STRUCTURAL CALCULATIONS

for

YESCO

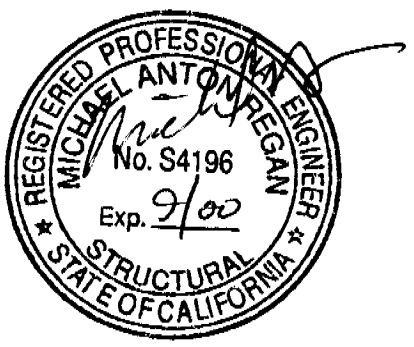
C.S.A.C.

1100 K Street.
Sacramento, CA

by

MICHAEL "Tony" REGAN

August 2, 1999



CRITERIA

CITY OF SACRAMENTO

'97 UBC

WIND 75 C (PER T/C W/ CITY BLDG DEPT)

SEISMIC ZONE 3 (WIND CONTROLS)

SCOPE

DESIGN SQUARE TUBE & CONNECTION TO BLDG.

ASSUME:- INTEGRITY OF CIP BEAM IS ADEQUATE PER FIELD INSP BY YESCO

- SIGN'S INTERNAL STRUCTURE IS ADEQUATE (SIGN BY OTHERS)

LAYOUT

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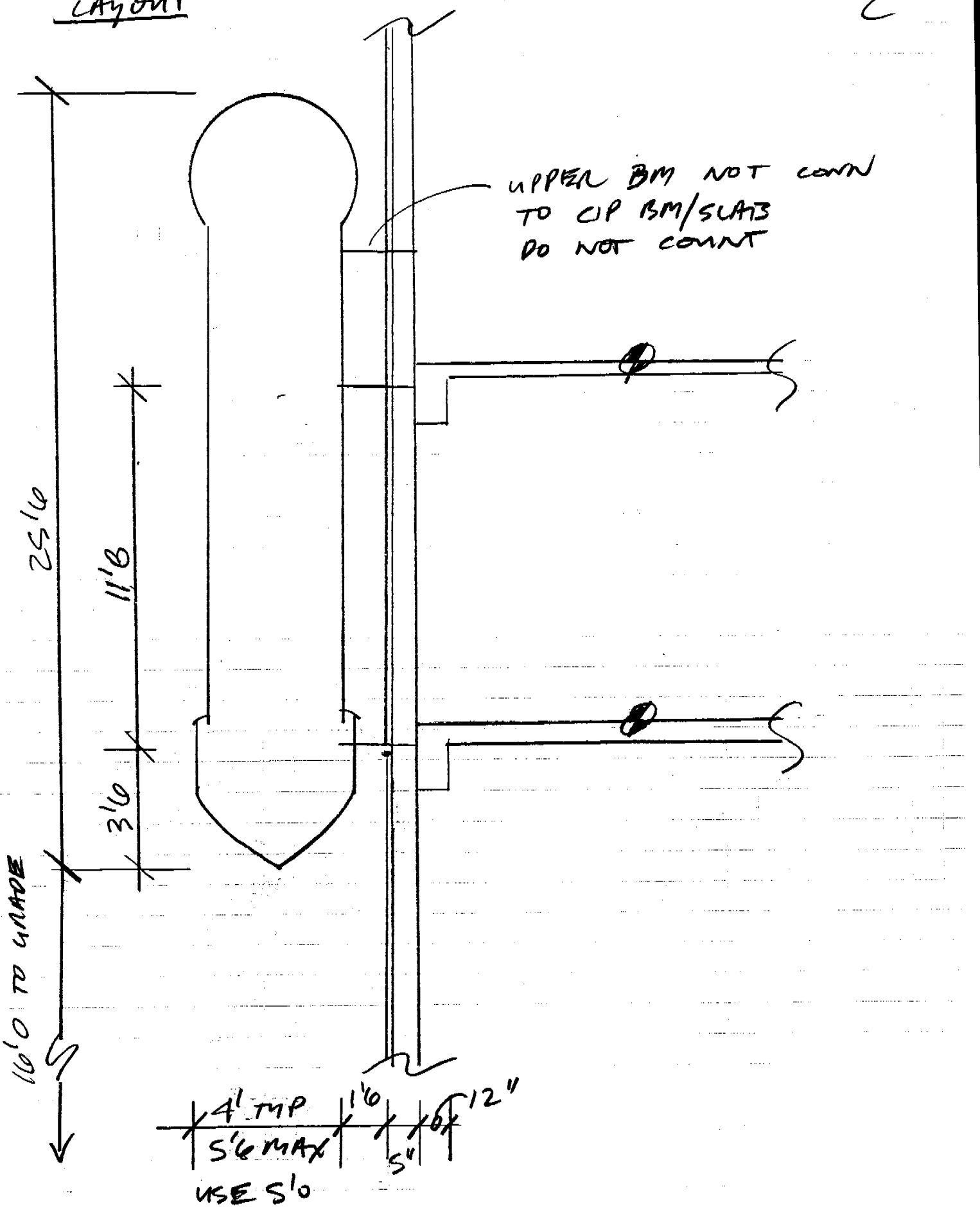

UPPER BM NOT CONN TO CIP BM/SLABS DO NOT COUNT
25'0
11'6
3'0
110'0 TO GRADE
4' TYP
5'6 MAX
1'6
6"
12"
5"
USE 5'0

WIND PRESSURES

p=CeCqqsI
speed 75 >>>>>> qs = 14.5
exposure b
importance 1

height	"Ce"		windward wall	leeward wall	windward roof	leeward roof	wall element	method 2	sign
		Cq =	0.8	0.5	0.3	0.7	1.2	1.3	1.4
15	0.62	p =	7.2	4.5	2.7	6.3	10.8	11.7	12.6
16	0.63		7.3	4.6	2.7	6.4	11.0	11.9	12.8
17	0.64		7.4	4.6	2.8	6.5	11.1	12.1	13.0
18	0.65		7.5	4.7	2.8	6.6	11.3	12.3	13.2
19	0.66		7.7	4.8	2.9	6.7	11.5	12.4	13.4
20	0.67		7.8	4.9	2.9	6.8	11.7	12.6	13.6
21	0.68		7.9	4.9	3.0	6.9	11.8	12.8	13.8
22	0.69		8.0	5.0	3.0	7.0	12.0	13.0	14.0
23	0.70		8.1	5.1	3.0	7.1	12.2	13.2	14.2
24	0.71		8.2	5.1	3.1	7.2	12.4	13.4	14.4
25	0.72		8.4	5.2	3.1	7.3	12.5	13.6	14.6
26	0.73		8.4	5.3	3.2	7.4	12.7	13.7	14.8
27	0.74		8.5	5.3	3.2	7.5	12.8	13.9	14.9
28	0.74		8.6	5.4	3.2	7.6	12.9	14.0	15.1
29	0.75		8.7	5.5	3.3	7.6	13.1	14.2	15.3
30	0.76		8.8	5.5	3.3	7.7	13.2	14.3	15.4
31	0.77		8.9	5.6	3.3	7.8	13.4	14.5	15.6
32	0.78		9.0	5.6	3.4	7.9	13.5	14.6	15.8
33	0.78		9.1	5.7	3.4	8.0	13.6	14.8	15.9
34	0.79		9.2	5.7	3.4	8.0	13.8	14.9	16.1
35	0.80		9.3	5.8	3.5	8.1	13.9	15.1	16.2
36	0.81		9.4	5.9	3.5	8.2	14.1	15.2	16.4
37	0.82		9.5	5.9	3.5	8.3	14.2	15.4	16.6
38	0.82		9.6	6.0	3.6	8.4	14.3	15.5	16.7
39	0.83		9.7	6.0	3.6	8.4	14.5	15.7	16.9
40	0.84		9.7	6.1	3.7	8.5	14.6	15.8	17.1

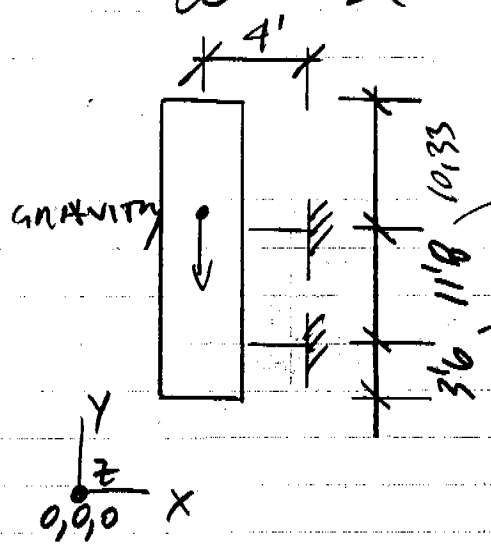
WIND FORCES

AREA = 5 X 25.5 = 128 SF

$\bar{h}$ = 16 + 25.5/2 = 29'

$P_{29'}$ = 15.3 PSF = .0153 KSF

ω = 5(.0153) = .077 klf ⊥ TO FACE (INTO PAGE)



R_{1z} = 1.56 K WIND

M_{1y} = 1.56 (4) = 6.24 KFT

R_{2z} = .41 K WIND

M_{2y} = .41 (4) = 1.64 KFT

GRAVITY FORCES

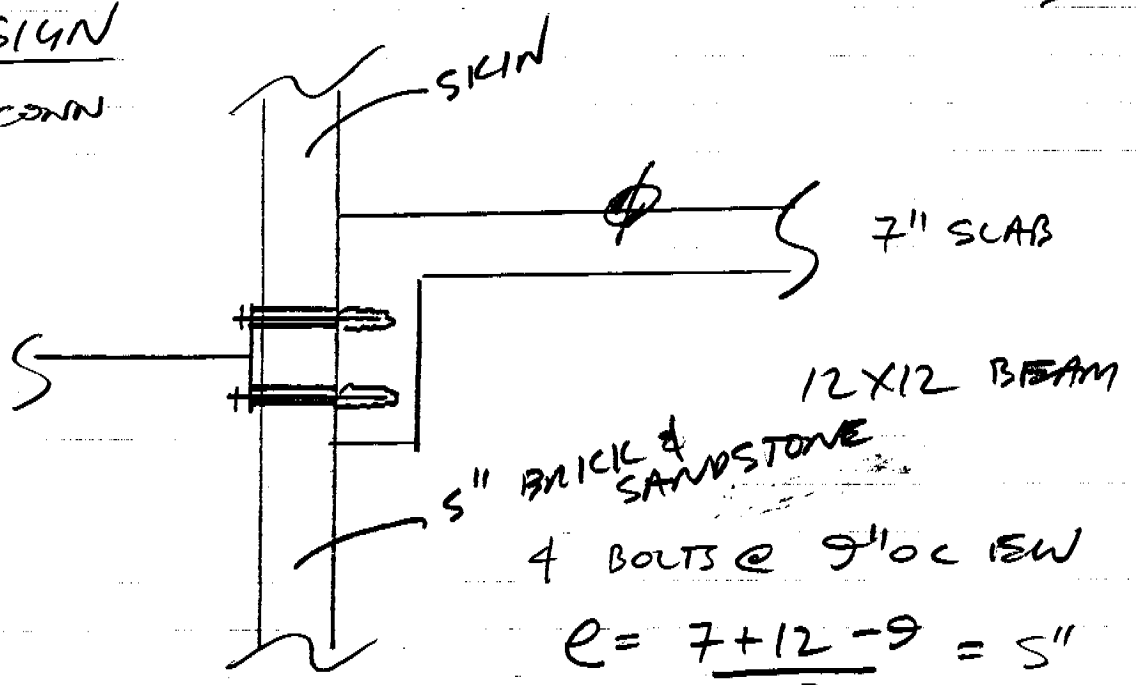
WEIGHT = 128 (.015) = 1.92 K

R_{1x} = 1.92 4/11.67 = .66 K

R_{1y} = 1.92/2 = .96 K

DESIGN

CONN



4 BOLTS @ 9" o.c. EW

$$e = \frac{7+12-9}{2} = 5"$$

$$T_{MAX} = \frac{.66}{4} + \frac{6.24(12)}{9(2)}$$

$$.17 + 4.16 = 4.33^{K}$$

$$V_{MAX} = \left[\left(\frac{1.56}{4}\right)^2 + \left(\frac{.96}{4}\right)^2\right]^{1/2} = .46^{K}$$

TRY $3/4"\phi$ X $6\frac{3}{4}"$ EMBED A307 NOD

$S = 9"$

$e = 5"$

DESIGN

BOLTS

- TENSION ALLOWED

ϕ	h	s	c	T	V
3/4	3 1/4	7 1/2	3 3/4	3440	
	6 3/4	10 1/4	6 3/4	6620	5040

EDGE DISTANCE $C_{MIN} = 6\frac{3}{4}(1.5) = 3.375$

$$F_{t1}\left(\frac{5 - 3.375}{6\frac{3}{4} - 3.375}\right)(.3) + .7 = .84$$

SPACING $S_{MIN} = 10\frac{1}{4}(1.5) = 5.125$

$$F_{t2}\left(\frac{9 - 5.125}{10.25 - 5.125}\right).3 + .7 = .93$$

$$T = .84\,(.93)\,6620 = 5172$$

- SHEAR ALLOWED

$C_{MIN} = 6\frac{3}{4}(.67) = 4.52$

$$F_{V_1} = \left(\frac{5 - 4.52}{6\frac{3}{4} - 4.52}\right)(1 - .5) + .5 = .61$$

$S_{MIN} = 10\frac{1}{4}(.5) = 5.125$

$$F_{V_2} = \left(\frac{9 - 5.125}{10.25 - 5.125}\right)(1 - .6) + .6 = .90$$

$$V = .61\,(.90)\,5040 = 2767$$

DESIGN

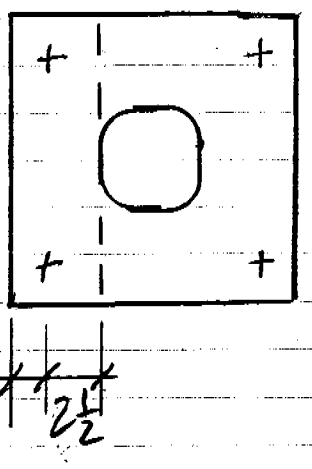
BOLTS (CONT)

COMBINE PER COVERT'S "ELIPTICAL CURVE METHOD"

$$(T/T_c)^{5/3} + (V/V_c)^{5/3} \leq 1$$

$$\left(\frac{4.33}{5.172}\right)^{5/3} + \left(\frac{.46}{2.767}\right)^{5/3} = .79 \leq 1 \quad \text{OK}$$

PLATE



$M = 4.33\ 2.5 + .46(5) = 13.1$

$F_b = .75(36) = 27$

$S_{REQ'D} = \frac{13.1}{27} = .49$

$S = 12(t)^2/6$

$t = \sqrt{\frac{.49(6)}{12}} = .49''$

USE R 3/4

DESIGN

TUBE

$M_y = 6.24\,(12) = 75$ KIN

$M_z = .96\,(4)(12) = 46$

$F_b = .66\,(46) = 30.4$ KSI

SAY BIAXIAL

TS 4x4x 1/4 $\quad S = 4.11$

$$\frac{\frac{75}{4.11}}{30.4} + \frac{\frac{46}{4.11}}{30.4} =$$

$.60 + .37 = .97 < 1.33$ OK

CONNECTION

1/4" FILLET CS

$\frac{30.4}{70(.3)}$ $.97 = 1.40 > 1.33$ NG!

5/16 $\quad S = 4.79$

$1.4\ \frac{4.11}{4.79} = 1.21 < 1.33 \rightarrow$

TS 4x4x 5/16

5/16 WELD CS

ICBO Evaluation Service, Inc.

5360 WORKMAN MILL ROAD • WHITTIER, CALIFORNIA 90601-2299

A subsidiary corporation of the International Conference of Building Officials

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EVALUATION REPORT

ER-4846

Reissued December 1, 1997

Filing Category: FASTENERS—Concrete and Masonry Anchors (066)

COVERT INJECTION ADHESIVE ANCHORS AND UNDERCUT ANCHORS

COVERT OPERATIONS, INC.
1940 FREEMAN AVENUE
LONG BEACH, CALIFORNIA 90804

1.0 SUBJECT

Covert Injection Adhesive Anchors and Undercut Anchors.

2.0 DESCRIPTION

2.1 Covert Injection Adhesive:

2.1.1 General: The Covert Injection Adhesive (CIA) is a two-component structural epoxy adhesive for anchoring stud-type, threaded steel anchor bolts or deformed steel reinforcing bars into concrete and unreinforced brick. The adhesive formulation is designated as CIA-Gel 7000. The CIA-Gel adhesive anchors consist of CIA-Gel 7000 epoxy and a threaded steel rod, with a nut and washer, or deformed steel reinforcing bars. The installation in normal-weight concrete in general; unreinforced masonry; reinforced masonry walls; and concrete foundation walls is as described in Sections 2.1.4 through 2.1.8.

2.1.2 Materials:

2.1.2.1 Adhesive: The CIA-Gel 7000 epoxy two-component adhesive is packaged in equal-volume, side-by-side plastic cartridges. The cartridges are sealed individually with D-shaped plugs and/or a screw-on cap, which may be reused after partial use of contents. The epoxy is mixed when dispensed through a spiral motionless mixer attached to the cartridge. The epoxy may be dispensed with either a manual or a pneumatically activated tool. The CIA-Gel 7000 epoxy adhesive components have a shelf life of one year when stored in a dry environment at a temperature of 70°F (21°C). The recommended hardening times are noted in Table 3.

2.1.2.2 Threaded Rods: All threaded rods are manufactured from steel complying with ASTM A 193, Grade B7; A 307; or SS304. Specifications and installation of threaded rods are noted in Table 1.

2.1.2.3 Reinforcing Bars: Deformed reinforcement bars are manufactured from steel complying with ASTM A 615, Grade 60. Specifications and installation of reinforcing bar are noted in Table 2.

2.1.3 Design: Allowable tension and shear values for threaded rod or reinforcing bar are described in Tables 5 through 11. The allowable tension load values noted in Tables 5 through 11 must be adjusted for in-service temperatures in accordance with Figure 1 when anchors are installed in locations where the concrete temperatures may exceed 105°F (41°C). Adjustment of loads for reduced edge and end distances are noted in Table 4. Allowable loads for anchors subjected to combined shear and tension forces are determined by the following equation:

$$\left(\frac{P_a}{P_t}\right)^{5/3} + \left(\frac{V_a}{V_t}\right)^{5/3} \leq 1.0$$

where:

P_a = Applied tensile load.
P_t = Allowable tensile load.
V_a = Applied shear load.
V_t = Allowable shear load.

2.1.4 Installation In Concrete:

2.1.4.1 General: A hole is drilled with a hand-held electro-pneumatic rotary hammer drill using carbide-tipped drill bits conforming to ANSI Specification B212.15-1994. The holes are cleaned of dust and debris with a nylon brush and a jet of compressed air. The hole diameter, anchor embedment, spacing and edge distances must comply with Tables 4, 5, 6 and 9.

A mixing nozzle is attached to the adhesive cartridge and the assembly is placed into the hand or pneumatic injection tool. Before placement into the hole, a small amount of epoxy is pumped out of the nozzle until a uniform gray material is achieved. Holes are approximately half filled with the mixed epoxy. The threaded rods or deformed reinforcement bars are inserted with a rotating motion until the anchor contacts the bottom of the hole. The adhesive must be level with the concrete surface after insertion of the rod or bar. Oil, scale, and rust must be removed from the threaded rod or reinforcing bar prior to installation. During anchor installation, the hole and surrounding location may be wet. Anchors should not be loaded until cure time has passed.

2.1.4.2 Special Considerations: The anchors may be used within fire-resistive construction, provided the anchors only resist wind and/or seismic forces. In this application, the anchors cannot resist gravity loads, unless special consideration is given to fire conditions.

2.1.5 Installation in Unreinforced Masonry Walls:

2.1.5.1 General: Anchors installed in unreinforced masonry using the CIA-Gel 7000 adhesive are designed to resist seismic loads. The existing unreinforced brick walls must have a minimum thickness of 13 inches [330 mm (3 wythes of brick)].

Three types of anchor assemblies are used for seismic retrofitting. The anchor assembly resisting tension and shear loads where the outside of the wall is not accessible is the "combination" anchor. The anchor is installed in the wall at an angle of $22^1/_2$ degrees to the horizontal. It consists of a $^3/_4$-inch-diameter (19.1 mm) ASTM A 307 prebent threaded

rod used with a $^{15}/_{16}$-inch-outer-diameter (23.8 mm) screen tube, 13 inches (330 mm) long and made of steel wire cloth. The threaded rod must be embedded a minimum of 13 inches (330 mm) at the $22^{1}/_{2}$-degree angle. Figure 2 shows details of an installed "combination" anchor.

The anchor assembly for tension and shear applications where the outside of the wall is accessible is the "through-bolt" anchor. It consists of $^{5}/_{8}$-inch-diameter (15.9 mm) ASTM A 307 threaded rod, $^{13}/_{16}$-inch (20.6 mm) O.D. by $^{11}/_{16}$-inch (17.5 mm) I.D. AISI 1010 steel sleeve 8 inches (203 mm) in length, a $^{15}/_{16}$-inch-diameter-by-8-inch-long (23.8 mm by 203 mm) wire mesh screen tube, and an ASTM A 36 steel plate measuring 6 inches by 6 inches by $^{3}/_{8}$ inch (152 mm by 152 mm by 9.5 mm). The plate is bolted to the opposite side of the wall. The steel sleeve has a plastic plug at one end to prevent leakage of adhesive during installation. Figure 3 shows details of an installed "through-bolt" anchor.

The anchor assembly resisting shear load where the outside wall is inaccessible is the "shear" anchor. It consists of a $^{3}/_{4}$-, $^{5}/_{8}$- or $^{1}/_{2}$-inch-diameter (19.1, 15.9, or 12.7 mm) ASTM A 307 threaded rod or a No. 6, No. 5 or No. 4 reinforcing bar and a $^{15}/_{16}$-inch-diameter-by-8-inch-long (23.8 mm by 203 mm) wire mesh screen tube. Figure 4 shows details of an installed "shear" anchor.

2.1.5.2 Installation: One-inch-diameter (25.4 mm) holes are drilled using standard carbide-tipped masonry drill bits which meet ANSI Specifications B212.15-1994. A rotary drill, or rotary hammer drill set on "rotation only" is used to drill the holes.

Holes for the "combination" anchors (Figure 2) are drilled 13 inches (330 mm) deep at a $22^{1}/_{2}$-degree angle. Holes for the "through-bolt" anchors (Figure 3), and the "shear" anchors (Figure 4) are drilled perpendicular to the wall. For the "through-bolt" application the holes are drilled completely through the wall. For shear anchors, the holes are drilled 8 inches (203 mm) deep. The holes are cleaned using a nylon brush, and a jet of compressed air. An extension nozzle must be used to reach the back of the hole with compressed air.

Screen tubes are completely filled with CIA-Gel 7000 epoxy and then placed into the drilled holes. A $^{3}/_{4}$-inch-diameter (19.1 mm) threaded rod for the "combination" anchors and "shear" anchors, and $^{7}/_{8}$-inch-diameter (22 mm) steel sleeves for the "through-bolt" anchors are then slowly pushed into the screen tube, rotating continuously. The anchors or steel sleeves must be allowed to cure for the times listed in Table 3 before anchors are loaded. Bolt-up time refers to that period of cure after which hardware may be placed and nuts tightened. Care must be taken not to overtighten nuts nor induce tension in bolts. Design loads may not be applied until minimum cure time has transpired.

For the through-bolted anchor, a 1-inch-diameter (25.4 mm), 8-inch-deep (203 mm) hole is drilled and cleaned as noted above. A $^{7}/_{8}$-inch-outside-diameter (22 mm) steel sleeve is then pushed into an adhesive-filled screen in a manner similar to the rod. After curing, a hole is drilled through the sleeve and through the remainder of the masonry wall. Drilling is continued until the entire wall is penetrated. The $^{5}/_{8}$-inch-diameter (15.9 mm) rod is then inserted and fitted with a plate and nut to complete the through-bolted anchor connection. See Figure 3.

2.1.5.3 Conditions of Acceptance: Conditions of acceptance for threaded rods and reinforcing bars in unreinforced brick masonry are as follows:

2.1.5.3.1 Threaded Rods and Through-bolts in Tension and Shear:

1. Installation of threaded rods and through-bolts must comply with Section 2.1.5.
2. Maximum allowable tension load for the $^{3}/_{4}$-inch-diameter (19.1 mm) bent threaded rod or the $^{5}/_{8}$-inch-diameter (15.9 mm) through-bolt is 1,200 pounds (5340 N) with no increase for lateral loading.
3. The maximum allowable shear load for the $^{3}/_{4}$-inch-diameter (19.1 mm) bent threaded rod is 1,000 pounds (4450 N) and for the $^{5}/_{8}$-inch (15.9 mm) through-bolt is 750 pounds (3338 N), with no increase for lateral loading permitted.
4. For the $^{3}/_{4}$-inch-diameter (19.1 mm) bent threaded rod or the $^{5}/_{8}$-inch-diameter (15.9 mm) through-bolt subjected to tension and shear the allowable combined load is determined assuming straight line relationship between allowable shear and tension loads.
5. Minimum wall thickness is 13 inches [330 mm (three wythes of brick)].
6. The allowable tension and shear is applicable only to anchors installed in walls where in-place shear tests indicate a minimum mortar strength of 50 psi net.

2.1.5.3.2 Threaded Rods or Reinforcing Bars in Shear:

1. Installation of threaded rods and reinforcing bars intended to resist shear only must comply with Section 2.1.5.
2. The allowable shear load for the $^{3}/_{4}$-inch-diameter (19.1 mm) rod is 1,000 pounds (4450 N) and for the No. 6, No. 5 and No. 4 reinforcing bars the allowable shear loads are 1,000, 750 and 500 pounds (4450, 3338 and 2225 N), respectively. No increase for lateral loading is permitted with the above-noted loads.
3. Minimum wall thickness is 13 inches [339 mm (three wythes of brick)].
4. Allowable shear value is applicable only to anchors installed in walls where in-place shear tests indicate a minimum mortar strength of 50 psi (344.5 kPa) net.

2.1.5.3.3 Field Inspection:

1. Five percent of resisting tension anchors, threaded rods, and through-bolts must be tested in accordance with the procedure described in ASTM E 488-90, with a minimum of two tests required. Where the wall thickness varies, at least one test must be performed on an anchor which has the minimum embedment. Tests must show that bolts can maintain a tensile load of 3,000 pounds (13.35 kN) for 5 minutes. The test report must include:
   a. Test location(s)
   b. Brick/mortar condition
   c. Bolt movement/elongation
   d. Embedment depth
   e. Applied load
2. Twenty-five percent of installed anchors resisting tension and shear must be tested by a special inspector using a torque-calibrated wrench. The torque for the $^{1}/_{2}$-inch-diameter (12.7 mm) anchors, the $^{5}/_{8}$-inch-diameter (15.9 mm) anchors and the $^{3}/_{4}$-inch-diameter (19.1 mm) anchors is 40 foot-pounds, 50 foot-pounds and 60 foot-pounds (54.2 N-m, 67.8 N-m and 81.3 N-m), respectively. No visible deflection or deformation is permitted during the above-noted torque tests.
3. Twenty-five percent of installed threaded rods and reinforcing bar anchors resisting shear must be tested by a special inspector using a torque-calibrated wrench. The torque for the $^{3}/_{4}$-inch-diameter (19.1 mm) rod and the No. 6 reinforcing bar is 60 foot-pounds (81.3 N-m). For the No. 5 and No. 4 reinforcing bars, the torque is 50 foot-pounds and 40 foot-pounds (67.8 N-m and 54.2 N-m), respectively.

2.1.5.3.4 Miscellaneous: The Covert Injection Adhesive Anchors are intended for resisting short-term lateral loads only, such as wind or seismic loads. The anchors must be approved by the responsible design engineer and installed under special inspection in accordance with Section 2.3 of this report.

The anchors' edge distances and vertical and horizontal spacings for the three types of anchor assemblies described in Section 2.1.5.1 shall comply with Table 13.

2.1.6 Installation in Concrete Foundation Walls: CIA-Gel 7000 adhesive is used in concrete foundation walls utilizing $^5/_8$-inch- and $^7/_8$-inch-diameter (15.9 mm and 22 mm) anchors. The anchors are threaded rods complying with ASTM A 193, Grade B7, A307 or SS304. They must be installed in minimum 2,000 psi (13.8 MPa) normal-weight concrete. The installation is as described in Section 2.1.4. The allowable loads, embedment depths, end and edge distances are shown in Table 9.

2.1.7 Installation in Unreinforced, Grouted, Concrete Masonry Walls: CIA-Gel 7000 adhesive is installed in unreinforced, grouted concrete masonry walls, utilizing $^3/_8$-inch-, $^1/_2$-inch-, $^5/_8$-inch- and $^3/_4$-inch-diameter (9.5 mm, 12.7 mm, 15.9 mm and 19.1 mm) anchors designed to resist tension and shear loads. The anchors are threaded rods as described in Section 2.1.2.2. The anchors must be installed in minimum 2,000 psi (13.8 MPa) grouted concrete masonry. The existing unreinforced concrete masonry walls must have a minimum thickness of 8 inches (203 mm). The installation is as described in Section 2.1.4. Allowable loads, embedment depths, and end and edge distances are noted in Table 10.

2.1.8 Installation in Reinforced Brick Masonry Walls: CIA-Gel 7000 adhesive is installed in brick masonry walls, utilizing $^1/_2$-inch- and $^3/_4$-inch-diameter (12.7 mm and 19.1 mm) anchors. The anchors are threaded rods complying with ASTM A 193, Grade B7. The existing reinforced brick wall must have a minimum thickness of 9 inches (229 mm). The anchors must be installed in masonry units having a minimum 1,300 psi (8.9 MPa) strength. Installation is as described in Section 2.1.4. Allowable loads are noted in Table 11.

2.2 Covert Operations Ductile Undercut Anchors (DUC):

2.2.1 General: The DUC anchor is designed to be a ductile anchor which transfers loads from the anchor stud and sleeve to the concrete through bearing. The DUC anchors consist of three main components: An expander coupling, an expansion sleeve and a threaded rod. The anchors are available in $^3/_8$-inch-, $^1/_2$-inch- and $^5/_8$-inch-diameter (9.5 mm, 12.7 mm and 15.9 mm) threads. The threaded rod used with the 60 series anchors complies with ASTM A 36 specification. The threaded rod used with the 125 series anchors complies with ASTM A 193, Grade B7 specification. The 60 series rods have a zinc chromate finish and the 125 series rods have a yellow chromate finish. The expanded anchor sleeve creates a mechanical interlock with the surrounding concrete. The allowable loads and pertinent installation data is shown in Table 12. DUC anchor allowable loads may also be calculated using the strength design provisions of Section 1923.3 of the code.

2.2.2 Installation of DUC Anchors: A hole is drilled with a carbide-tipped drill bit with the same nominal diameter as the required hole diameter (see Table 12). The drill bit must conform to the tip diameter tolerances of ANSI Specification B212.15-1994. The hole is drilled to the minimum depth required in Table 12. Dust and debris are cleaned from the hole using a nylon brush and a blowout bulb or compressed air. The undercutting drill bit is attached to a small rotary hammer drill. The drill is set into the rotary hammer mode and inserted into the hole. The drill is turned on and the drill bit is pushed slowly into the hole. The undercutting process begins once the drill bit bottoms out in the hole and is completed when the spring-loaded collar is fully compressed (gap closed). Dust and debris are cleaned out from the hole using a blowout bulb or compressed air. A washer and nut are placed on the anchor. The anchor is driven through the material to be anchored and into the work surface until the nut and washer are snug with the material to be attached or until the anchor bottoms out in the hole. The nut is turned until finger tight, then turned several full turns using a wrench until the expansion sleeve is set. Should the threaded rod spin inside the sleeve, a screw driver or similar tool is placed in the slot to prevent the threaded rod from spinning. A torque wrench is used to apply the appropriate amount of installation torque listed in Table 12.

2.3 Special Inspection:

Adhesive anchor installations require special inspection in accordance with Section 1701 of the code. The special inspector must record product description (including product name), adhesive expiration date, concrete type and strength, anchor diameter and steel grade, compliance of drill bit with this report, hole diameter and location, cleanliness of hole and anchor, adhesive application, anchor embedment, and verification that anchor installation is in accordance with the manufacturer's published installation instructions and this report. The manufacturer's instructions are included in each package.

2.4 Identification:

The CIA-Gel 7000 are identified by a label on the cartridge displaying the name and address of the manufacturer, the words "CIA-Gel 7000," and are accompanied by general installation instructions, expiration date, weight and evaluation report number (ER-4846). Steel sleeves and screen tubes are identified by a label on boxes displaying name and address of the manufacturer and size and quantity of the contents. Threaded rods and bars are identified by material certification. The DUC anchors are identified by a label on the boxes displaying the name and address of the manufacturer and size and quantity of the contents.

3.0 EVIDENCE SUBMITTED

Descriptive details and results of tension and shear tests for anchors in concrete. Unreinforced masonry anchors comply with the ICBO ES Acceptance Criteria for Unreinforced Masonry Anchors (AC60), dated January 1995. Adhesive anchors comply with the ICBO ES Acceptance Criteria for Adhesive Anchors in Concrete and Masonry Elements (AC58), dated April 1995.

4.0 FINDINGS

That Covert Operations anchors described in this report comply with the 1994 *Uniform Building Code*™, subject to the following conditions:

4.1 The anchors must be installed in accordance with this report and the manufacturer's installation instructions. The anchor size, minimum embedment depths, spacing and edge distances in concrete conform to pertinent tables in this report.

4.2 Allowable shear and tension loads in concrete are set forth in this report. Allowable loads must be adjusted for temperature in accordance with Figure 1.

4.3 Allowable shear and tension loads and pertinent installation dimensions for concrete foundation walls are as set forth in Table 9.

4.4 Allowable loads for anchors in concrete subjected to combined tension and shear forces are determined by the equation in Section 2.1.3 of this report.

4.5 Special inspection in accordance with Section 2.3 is provided for all adhesive anchor installations.

4.6 Calculations and details showing that the anchors comply with this report must be submitted to the local building official for approval.

4.7 The CIA-Gel 7000 anchors cannot be used to support fire-resistive construction, except as noted in Section 2.1.4.2 of this report.

4.8 The CIA-Gel 7000 anchors cannot be used to resist pullout forces in ceiling or wall installations in con-

crete, in accordance with Section 2.1.4 of this report, unless proper consideration is given to fire conditions.

4.9 The CIA-Gel 7000 adhesive may be used to resist wind and seismic forces for anchors installed in accordance with Section 2.1.4 and 2.1.5 of this report.

4.10 The tabulated allowable load values may be increased by $33^1/_3$ for short-term loads such as wind or earthquake loads for anchors installed in concrete in accordance with Section 2.1.4 of this report.

4.11 During CIA-Gel 7000 anchor installation in concrete, the hole and surrounding location are permitted to be wet.

4.12 The anchors are limited to interior use, except installation is permitted in severe, moderate or negligible exterior weathering locations in accordance with Figure 21-1-1 of UBC Standard 21-1 when stainless steel threaded rods are used.

4.13 Anchors are not permitted to be subjected to vibratory or shock loads such as those encountered by supports for reciprocating engines, crane loads and moving loads due to vehicles.

4.14 The DUC anchors are limited to nonfire-resistive construction unless appropriate data is submitted to demonstrate anchor performance is maintained in fire-resistive situations.

4.15 The DUC anchors are limited to installation in uncracked concrete, which is defined as concrete subject to maximum 170 psi (1172 kPa) tensile stress induced by external loads and deformations.

4.16 The adhesive is manufactured in Long Beach, California, under a quality control program administered by CTI Engineering (AA-639).

This report is subject to re-examination in two years.

TABLE 1—SPECIFICATION AND INSTALLATION DETAILS FOR THREADED ROD INSTALLED WITH COVERT INJECTION ADHESIVE

d	Rod diameter (in.)	$^3/_8$	$^1/_2$	$^5/_8$	$^3/_4$	$^7/_8$	1
A_s	Tensile stress area (in.^{2})	0.0775	0.142	0.226	0.334	0.462	0.606
A_b	Nominal area of rod (in.^{2})	0.1042	0.1867	0.2935	0.4246	0.6013	0.7854
d_o	Nominal bit diameter hole size (in.)	$^1/_2$	$^5/_8$	$^3/_4$	$^7/_8$	1	$1^1/_4$
T_{max}	Maximum tightening torque (ft.-lbs.)	15	30	70	150	200	310

For SI: 1 inch = 25.4 mm, 1 in^2 = 645 mm^2, 1 ft.-lb. = 1356 N·mm.

TABLE 2—SPECIFICATION AND INSTALLATION DETAILS FOR REINFORCING BAR INSTALLED WITH COVERT INJECTION ADHESIVE

d_r	Rebar size	#3	#4	#5	#6	#8	#10
A_{br}	Nominal area of rebar (in.^{2})	0.11	0.20	0.31	0.44	0.79	1.27
d_o	Nominal bit diameter hole size (in.)	$^1/_2$	$^5/_8$	$^3/_4$	1	$1^1/_4$	$1^1/_2$

For SI: 1 inch = 25.4 mm, 1 in^2 = 645 mm^2.

TABLE 3—RECOMMENDED HARDENING TIME FOR COVERT INJECTION ADHESIVE

TEMPERATURE (°F)[1]	BOLT-UP TIME (hours)[2]	CURE TIME (hours)[3]
65-70	6	48
71-80	4	36
>80	4	24

For SI: 1°C = (t°F – 32) ÷ 8.

[1]Covert injection adhesives should not be installed in substrates colder than 65°F.

[2]See Section 2.1.5.2 for explanation of bolt-up time.

[3]Minimum cure time is the time required for the epoxy to achieve full strength.

TABLE 4—REDUCTION FACTORS FOR REDUCED SPACING AND EDGE DISTANCES[1,2]

TENSION CAPACITY		SHEAR CAPACITY			
				Factor (F_i)	
Spacing (s) and Edge Distance (c)	Factor (F_i)	Spacing (s) and Edge Distance (c)	Direction of Load	Threaded Rod	Reinforced Steel
$s_{min} = 0.25s$	0.65	$c_{min} = 0.5c$	Toward edge Not toward edge	0.73 0.73	0.65 0.65
$c_{min} = 0.50c$	0.85	$c_{min} = 0.25c$	Toward edge Not toward edge	0.25 0.4	0.20 0.40
—	—	$s_{min} = 0.5s$	Toward edge Not toward edge	0.6 1.0	0.6 1.0

[1]Linear interpolation is allowed for edge distances which fall between $0.25c$ and $0.5c$ or $0.5c$ and $1.0c$, and anchor spacing which falls between $0.5s$ and $1.0s$.

[2]Load reduction factors must be combined where applicable. In the case where three or more anchors are used, spacing reduction factors must be multiplied together. Where two or more edge distances affect performance, edge reduction factors must be multiplied together. When a group of anchors is affected by both reduced spacing and reduced edge distances, the edge and spacing reduction factors must be multiplied together.

TABLE 5—ALLOWABLE TENSILE LOADS FOR THREADED ROD INSTALLED IN NORMAL-WEIGHT CONCRETE USING COVERT INJECTION ADHESIVE (pounds)[1,2,3,4,5,6,7]

STUD DIAMETER, d (Inch)	MINIMUM EMBEDMENT DEPTH, h_{ef} (Inches)	SPACING, s (Inches)	EDGE DISTANCE, c (Inches)	BASED ON BOND STRENGTH		BASED ON STEEL STRENGTH		
				$f_c' = 2{,}000$ psi	$f_c' = 4{,}000$ psi			
				With Special Inspection		A 307 (SAE 1016)	A 193 Gr. B7 (SAE 4140)	SS 304
3/8	3 3/8	6 3/4	3 3/8	2,150	2,590	2,185	4,580	2,732
	1 7/8	3 7/8	1 7/8	1,190	1,190			
1/2	5 1/2	11	1 3/4	2,590	—	3,885	8,210	4,860
	2 1/2	5	2 1/2	1,940	—			
	4 1/2	9	4 1/2	3,495	3,475			
5/8	7	14	1 3/4	3,370	—	6,070	12,910	7,290
	3 1/8	6 1/4	3 1/8	2,600	—			
	5 5/8	11 1/4	5 5/8	5,400	5,525			
3/4	7 7/8	15	1 3/4	4,540	—	8,740	18,680	10,925
	3 3/4	7 1/2	3 3/4	3,915	—			
	6 3/4	13 1/2	6 3/4	5,210	6,470			
7/8	7 7/8	15 3/4	7 7/8	8,490	9,725	11,900	25,510	14,875
1	9	18	9	12,330	11,880	15,540	33,390	19,428

For SI: 1 inch = 25.4 mm, 1 psi = 6.89 kPa, 1 lbf = 4.45 N.

[1]Allowable load must be the lesser of bond or steel strength.

[2]The tabulated values are for anchors installed at the specified spacing (s) and edge (c) distances. Spacing and edge distances may be reduced in accordance with Table 4. Linear interpolation may be used for intermediate spacings.

[3]The tabulated values are for anchors installed in concrete having the designated compressive strength or higher at the time of installation.

[4]CIA anchors experience a reduction in tensile capacity with increased ambient temperatures. The temperature load factors noted in Figure 1 must be applied to the values in Table 5 when the anchors are installed in locations where the concrete temperatures may exceed 105°F.

[5]The allowable loads listed under allowable bond strength in the table are based on a safety factor of 4.0.

[6]Allowable load based on bond strength may be interpolated for compressive strengths between $f_c' = 2{,}000$ psi and $f_c' = 4{,}000$ psi.

[7]Allowable loads may be increased by 33 1/3 percent for short-term loading due to earthquakes or wind.

TABLE 6—ALLOWABLE SHEAR LOADS FOR THREADED ROD INSTALLED IN NORMAL-WEIGHT CONCRETE USING COVERT INJECTION ADHESIVE (pounds)[1,2,3,4,5]

STUD DIAMETER, d (Inch)	MINIMUM EMBEDMENT DEPTH, h_{ef} (Inches)	SPACING, s (Inches)	EDGE DISTANCE, c (Inches)	BASED ON STEEL STRENGTH			BASED ON BOND STRENGTH
				A 307 (SAE 1016)	A 193 Gr. B7 (SAE 4140)	SS 304	$f_c' = 2{,}000$ psi
3/8	3 3/8	6 3/4	6 3/4	1,125	2,347	1,400	1,470
1/2	4 1/2	9	9	2,000	4,170	2,500	2,835
5/8	5 5/8	11 1/4	11 1/4	3,125	6,520	3,900	4,435
5/8	5 3/4	11 1/2	1 3/4	2,700[5]	6,520	3,900	2,700
3/4	6 3/4	13 1/2	13 1/2	4,500	9,390	5,610	6,905
7/8	7 7/8	15 3/4	15 3/4	6,130	12,775	7,650	8,687
1	9	18	18	8,000	16,700	10,000	11,356

For SI: 1 inch = 25.4 mm, 1 psi = 6.89 kPa, 1 lbf = 4.45 N.

[1]Allowable load must be the lesser of bond or steel strength.

[2]The tabulated values are for anchors installed at the specified spacing (s) and edge (c) distances. Spacing and edge distances may be reduced in accordance with Table 4. Linear interpolation may be used for intermediate spacings.

[3]The tabulated values are for anchors installed in concrete having the designated compressive strength or higher at the time of installation.

[4]Allowable loads may be increased by 33 1/3 percent for short-term loading due to earthquakes or wind.

[5]Load based on bond strength. Value is for anchors loaded parallel to the edge.

TABLE 7—ALLOWABLE TENSILE LOADS FOR ASTM A 615 GRADE 60 REINFORCING BAR INSTALLED IN NORMAL-WEIGHT CONCRETE USING COVERT INJECTION ADHESIVE (pounds)[1,2,3,4,5]

DOWEL SIZE	DRILL BIT DIAMETER (inches)	MINIMUM EMBEDMENT, h_{ef} (inches)	SPACING, s (inches)	EDGE DISTANCE, c (inches)	BASED ON BOND STRENGTH f'_c = 2,000 psi
#3	1/2	4	6 3/4	3 3/8	1,923
#4	5/8	4 1/2	9	4 1/2	3,700
#5	3/4	5 5/8	11 1/4	5 5/8	4,870
#6	1	6 3/4	13 1/2	6 3/4	7,270
#7	1 1/8	7 7/8	15 1/4	7 7/8	8,720
#8	1 1/4	9	18	9	12,266
#10	1 1/2	11	23	11 1/4	14,087

For SI: 1 inch = 25.4 mm, 1 psi = 6.89 kPa, 1 lbf = 4.45 N.

[1]The tabulated values are for rebar installed in concrete having the designated compressive strength or higher at the time of installation.

[2]The tabulated values are for anchors installed at the specified spacing (s) and edge (c) distances. Spacing and edge distances may be reduced in accordance with Table 4. Linear interpolation may be used for intermediate spacing.

[3]The allowable loads listed under allowable bond strength in the table are based on a safety factor of 4.0.

[4]CIA anchors experience a reduction in tensile capacity with increased ambient temperatures. The load factors noted in Figure 1 must be applied to the values noted in the above table when the anchors are installed in locations where the concrete temperature may exceed 105°F.

[5]Allowable loads may be increased by 33 1/3 percent for short-term loading due to earthquake or wind.

TABLE 8—ALLOWABLE SHEAR LOADS FOR ASTM A 615 GRADE 60 REINFORCING BAR INSTALLED IN NORMAL-WEIGHT CONCRETE USING COVERT INJECTION ADHESIVE (pounds)[1,2,3,4]

DOWEL SIZE	DRILL BIT DIAMETER (inches)	MINIMUM EMBEDMENT (inches)	SPACING, s (inches)	EDGE DISTANCE, c (inches)	BASED ON CONCRETE STRENGTH f'_c = 2,000 psi	BASED ON STEEL STRENGTH
#3	1/2	4	6 3/4	6 3/4	2,090	2,640
#4	5/8	4 1/2	9	9	3,795	4,800
#5	3/4	5 5/8	11 1/4	11 1/4	5,885	7,440
#6	1	6 3/4	13 1/2	13 1/2	8,350	10,560
#7	1 1/8	7 7/8	15 3/4	15 3/4	11,390	14,400
#8	1 1/4	9	18	18	14,995	18,960
#10	1 1/2	11	23	23	24,110	30,480

For SI: 1 inch = 25.4 mm, 1 psi = 6.89 kPa, 1 lbf = 4.45 N.

[1]Allowable load must be the lesser of bond or steel strength.

[2]The tabulated values are for rebar installed in concrete having the designated compressive strength or higher at the time of installation.

[3]The tabulated values are for anchors installed at the specified spacings (s) and edge (c) distances. Spacing and edge distances may be reduced in accordance with Table 4. Linear interpolation may be used for intermediate spacings.

[4]Allowable loads may be increased by 33 1/3 percent for short-term loading due to wind or earthquake.

TABLE 9—ALLOWABLE TENSILE LOADS FOR THREADED ROD INSTALLED IN A CONCRETE FOUNDATION WALL USING COVERT INJECTION ADHESIVE (pounds)[1,2,3,4]

STUD DIAMETER, d (inch)	MINIMUM EMBEDMENT DEPTH, h_{ef} (inch)	MINIMUM WALL WIDTH (inch)	MINIMUM EDGE DISTANCE, c_1 (inches)	MINIMUM ANCHOR SPACING, s (inches)	BASED ON BOND OR CONCRETE STRENGTH f'_c = 2,500 psi (minimum)	
					Center Location ($c_2 \geq 12$ inches)	Corner Location (5 inches $\leq c_2 <$ 12 inches)
5/8	9	5	1 3/4	9	3,460	2,780
7/8	12 1/4	8	2 3/4	12	5,910	4,760

For SI: 1 inch = 25.4 mm, 1 psi = 6.89 kPa, 1 lbf = 4.45 N.

[1]The tabulated values are for anchors installed at the specified spacing (s) and edge (c) distances.

[2]The tabulated values are for anchors installed in concrete having the designated compressive strength or higher at the time of installation.

[3]CIA anchors experience a reduction in tensile capacity with increased ambient temperatures. The load factors noted in Figure 1 must be applied to the values noted in the above table when the anchors are installed in locations where the concrete temperature may exceed 105°F.

[4]c_2 is rod spacing distance in inches.

TABLE 10—ALLOWABLE TENSION AND SHEAR LOADS FOR THREADED ROD INSTALLED IN GROUT-FILLED NORMAL-WEIGHT CONCRETE MASONRY UNITS[1,2,3,4]

STUD DIAMETER (Inch)	DRILL DIAMETER (Inch)	EMBEDMENT, h_{ef} (Inches)	SPACING, s (Inches)	EDGE DISTANCE, c (Inches)	TENSION		SHEAR
					Cell (lbs.)	Joint (lbs.)	Cell (lbs.)
3/8	1/2	3 1/2	6 3/4	3 3/8	1,570	990	1,460
1/2	5/8	4 1/4	9	4 1/2	2,010	1,325	2,350
5/8	3/4	4 7/8	11 1/4	5 5/8	2,475	1,700	2,840
3/4	7/8	6 1/2	13 1/2	6 3/4	2,390	3,070	3,720

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N, 1°C = (t°F – 32) ÷ 8.

[1]Values are for 6- and 8-inch-wide, Grade N type, lightweight, medium-weight, or normal-weight concrete masonry units conforming to UBC Standard 21-4, with a minimum compressive strength of 2,000 psi. Grout shall meet the proportions of Table 21-B of the UBC.

[2]Allowable load must be the lesser of bond or steel strength.

[3]The tabulated values are for anchors installed at the specified spacing (s) and edge (c) distances. Spacing and edge distances may be reduced in accordance with Table 4. Linear interpolation may be used for intermediate spacings.

[4]The CIA-Gel 7000 experiences a reduction in tensile capacity with increased ambient temperatures. The temperature load factors noted in Figure 1 must be applied to the tension values when anchors are installed in locations where the concrete temperatures may exceed 105°F.

TABLE 11—ALLOWABLE TENSION AND SHEAR VALUES IN CLAY BRICK MASONRY FOR THREADED RODS WITH CIA-GEL 7000 EPOXY[1,2,3,4,5]

STUD DIAMETER (Inch)	DRILL DIAMETER (Inch)	EMBEDMENT (Inches)	SPACING (Inches)	EDGE DISTANCE (Inches)	TENSION (lbs.)	SHEAR (lbs.)			
						Bond	A307	A193 GB7	SS 304
1/2	5/8	6	12	6	3,861	2,980	2,060	4,100	2,000
3/4	7/8	7 3/4	15	7 3/4	5,609	4,740	4,500	9,390	4,500

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N, 1°C = (t°F – 32) ÷ 8.

[1]Allowable load must be the lesser of bond or steel strength.

[2]The tabulated values are for anchors installed at the specified spacing (s) and edge (c) distances. Spacing and edge distances may be reduced in accordance with Table 4. Linear interpolation may be used for intermediate spacings.

[3]The tabulated values are for anchors installed in minimum 9-inch-thick reinforced clay brick masonry with a minimum $f_m' = 1{,}300$ psi.

[4]The CIA-Gel 7000 experiences a reduction in tensile capacity with increased ambient temperatures. The temperature load factors noted in Figure 1 must be applied to the tension values when anchors are installed in locations where the concrete temperatures may exceed 105°F.

[5]Anchors may be installed in the brick face or the mortar joint.

TABLE 12—ALLOWABLE TENSION AND SHEAR VALUES (WORKING STRESS METHOD) DUC UNDERCUT ANCHORS INSTALLED IN MINIMUM 2,500 PSI STONE-AGGREGATE CONCRETE (in pounds)[1,2]

CATALOG NUMBER	STUD DIAMETER, d (Inch)	HOLE DIAMETER, d_o (Inch)	MINIMUM HOLE DEPTH[3], h (Inches)	MINIMUM ANCHOR EMBEDMENT[4], h_{ef} (Inches)	ANCHOR SPACING, s (Inches)	EDGE DISTANCE, c (Inches)	INSTALLATION TORQUE, T_1 (foot-pounds)	TENSION[5]	SHEAR
60 Series									
DUC38-275	3/8	5/8	3 1/2	2 3/4	5 1/2	4 1/8	20	1,130	1,400
DUC12-400	1/2	3/4	4 3/4	4	8	6	55	1,800	2,510
DUC58-450	5/8	1	5 1/2	4 1/2	9	2 1/4	90	2,730	3,910
125 Series									
DUC38-450	3/8	5/8	5 1/4	4 1/2	9	6 3/4	35	1,900	2,460
DUC12-600	1/2	3/4	6 3/4	6	12	9	100	3,090	3,970
DUC58-750	5/8	1	8 1/2	7 1/2	15	11 1/4	140	5,360	6,320

For **SI:** 1 inch = 25.4 mm, 1 psi = 6.89 kPa, 1 lbf = 4.45 N, 1 lbf · ft = 1.36 N · m.

[1]The tabulated values are for anchors installed at the specified spacing (s) and edge (c) distances. Spacing and edge distances may be reduced using the provisions of Section 1923.3 of the code.

[2]The tabulated values are for anchors installed in concrete having the designated compressive strength or higher at the time of installation.

[3]Hole depth is measured from the concrete surface to the bottom of the hole.

[4]Anchor embedment is measured from the concrete surface to the bottom of the expansion sleeve.

[5]These tension values are only applicable when the anchors are installed without special inspection. Where special inspection is provided, allowable tension loads are twice the tabulated values.

TABLE 13—MINIMUM SPACING AND EDGE DISTANCE FOR ANCHORS IN UNREINFORCED MASONRY (inches)

ANCHOR TYPE	MINIMUM VERTICAL SPACING	MINIMUM HORIZONTAL SPACING	MINIMUM EDGE DISTANCE
All Types[1]	16	16	16

For **SI:** 1 inch = 25.4 mm.

[1]"All Types" refers to the three types of anchor assemblies described in Section 2.1.5.1 and Figures 2, 3 and 4 of this report.

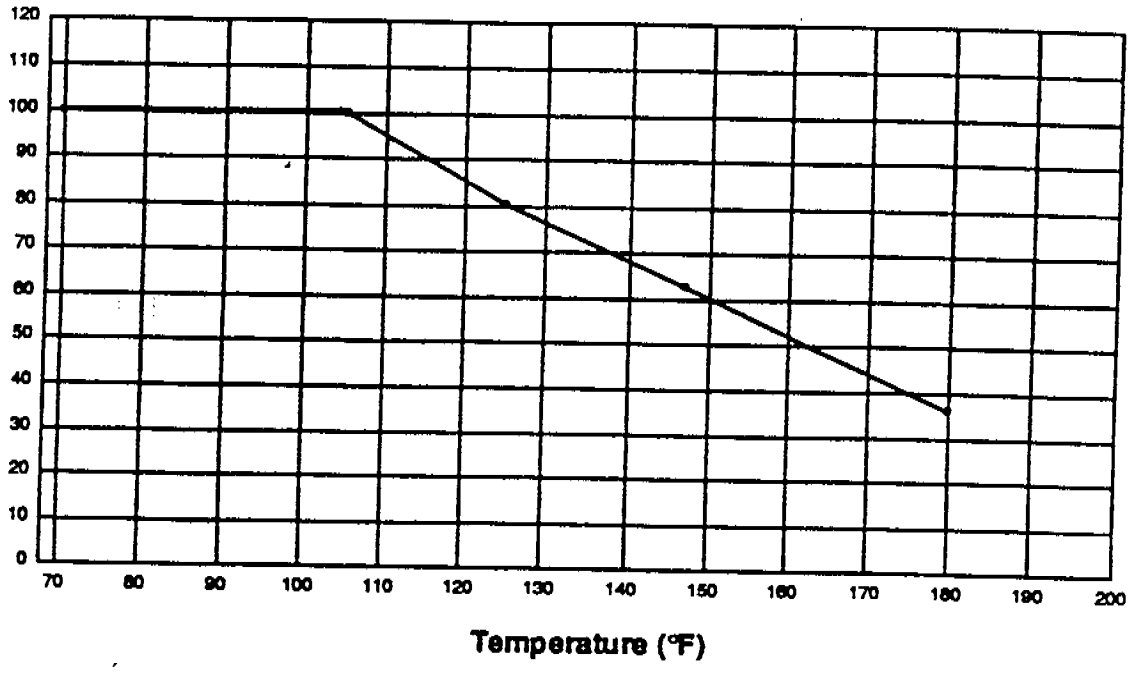

FIGURE 1—CONCRETE TEMPERATURE SENSITIVITY LOAD FACTOR FOR CIA ANCHORS

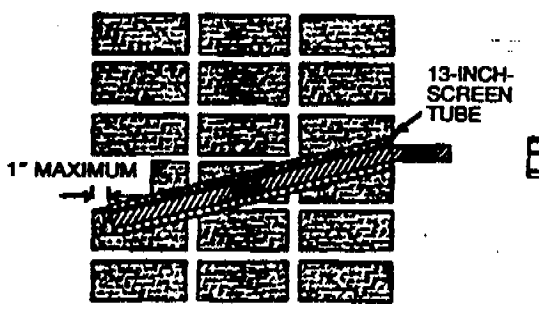

FIGURE 2
THE COMBINATION ANCHOR

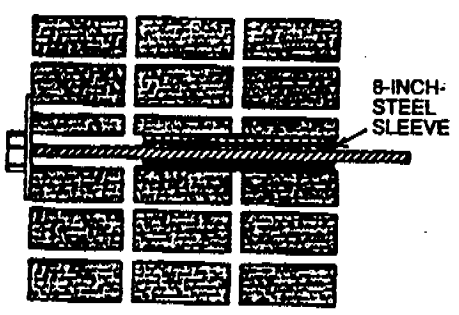

FIGURE 3
THE THRU-BOLT ANCHOR

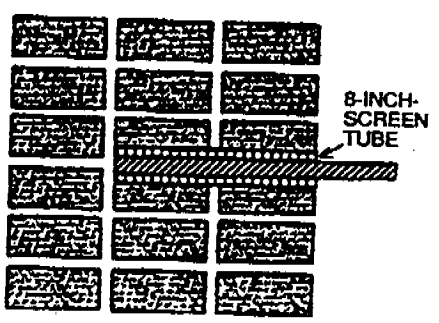

FIGURE 4
THE SHEAR ANCHOR