SLAC National Accelerator Laboratory

Structural Calculation

Delta Undulator Anchor Bolt Design

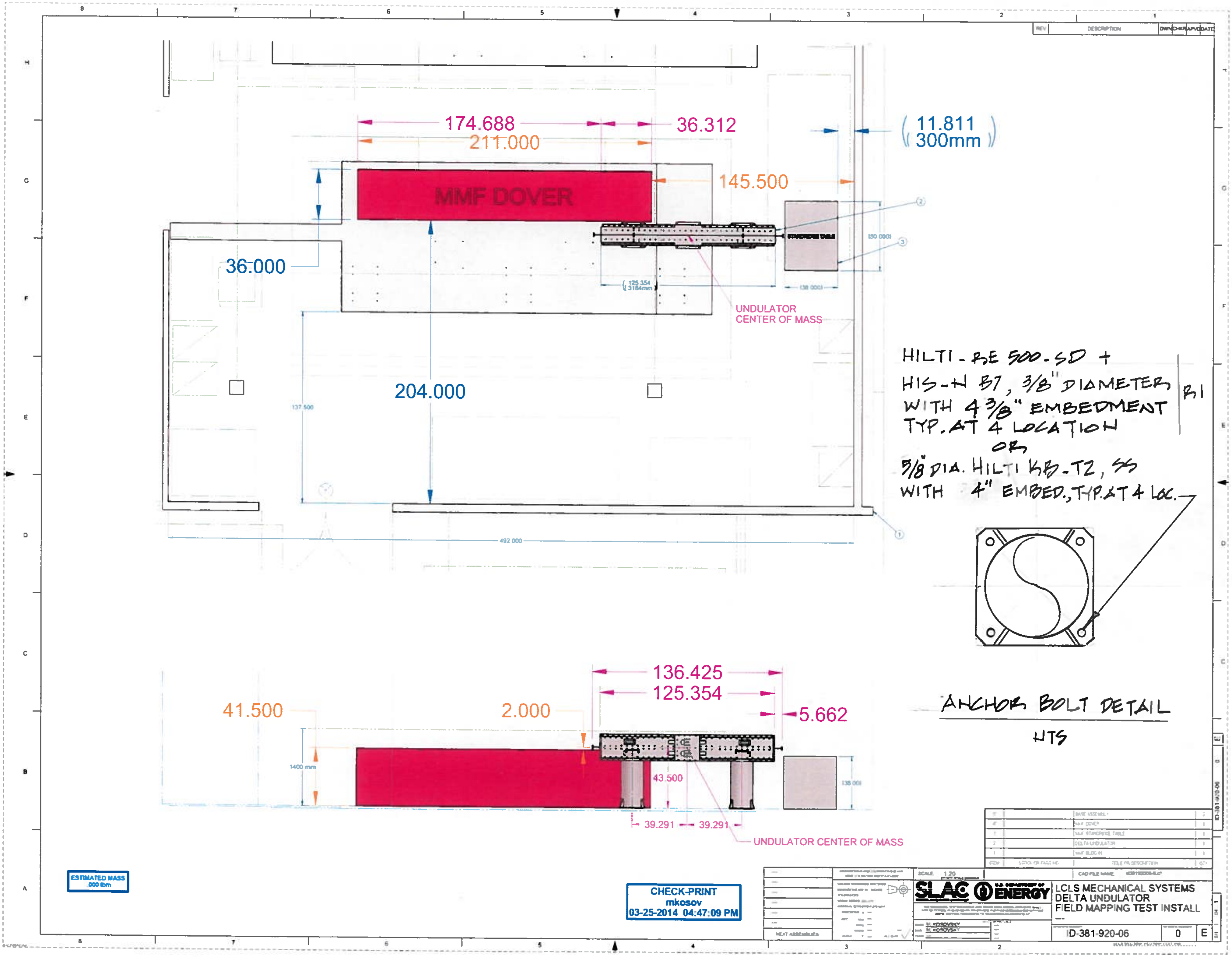
Location: B081

R1: OPTIONAL TO USE INSERT

By: Felix K. Adikara

fa

April 9, 2014



174.688
211.000
36.312
11.811
300mm
145.500
MMF DOVER
36.000
125.354
3184mm
UNDULATOR
CENTER OF MASS
204.000
137.500
492.000
HILTI - RE 500-SD +
HIS-N B7, 3/8" DIAMETER
WITH 4 3/8" EMBEDMENT
TYP. AT 4 LOCATION
OR
5/8" DIA. HILTI KB-T2, SS
WITH 4" EMBED., TYP. AT 4 LOC.
R1
ANCHOR BOLT DETAIL
NTS
136.425
125.354
5.662
41.500
2.000
1400 mm
43.500
39.291
39.291
UNDULATOR CENTER OF MASS
ESTIMATED MASS
000 lbm
CHECK-PRINT
mkosov
03-25-2014 04:47:09 PM
SLAC
ENERGY
LCLS MECHANICAL SYSTEMS
DELTA UNDULATOR
FIELD MAPPING TEST INSTALL
ID-381-920-06
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E

Project: To calculate the anchor bolt requirement for the delta undulator

Location: B081 First Floor

Note: Undulator is not part of this calculation

Reference:

1. 2013 California Building Code
2. ASCE 7-10 Minimum Design Loads for Buildings and Other Structures
3. AISC ninth edition
4. Drawings: SLAC: ID-381-920-06-C0
5. ESR - 1917 dated 5/1/2013 for HILTI Kwik Bolt TZ
6. SLAC-I-720-0A24E-001-R004D: Seismic Design Specification for Buildings, Structures, Equipment and Systems: 2014
   Rev. 4D has not been issued at this time, but calculation is conservative relative to Rev. 3

Governing code:

Ref. 2 - Chapter 13: Seismic design requirements for non-structural component that are permanently attached to structure.

Paragraph 13.3: Seismic demands on non-structural component

Input Data: Occupancy category II (Ref. 1 Table 1-1)

Weight of undulator =	3900	lbs	Provided by user
Weight of pipe support (16" dia. Std. 3 feet ea)=	376	lbs	
Weight of top and bott plates (18"x18"x 1/2") =	92	lbs	
Weight of equipment + pipe stand +plates =	4367	lbs	
Height of equipment =	44.00	inch	Ref. 4
Dist. betw cg of equip. and top of floor h =	43.50	inch	Ref. 4
Distance between post d =	15.00	inch	Field measurement

Ip =	1	Importance factor	Ref. 2 Table 11.5-1 for occupancy category II
Rp =	2.5	Response modification factor	Ref. 2 Table 13.5-1 for laboratory equipment
ap =	1	Component amplification factor	Ref. 2 Table 13.5-1 for laboratory equipment

Seismic Ground Motion Value: Location 13 (max. value) Ref. 6

Soil classification: D

Ss =	3.001 g	MCE spectral acceleration at short period
S1 =	1.198 g	MCE spectral acceleration at one period
SDs =	2.000 g	Design spectral acceleration at short period
SD1 =	1.198 g	Design spectral acceleration at one second

Base shear:

The horizontal seismic design force Fp:	z =	0	ft (height in structure of point of attachment, z = 0 for first floor)	
	H =	20	ft (height of roof)	
Fp = [(0.4 x ap x SDs x Wp) / (Rp/Ip)] x (1 + 2 z/H) =		1398	lbs	Ref.2 Eq. 13.3-1
Fp max = 1.6 x SDs x Ip x Wp =		13976	lbs	Ref.2 Eq. 13.3-2
Fp min = 0.3 x SDs x Ip x Wp =		2620	lbs **Control**	Ref.2 Eq. 13.3-3
		0.60	Wp	

1. Anchor Bolt:

Strength Design load combination: 0.5 D + 1.0 E — Ref.2 Section 12.4.2.3; Ref. 2 Section 13.3.1

Applied load to the base plate:	fv = Fp / 2 =	1310	lbs
	Mo = (1.0 E x h) / 2 =	56996	in.lbs
	DL = (0.5 x DL)	-2184	lbs

4 - HILTI HIT-RE 500-SD with HIS-N B7 3/8" diameter with 4 3/8" embedment per leg is adequate

2. Pipe 16" std. pipe: Allow. Stress Design: 1.3 D + 0.7 E — Ref.2 Section 12.4.2.3 and Ref. 2 Section 13.3.1

Area A =	18.4 inch^2	S =		70.30 inch^3		
M = (0.7 x Fp x 0.5) x (h) =				39897 inch. lbs		
Axial load Pa = 0.5 x 1.3 x DL =				2839 lbs		
Shear load fv = 0.5 x 0.7 x Fp =				917 lbs		
Yield Strength Fy for SS 304 =				30000 psi		
fa = Pa / A =	154 psi	<	Fa =	18000 psi	OK	
fb = M / S =	568 psi	<	Fb =	18000 psi	OK	
fv = fv / A =	50 psi	<	Fb =	12000 psi	OK	

Pipe 16" std. pipe is acceptable

Note: Stress is very low, therefore weld between base plate and pipe is OK
Axial load is small, therefore local stress/punching shear on exist. Slab is OK

Figure 2 SLAC Map

Table 2 Seismic Ground Motion Values

Location	S_s	S_1	S_{DS}	S_{D1}	SDC R.C. I/II	SDC R.C. III	SDC R.C. IV
1	2.166	0.0.917	1.444	0.917	E	E	F
2	2.170	0.923	1.447	0.923	E	E	F
3	2.267	0.952	1.512	0.952	E	E	F
4	2.358	0.977	1.572	0.977	E	E	F
5	2.563	1.014	1.709	1.014	E	E	F
6	2.403	0.973	1.602	0.973	E	E	F
7	2.483	0.991	1.655	0.991	E	E	F
8	2.613	1.022	1.742	1.022	E	E	F
9	2.745	1.055	1.830	1.055	E	E	F
10	2.840	1.094	1.893	1.094	E	E	F
11	2.897	1.132	1.931	1.132	E	E	F
12	2.946	1.164	1.964	1.164	E	E	F
13	3.001	1.198	2.000	1.198	E	E	F
14	2.315	0.958	1.543	0.958	E	E	F

*The SDS values are based on site class D

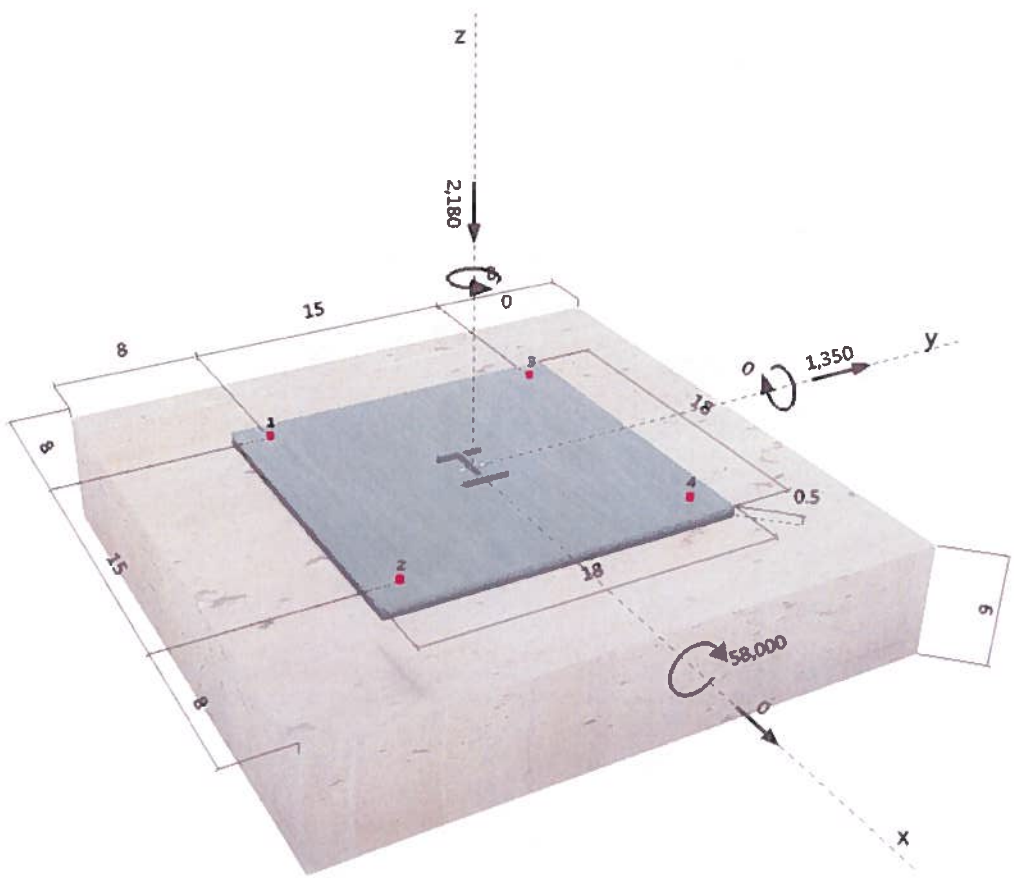
Company:	SLAC National Accelerator Laboratory	Page:	1
Specifier:	Felix K. Adikara	Project:	Delta Undulator
Address:	2575 Sand Hill Road, Menlo Park, CA 94025	Sub-Project I Pos. No.:	B081 First Floor
Phone I Fax:	|	Date:	4/9/2014
E-Mail:			

Specifier's comments:

1 Input data

Anchor type and diameter:	**HIT-RE 500-SD + HIS-N B7 3/8**
Effective embedment depth:	$h_{ef,act}$ = 4.375 in., h_{nom} = 4.375 in.
Material:	ASTM A 193 Grade B7
Evaluation Service Report:	ESR-2322
Issued I Valid:	1/1/2014 | 4/1/2014
Proof:	design method ACI 318 / AC308
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.500 in.
Anchor plate:	l_x x l_y x t = 18.000 in. x 18.000 in. x 0.500 in.; (Recommended plate thickness: not calculated)
Profile:	S shape (AISC); (L x W x T x FT) = 3.000 in. x 2.330 in. x 0.170 in. x 0.260 in.
Base material:	cracked concrete, 3000, f_c' = 3000 psi; h = 6.000 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)	yes (D.3.3.6)

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



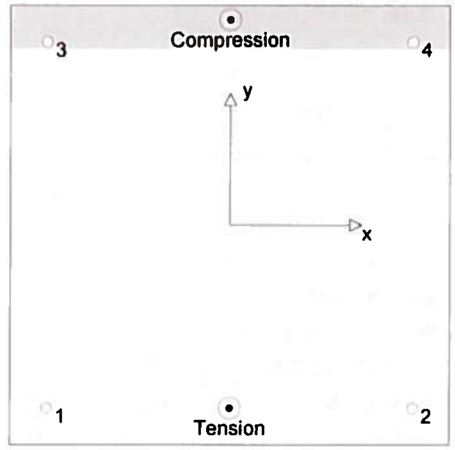
2 Load case/Resulting anchor forces

Load case: Design loads

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

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	1247	338	0	338
2	1247	338	0	338
3	0	338	0	338
4	0	338	0	338

max. concrete compressive strain: 0.07 [‰]
max. concrete compressive stress: 292 [psi]
resulting tension force in (x/y)=(0.000/-7.500): 2494 [lb]
resulting compression force in (x/y)=(0.000/8.407): 4674 [lb]



3 Tension load

	Load N_{ua} [lb]	Capacity ϕN_n [lb]	Utilization $\beta_N = N_{ua}/\phi N_n$	Status
Steel Strength*	1247	4409	29	OK
Bond Strength**	2494	4122	61	OK
Concrete Breakout Strength**	2494	5815	43	OK

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

3.1 Steel Strength

N_{sa} = ESR value refer to ICC-ES ESR-2322
$\phi N_{steel} \geq N_{ua}$ ACI 318-08 Eq. (D-1)

Variables

n	$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
1	0.08	120039

Calculations

N_{sa} [lb]
9690

Results

N_{sa} [lb]	ϕ_{steel}	$\phi_{nonductile}$	ϕN_{sa} [lb]	N_{ua} [lb]
9690	0.650	0.700	4409	1247

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3.2 Bond Strength

$N_{ag} = \left(\frac{A_{Na}}{A_{Na0}}\right) \psi_{ed,Na}\, \psi_{g,Na}\, \psi_{ec,Na}\, \psi_{p,Na}\, N_{a0}$	ICC-ES AC308 Eq. (D-16b)
$\phi\, N_{ag} \geq N_{ua}$	ACI 318-08 Eq. (D-1)
A_{Na} = see ICC-ES AC308, Part D.5.3.7	
$A_{Na0} = s^2_{cr,Na}$	ICC-ES AC308 Eq. (D-16c)
$s_{cr,Na} = 20d\sqrt{\frac{\tau_{k,uncr}}{1450}} \leq 3\, h_{ef}$	ICC-ES AC308 Eq. (D-16d)
$c_{cr,Na} = \frac{s_{cr,Na}}{2}$	ICC-ES AC308 Eq. (D-16e)
$\psi_{ed,Na} = 0.7 + 0.3\left(\frac{c_{a,min}}{c_{cr,Na}}\right) \leq 1.0$	ICC-ES AC308 Eq. (D-16m)
$\psi_{g,Na} = \psi_{g,Na0} + \left[\left(\frac{s_{avg}}{s_{cr,Na}}\right)^{0.5} \cdot (1 - \psi_{g,Na0})\right] \geq 1.0$	ICC-ES AC308 Eq. (D-16g)
$\psi_{g,Na0} = \sqrt{n} - \left[(\sqrt{n} - 1) \cdot \left(\frac{\tau_{k,c}}{\tau_{k,max,c}}\right)^{1.5}\right] \geq 1.0$	ICC-ES AC308 Eq. (D-16h)
$\tau_{k,max,c} = \frac{k_c}{\pi \cdot d}\sqrt{h_{ef} \cdot f'_c}$	ICC-ES AC308 Eq. (D-16i)
$\psi_{ec,Na} = \left(\frac{1}{1 + \frac{2e_N}{s_{cr,Na}}}\right) \leq 1.0$	ICC-ES AC308 Eq. (D-16j)
$\psi_{p,Na} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{c_{cr,Na}}{c_{ac}}\right) \leq 1.0$	ICC-ES AC308 Eq. (D-16p)
$N_{a0} = \tau_{k,c} \cdot \alpha_{N,seis} \cdot \kappa_{bond} \cdot \pi \cdot d \cdot h_{ef}$	ICC-ES AC308 Eq. (D-16f)

Variables

$\tau_{k,c,uncr}$ [psi]	d_{anchor} [in.]	h_{ef} [in.]	$c_{a,min}$ [in.]	s_{avg} [in.]	n	$\tau_{k,c}$ [psi]
2125	0.650	4.375	8.000	15.000	2	1040

k_c	f'_c [psi]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	c_{ac} [in.]	κ_{bond}	$\alpha_{N,seis}$
17	3000	0.000	0.000	9.938	1.00	0.650

Calculations

$s_{cr,Na}$ [in.]	$c_{cr,Na}$ [in.]	A_{Na} [in.^{2}]	A_{Na0} [in.^{2}]	$\psi_{ed,Na}$	$\tau_{k,max}$ [psi]
13.125	6.563	344.53	172.27	1.000	954

$\psi_{g,Na0}$	$\psi_{g,Na}$	$\psi_{ec1,Na}$	$\psi_{ec2,Na}$	$\psi_{p,Na}$	N_{a0} [lb]
1.000	1.000	1.000	1.000	1.000	6039

Results

N_{ag} [lb]	ϕ_{bond}	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\, N_{ag}$ [lb]	N_{ua} [lb]
12079	0.650	0.750	0.700	4122	2494

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Phone I Fax:	|	Date:	4/9/2014
E-Mail:			

3.3 Concrete Breakout Strength

$N_{cbg} = \left(\frac{A_{Nc}}{A_{Nc0}}\right) \psi_{ec,N}\, \psi_{ed,N}\, \psi_{c,N}\, \psi_{cp,N}\, N_b$ ACI 318-08 Eq. (D-5)

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

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

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

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

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

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

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

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
4.375	0.000	0.000	8.000	1.000

c_{ac} [in.]	k_c	λ	f'_c [psi]
9.938	17	1	3000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
344.53	172.27	1.000	1.000	1.000	1.000	8521

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\, N_{cbg}$ [lb]	N_{ua} [lb]
17041	0.650	0.750	0.700	5815	2494

4 Shear load

	Load V_{ua} [lb]	Capacity ϕV_n [lb]	Utilization $\beta_V = V_{ua}/\phi V_n$	Status
Steel Strength*	338	1710	20	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength (Bond Strength controls)**	1350	17756	8	OK
Concrete edge failure in direction y+**	1350	3438	40	OK

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

4.1 Steel Strength

$V_{sa} = \alpha_{V,seis} (n\ 0.6\ A_{se,V}\ f_{uta})$ refer to ICC-ES ESR-2322

$\phi V_{steel} \geq V_{ua}$ ACI 318-08 Eq. (D-2)

Variables

n	$A_{se,V}$ [in.^{2}]	f_{uta} [psi]	$\alpha_{V,seis}$	$(n\ 0.6\ A_{se,V}\ f_{uta})$ [lb]
1	0.08	120039	0.700	5815

Calculations

V_{sa} [lb]
4070

Results

V_{sa} [lb]	ϕ_{steel}	$\phi_{nonductile}$	ϕV_{sa} [lb]	V_{ua} [lb]
4070	0.600	0.700	1710	338

4.2 Pryout Strength (Bond Strength controls)

$V_{cpg} = k_{cp}\left[\left(\frac{A_{Na}}{A_{Na0}}\right)\psi_{ed,Na}\,\psi_{g,Na}\,\psi_{ec,Na}\,\psi_{p,Na}\,N_{a0}\right]$ ACI 318-08 Eq. (D-31)

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

A_{Na} see ICC-ES AC308, Part D.5.3.7

$A_{Na0} = s^2_{cr,Na}$ ICC-ES AC308 Eq. (D-16c)

$s_{cr,Na} = 20\,d\,\sqrt{\frac{\tau_{k,uncr}}{1450}} \leq 3\,h_{ef}$ ICC-ES AC308 Eq. (D-16d)

$c_{cr,Na} = \frac{s_{cr,Na}}{2}$ ICC-ES AC308 Eq. (D-16e)

$\psi_{ed,Na} = 0.7 + 0.3\left(\frac{c_{a,min}}{c_{cr,Na}}\right) \leq 1.0$ ICC-ES AC308 Eq. (D-16m)

$\psi_{g,Na} = \psi_{g,Na0} + \left[\left(\frac{s_{avg}}{s_{cr,Na}}\right)^{0.5} \cdot (1 - \psi_{g,Na0})\right] \geq 1.0$ ICC-ES AC308 Eq. (D-16g)

$\psi_{g,Na0} = \sqrt{n} - \left[(\sqrt{n} - 1) \cdot \left(\frac{\tau_{k,c}}{\tau_{k,max,c}}\right)^{1.5}\right] \geq 1.0$ ICC-ES AC308 Eq. (D-16h)

$\tau_{k,max,c} = \frac{k_c}{\pi \cdot d}\sqrt{h_{ef} \cdot f'_c}$ ICC-ES AC308 Eq. (D-16i)

$\psi_{ec,Na} = \left(\frac{1}{1 + \frac{2e'_{N}}{s_{cr,Na}}}\right) \leq 1.0$ ICC-ES AC308 Eq. (D-16j)

$\psi_{p,Na} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{c_{cr,Na}}{c_{ac}}\right) \leq 1.0$ ICC-ES AC308 Eq. (D-16p)

$N_{a0} = \tau_{k,c} \cdot \alpha_{N,seis} \cdot \kappa_{bond} \cdot \pi \cdot d \cdot h_{ef}$ ICC-ES AC308 Eq. (D-16f)

Variables

k_{cp}	$\tau_{k,c,uncr}$ [psi]	$\tau_{k,c}$ [psi]	d_{anchor} [in.]	h_{ef} [in.]
2.000	2125	1040	0.650	4.375

s_{avg} [in.]	n	k_c	f'_c [psi]	$e_{c1,N}$ [in.]
15.000	4	17	3000	0.000

$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	c_{ac} [in.]	κ_{bond}	$\alpha_{N,seis}$
0.000	8.000	9.938	1.00	0.650

Calculations

$s_{cr,Na}$ [in.]	$c_{cr,Na}$ [in.]	A_{Na} [in.^{2}]	A_{Na0} [in.^{2}]	$\psi_{ed,N}$	$\tau_{k,max}$ [psi]
13.125	6.563	689.06	172.27	1.000	954

$\psi_{g,Na0}$	$\psi_{g,Na}$	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{p,Na}$	N_{a0} [lb]
1.000	1.000	1.000	1.000	1.000	6039

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\,V_{cpg}$ [lb]	V_{ua} [lb]
48315	0.700	0.750	0.700	17756	1350

4.3 Concrete edge failure in direction y+

$V_{cbg} = \left(\frac{A_{Vc}}{A_{Vc0}}\right) \psi_{ec,V}\, \psi_{ed,V}\, \psi_{c,V}\, \psi_{h,V}\, \psi_{parallel,V}\, V_b$ — ACI 318-08 Eq. (D-22)

$\phi\, V_{cbg} \geq V_{ua}$ — ACI 318-08 Eq. (D-2)

A_{Vc} see ACI 318-08, Part D.6.2.1, Fig. RD.6.2.1(b)

$A_{Vc0} = 4.5\, c_{a1}^2$ — ACI 318-08 Eq. (D-23)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{2e_V}{3c_{a1}}}\right) \leq 1.0$ — ACI 318-08 Eq. (D-26)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ — ACI 318-08 Eq. (D-28)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ — ACI 318-08 Eq. (D-29)

$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda \sqrt{f'_c}\, c_{a1}^{1.5}$ — ACI 318-08 Eq. (D-24)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
5.333	8.000	0.000	1.000	6.000

l_e [in.]	λ	d_a [in.]	f'_c [psi]	$\psi_{parallel,V}$
4.375	1.000	0.650	3000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
186.00	128.00	1.000	1.000	1.155	5575

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ V_{cbg}$ [lb]	V_{ua} [lb]
9354	0.700	0.750	0.700	3438	1350

5 Combined tension and shear loads

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.605	0.393	5/3	65	OK

$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} <= 1$

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6 Warnings

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

Fastening meets the design criteria!

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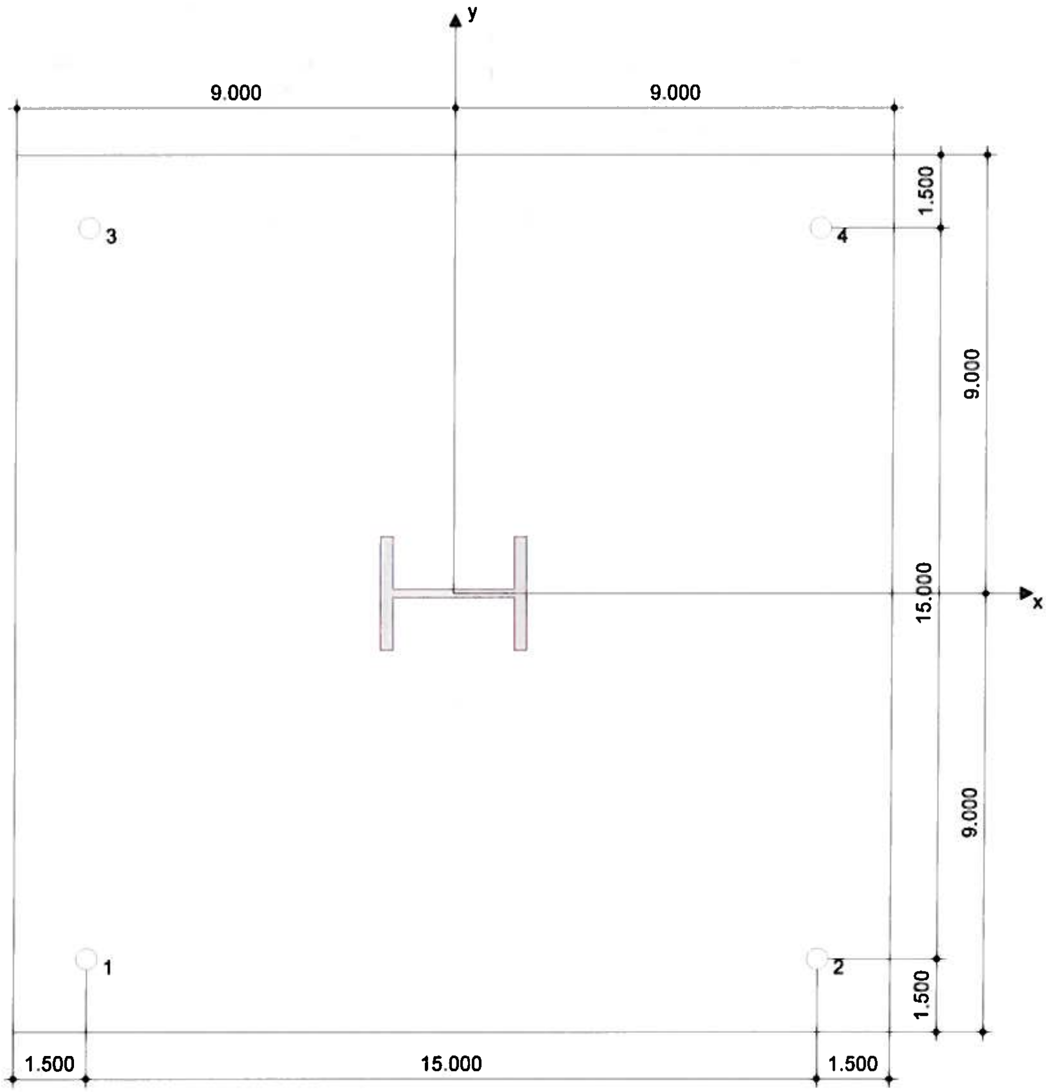
Address:	2575 Sand Hill Road, Menlo Park, CA 94025	Sub-Project I Pos. No.:	B081 First Floor
Phone I Fax:	|	Date:	4/9/2014
E-Mail:			

7 Installation data

Anchor plate, steel: -
Profile: S shape (AISC); 3.000 x 2.330 x 0.170 x 0.260 in.
Hole diameter in the fixture: d_f = 0.438 in.
Plate thickness (input): 0.500 in.
Recommended plate thickness: not calculated
Cleaning: Premium cleaning of the drilled hole is required

Anchor type and diameter: HIT-RE 500-SD + HIS-N B7, 3/8
Installation torque: 177.015 in.lb
Hole diameter in the base material: 0.688 in.
Hole depth in the base material: 4.375 in.
Minimum thickness of the base material: 5.900 in.



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-7.500	-7.500	8.000	23.000	8.000	23.000
2	7.500	-7.500	23.000	8.000	8.000	23.000
3	-7.500	7.500	8.000	23.000	23.000	8.000
4	7.500	7.500	23.000	8.000	23.000	8.000

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8 Remarks; Your Cooperation Duties

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Adikara, Felix K.

From: Levashov, Yurii I.
Sent: Wednesday, March 26, 2014 8:08 AM
To: Adikara, Felix K.
Subject: Anchoring DELTA undulator
Attachments: Measurement set-up.pdf

Hi Felix,

We need to anchor an another undulator, called DELTA, in our lab, Bldg.81, rm.114, next to the our Dover bench, see picture attached.
It is 3.2m long device, ~3900 lbs. weight. It will stay in our lab for 1 month then will be moved into LCLS tunnel.
We'll place the undulator on 2 support stands to be designed. One stand will rest on 3' thick concrete pad. Another one will be on 6" floor.
How should we secure them safely to the floor to meet all requirements? Which anchors should we use, what footprint is required for the supports?

Thanks,
Yurii Levashov
x2178