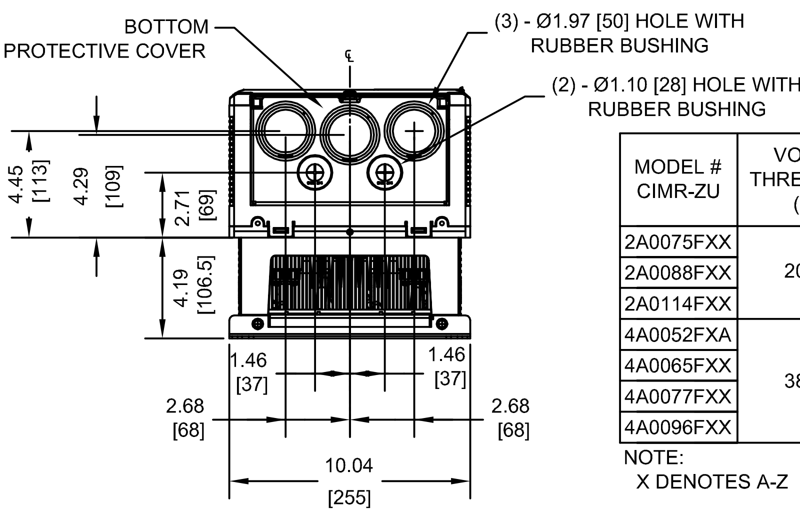
LIFTING AND EYEBOLT DETAILS



NOTE:
SPREADER BAR REQUIRED TO AVOID DAMAGE DURING LIFTING







MODEL # CIMR-ZU	VOLTAGE THREE-PHASE (VAC)	OUTPUT CURRENT (A)	WEIGHT LBS (Kg)	HEAT LOSS (W) (Fc=5kHz)		
				INT	EXT	TOT
2A0075FXX	200/240	74.8	59 (27)	132	557	689
2A0088FXX		88	62 (28)	157	670	827
2A0114FXX		114	64 (29)	200	864	1064
4A0052FXA	380/480	52	59 (27)	130	463	593
4A0065FXX		65	64 (29)	161	576	737
4A0077FXX		77	68 (31)	225	891	1116
4A0096FXX		96	70 (32)	288	1131	1419

NOTE:
X DENOTES A-Z

INT=INTERNAL COMPONENTS
EXT=EXTERNAL HEATSINK
TOT=TOTAL

FOR ADDITIONAL DETAILS AND SPECIFICATIONS, CONSULT MANUAL

TOLERANCES / REFERENCES:	YASKAWA	DRAWN: J. MATTAS	DATE 8-23-11	TITLE: Z1000 DIMENSION DRAWING FRAME SIZE 4 NEMA TYPE 1 ENCLOSURE 2A0075 - 0114, 4A0052 - 0096
		CHECKED: J. PIOTROWSKI	DATE 10-21-11	
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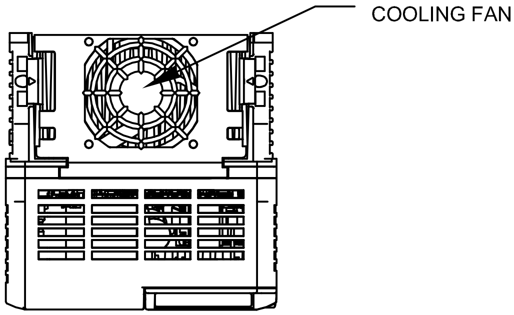
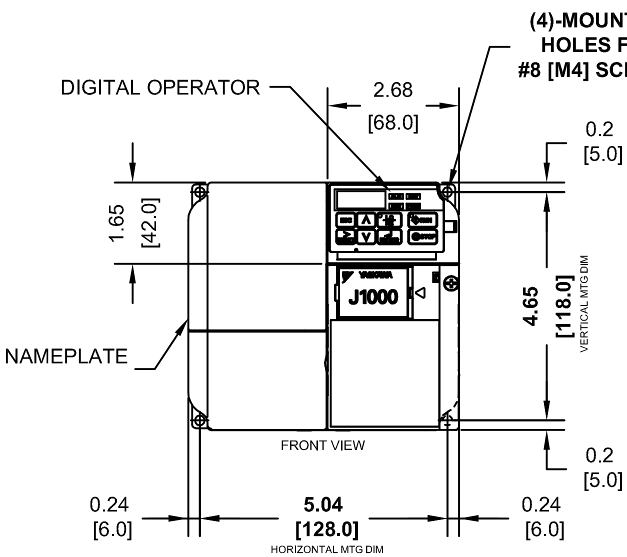
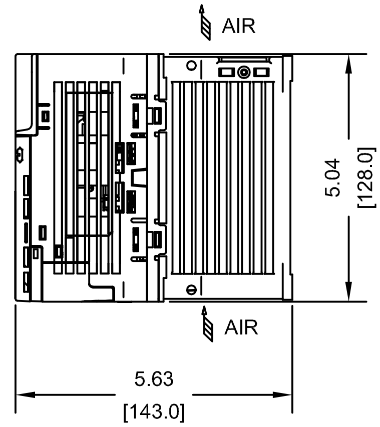
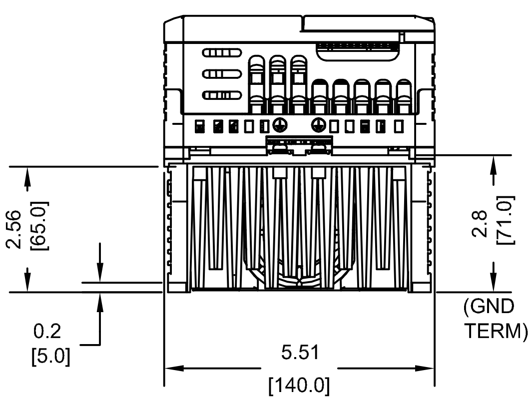
UNITS: IN[mm] / SCALE: 1:8		APPROVED: J. CAIRO	DATE 10-17-11	DRAWING #: DD.Z1K.FR4.N1
		ORIGINAL DESIGN: -	DATE -	









MODEL # CIMR-JU	VOLTAGE THREE PHASE (VAC)	OUTPUT CURRENT (A)		WEIGHT LBS (Kg)	HEAT LOSS (W)					
					ND (Fc=2kHz)			HD (Fc=8kHz)		
		ND	HD		INT	EXT	TOT	INT	EXT	TOT
2A0020BXX	208/240	19.6	17.5	5.3 (2.4)	46.3	98.7	145.0	43.3	110.5	153.8
4A0011BXX	380/480	11.1	9.2	5.3 (2.4)	46.0	81.7	127.7	41.5	107.2	148.7

NOTE:
XX DENOTES AA-ZZ

INT=INTERNAL COMPONENTS
EXT=EXTERNAL HEATSINK
TOT=TOTAL

FOR ADDITIONAL DETAILS AND SPECIFICATIONS, CONSULT MANUAL

TOLERANCES / REFERENCES:	YASKAWA The Drive for Quality™	DRAWN: J. MATTAS	DATE 8-1-08	TITLE: J1000 DIMENSION DRAWING FRAME SIZE 11 OPEN ENCLOSURE (IP20 RATING) 2A0020B & 4A0011B
		CHECKED: J. PIOTROWSKI	DATE 4-16-09	
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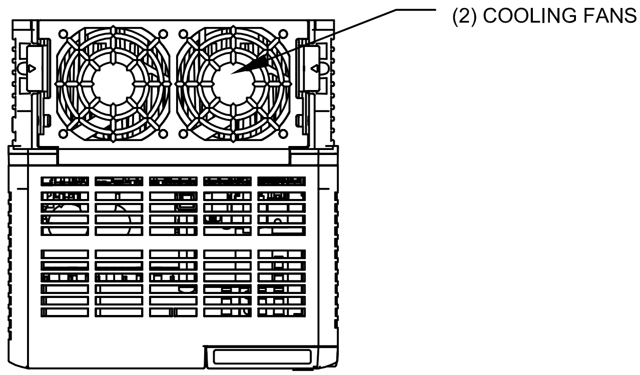
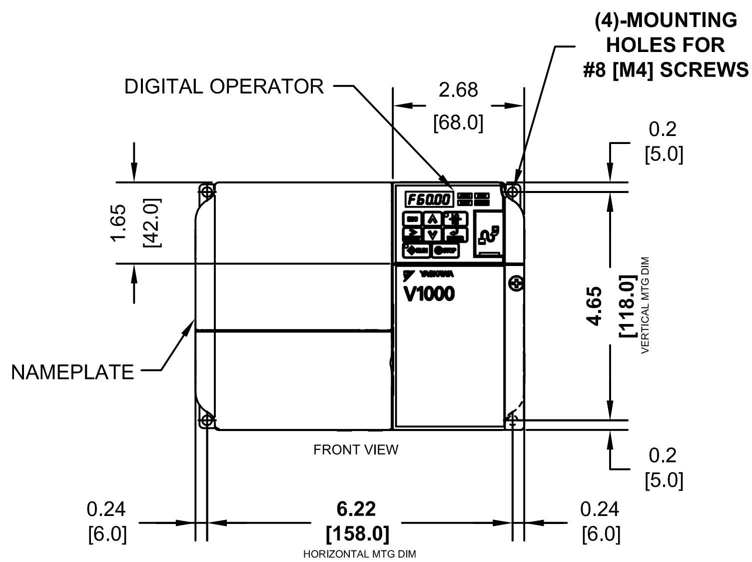
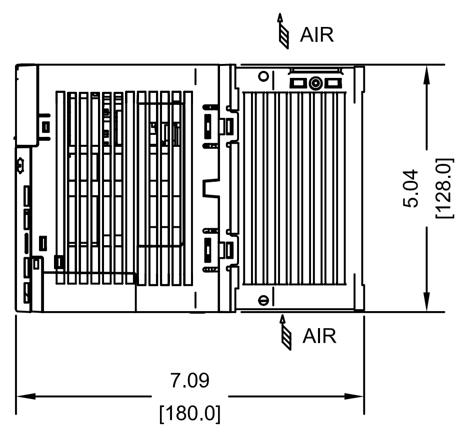
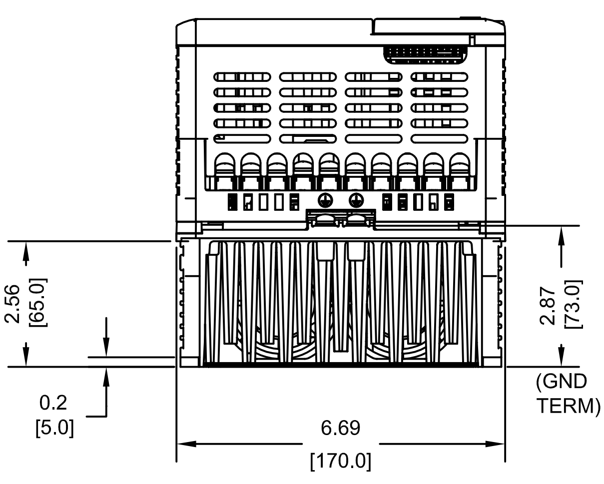
		APPROVED: T. SASADA	DATE 5-14-09	
UNITS: IN[mm] / SCALE: 1:4		ORIGINAL DESIGN: -	DATE -	DRAWING #: **DD.J1K.FR11.IP20**









MODEL # CIMR-VU	VOLTAGE SINGLE PHASE (VAC)	OUTPUT CURRENT (A)		WEIGHT LBS (Kg)	HEAT LOSS (W)					
					ND (Fc=2kHz)			HD (Fc=8kHz)		
		ND	HD		INT	EXT	TOT	INT	EXT	TOT
BA0018BXX	208/240	-	17.5	6.6 (3.0)	-	-	-	51.4	110.5	161.9

NOTE:
XX DENOTES AA-ZZ

INT=INTERNAL COMPONENTS
EXT=EXTERNAL HEATSINK
TOT=TOTAL

FOR ADDITIONAL DETAILS AND SPECIFICATIONS, CONSULT MANUAL

TOLERANCES / REFERENCES:

UNITS: IN[mm] SCALE: 1: 4

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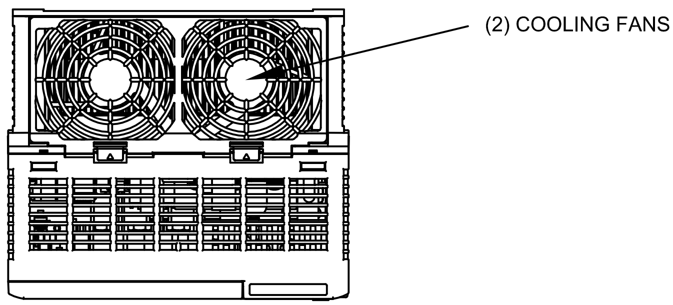
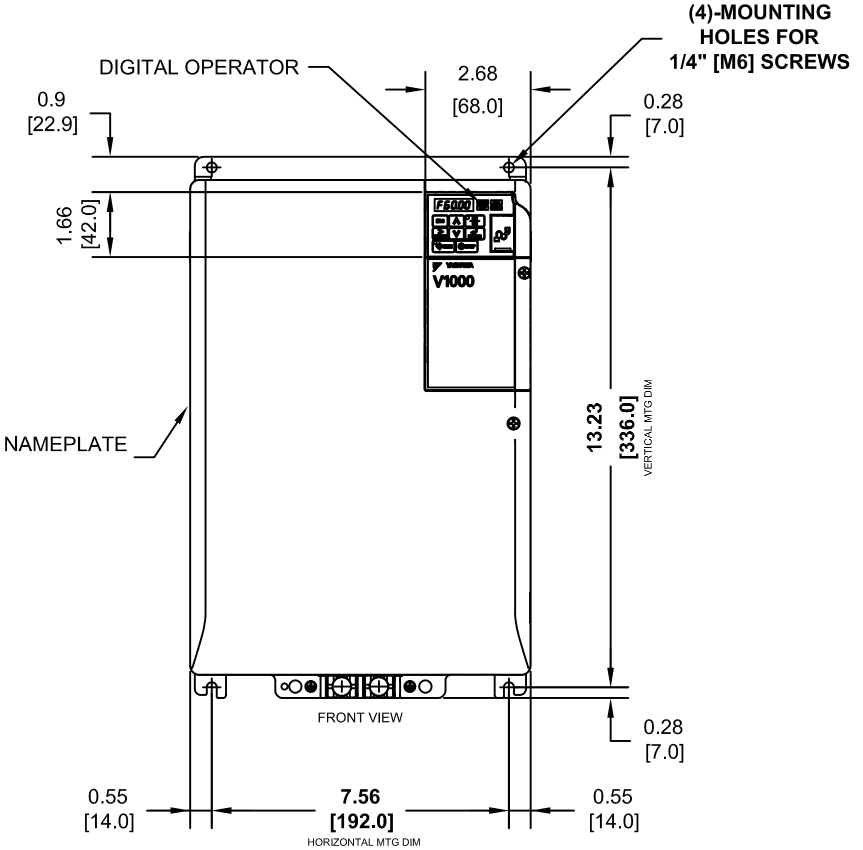
		DATE
DRAWN:	J. MATTAS	1-27-09
CHECKED:	J. PIOTROWSKI	8-21-09
TECH:	J. CAIRO	8-24-09
APPROVED:	T. SASADA	8-28-09
ORIGINAL DESIGN:	-	-

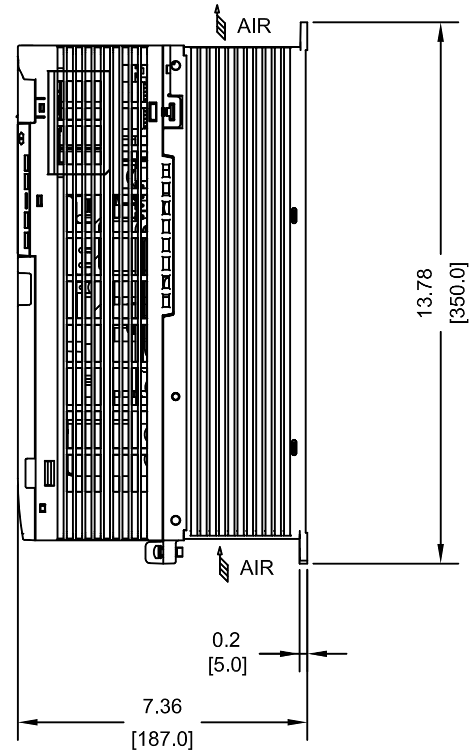
TITLE:
V1000 DIMENSION DRAWING
FRAME SIZE 13
OPEN ENCLOSURE (IP20 RATING)
BA0018B

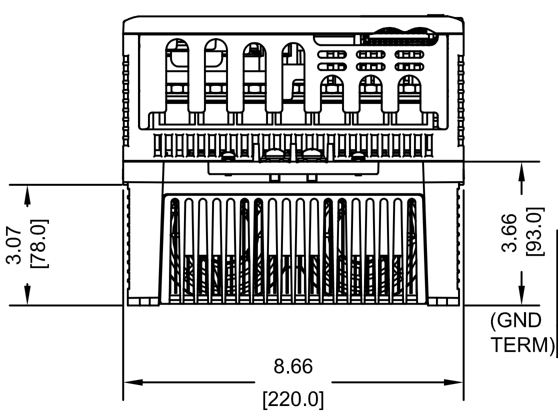
SIZE	REVISION	PAGE
A	R00	1 of 3

DRAWING #: **DD.V1K.FR13.IP20**









MODEL # CIMR-VU	VOLTAGE THREE PHASE (VAC)	OUTPUT CURRENT (A)		WEIGHT LBS (Kg)	HEAT LOSS (W)					
					ND (Fc=2kHz)			HD (Fc=8kHz)		
		ND	HD		INT	EXT	TOT	INT	EXT	TOT
2A0069AXX	208/240	69.0	60.0	19.1 (8.7)	184.5	461.7	646.2	151.4	437.7	589.1

NOTE:
XX DENOTES AA-ZZ

INT=INTERNAL COMPONENTS
EXT=EXTERNAL HEATSINK
TOT=TOTAL

FOR ADDITIONAL DETAILS AND SPECIFICATIONS, CONSULT MANUAL

TOLERANCES / REFERENCES:	YASKAWA The Drive for Quality™	DRAWN: J. MATTAS	DATE 1-29-09	TITLE: V1000 DIMENSION DRAWING FRAME SIZE 17 OPEN ENCLOSURE (IP00 RATING) 2A0069A
		CHECKED: J. PIOTROWSKI	DATE 8-21-09	
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		APPROVED: T. SASADA	DATE 8-28-09	
UNITS: IN[mm] / SCALE: 1:5		ORIGINAL DESIGN: -	DATE -	DRAWING #: DD.V1K.FR17.IP00

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