

QUAKE BRAKE™

MODEL QBC-36 SEISMIC SWAY BRACING KIT

FEATURING

The QUAKE BRAKE™ Seismic Dampening Device. The QUAKE BRAKE™ was Certified NEBS Level 3 Zone 4 Compliant after being tested in accordance with Telcordia GR-63-CORE in a seismic sway bracing configuration that was attached to a telecommunications enclosure (rack, cabinet), which enclosure was consistent with the assumptions used in the calculations contained herein. Installed enclosures, on which the QBC-36 Seismic Sway Bracing Kits are installed in accordance with the installation instructions and calculations that follow, are themselves NEBS Level 3 Zone 4 Compliant.

In addition, enclosures having properly installed QBC-36 Seismic Sway Bracing Kits satisfy the seismic design requirements of the following Building Codes and Standards:

1. 1997 ICBO Uniform Building Code (UBC), which is used as California State Code (including OSHPD) for the most severe seismic loading conditions (Max. HLF of 1.32):

- Seismic Zones 1, 2A, 2B, 3 & 4
- Soil Profiles S_A , S_B , S_C , S_D & S_E
- Seismic Source Types A, B & C for all Near Source Factors (N_a)
- Importance Factors 1.0 & 1.5
- Component Amplification Factor (a_p) of 1.0
- Component Response Factor (R_p) of 3.0
- Equipment anchored at any level of the building

2. 1992 - 1999 BOCA National Building Code & 1992 - 1999 SBCCI Standard Building Code for the most severe seismic loading conditions (Max. HLF of 1.20):

- Seismic Hazard Groups I, II & III
- A_v Contour Lines 0.05, 0.10, 0.15, 0.20, 0.30 & 0.40

3. 2000 International Building Code (IBC), ASCE 7-98 and 1997 NEHRP (FEMA) for seismic loading conditions with a Max. HLF of 1.32:

- S_s (contour line from 0.2 sec Spectral Response Acceleration @ 5% Critical Damping %g) of 25 through 275 with equipment anchored at any level of the building.
- S_s (contour line from 0.2 sec Spectral Response Acceleration @ 5% Critical Damping %g) of 275 through 300 with equipment anchored at any level of the bottom 2/3 of the building.
- Site Class A, B, C & D
- Importance Factors 1.0 & 1.5
- Component Amplification Factor (a_p) of 1.0
- Component Response Factor (R_p) of 2.5

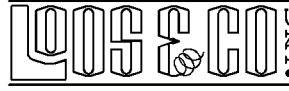
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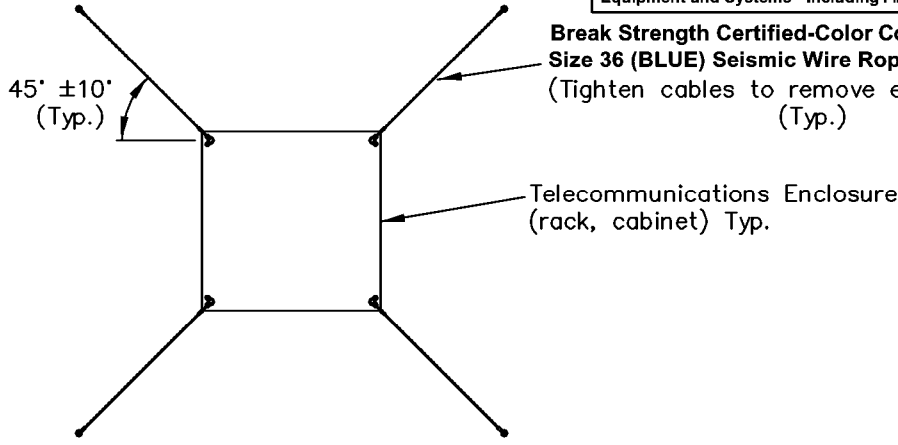


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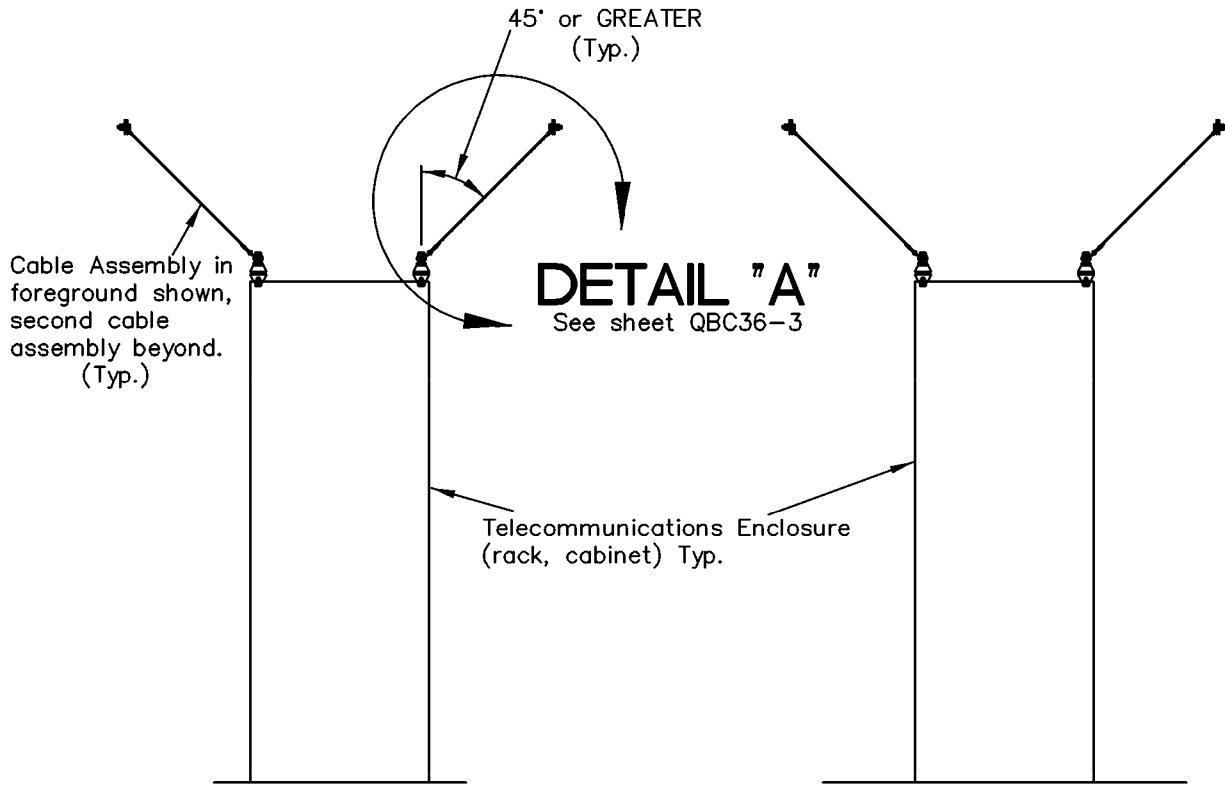
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Break Strength Certified-Color Coded-Prestretched Size 36 (BLUE) Seismic Wire Rope/Cable™ Brace Assembly (Tighten cables to remove excessive slack.) (Typ.)



PLAN VIEW



Cable Assembly in foreground shown, second cable assembly beyond. (Typ.)

DETAIL "A"
See sheet QBC36-3

Telecommunications Enclosure (rack, cabinet) Typ.

ELEVATION

END VIEW

QBC-36 QUAKE BRAKE™ Seismic Sway Bracing Kit

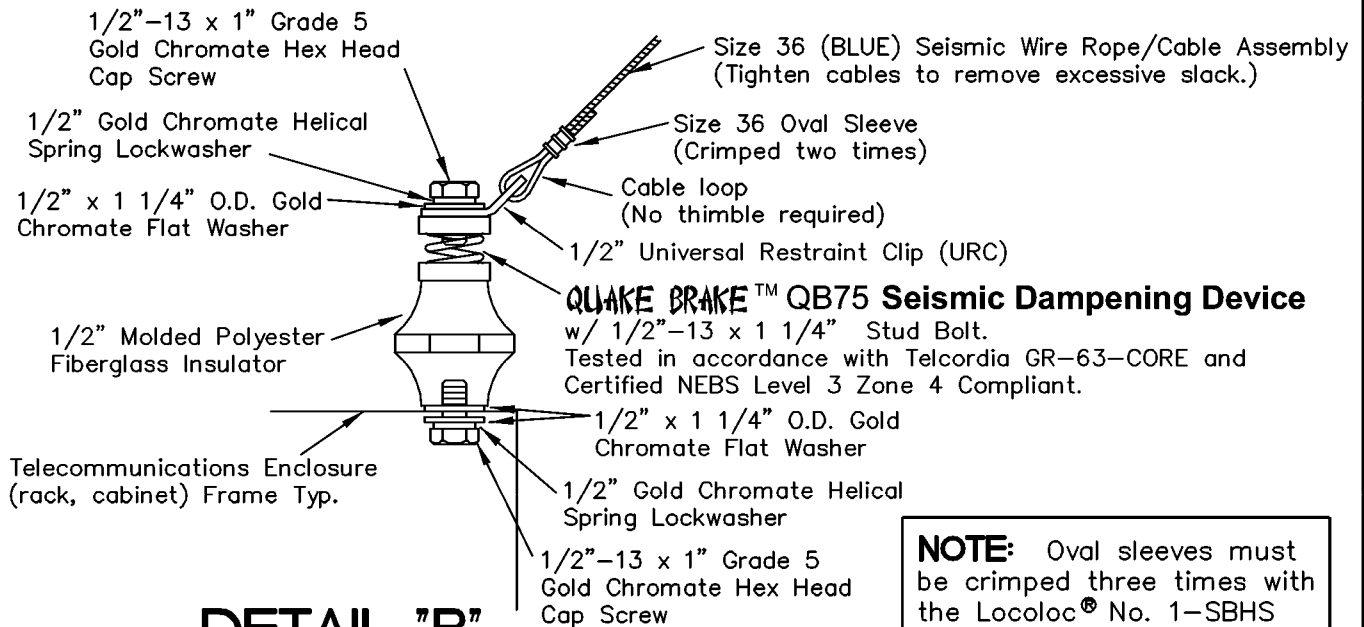
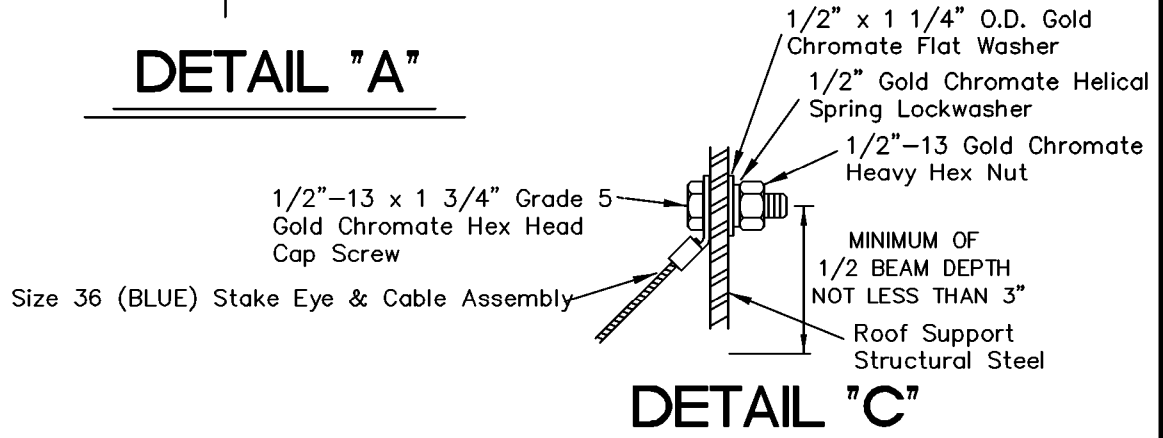
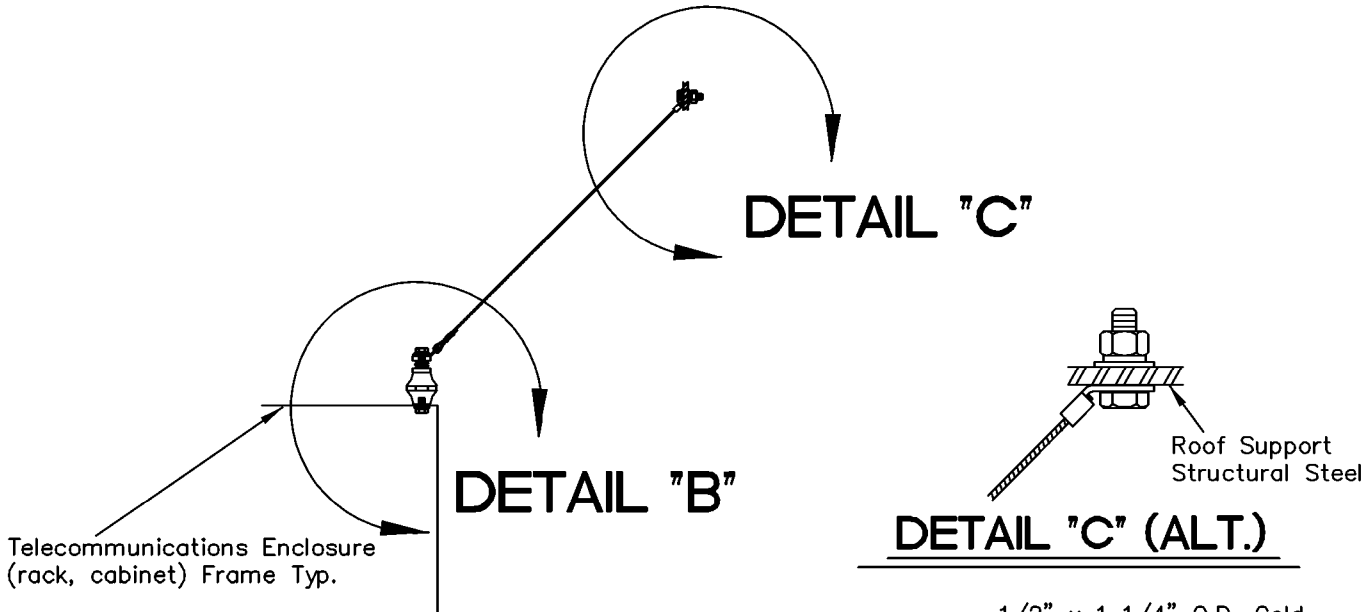
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QBC-36 QUAKE BRAKE™ Seismic Sway Bracing Kit

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MODEL QBC-36 SEISMIC SWAY BRACING KIT

BILL OF MATERIAL	
QTY.	DESCRIPTION
4	QB75 Quake Brake™
4	1/2"-13 x 1 1/4" Stainless Steel Stud Bolts
4	Fluorescent Green Quake Brake™ Tags
4	1/2" URC Clips
4	Size 36 Oval Sleeves
4	11 ft. long Size 36 (BLUE) Seismic Wire Rope/Cable™ w/ 45° Stake Eye for 1/2" bolt Hole
4	1/2" Molded polyester Fiberglass insulator
8	1/2"-13 x 1" (1" T) Hex Head Cap Screw Grade 5 Gold Chromate
4	1/2"-13 x 1 3/4" (1 1/4" T) Hex Head Cap Screw Grade 5 Gold Chromate
4	1/2"-13 Gold Chromate Heavy Hex Nut
16	1/2" x 1 1/4" O.D. Gold Chromate Flat Washer
12	1/2" Gold Chromate Helical Spring Lock Washer
4	1/2" x 3 3/4" WS-3836 ITW Trubolts

Special Tools Required for Installation

(Not included with Seismic Sway Bracing Kit - available from Loos & Co., Inc.)

Locoloc No. 1-SBHS Hand Swager

Felco C-9 Cable Cutter

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QBC36-4

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MODEL QBC-36 SEISMIC SWAY BRACING KIT

INSTALLATION INSTRUCTIONS

STEP 1. Anchorage of the enclosure (rack, cabinet) to the floor.

- a. Position the enclosure where it is intended to be installed and mark the floor for the (4) holes at the corners of the enclosure base frame. (NOTE: If these holes are not pre-drilled, drill 9/16" dia. holes through the enclosure base frame within 2" of each corner.)
- b. Move the enclosure out of the way and drill (4) ½ " dia. holes to a depth of 3 " at the locations marked on the floor and clean the residue from the holes.
- c. Reposition the enclosure over the (4) drilled holes and, with the hex nut adjusted to the top of the Trubolt, drive a ½ " x 3 ¾ " ITW Trubolt with a hammer through each hole in the enclosure frame and into the bottom of each of the (4) drilled holes.
- d. Expand each of the (4) Trubolt anchors by tightening the hex nut to an installation torque of 55 ft. lbs.

STEP 2. Quake Brake™ attachment to the enclosure (rack, cabinet). (Refer to DETAIL "B" on page QBC12-3)

- a. Locate the 9/16" dia. holes at the (4) corners of the enclosure top frame. (NOTE: If these holes are not pre-drilled, drill 9/16" dia. holes through the enclosure top frame within 2" of each corner.)
- b. Place a ½ " lock washer and ½ " flat washer on a ½ " x 1" hex head cap screw and insert cap screw through one of the holes in the enclosure top frame.
- c. Place a ½ " flat washer over the ½ " hex head cap screw, thread the ½ " Molded Polyester Fiberglass Insulator onto the 1/2" hex head cap screw. (Finish tightening by using a wrench on the head of the cap screw.)
- d. Thread the ½ " x 1 ¼ " stud bolt into the Molded Polyester Fiberglass Insulator and thread the Quake Brake™ onto the stud bolt. (Do not remove the green Quake Brake™ tag.)
- e. Place a ½ " lock washer and ½ " flat washer on a ½ " x 1" hex head cap screw, insert cap screw through a ½ " URC clips, thread the cap screw into the top of the Quake Brake™ finish tightening the cap screw.
- f. Repeat b. through e. at each of the remaining (3) top corners of the enclosure.

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MODEL QBC-36 SEISMIC SWAY BRACING KIT

INSTALLATION INSTRUCTIONS

(continued)

STEP 3. Stake Eye & Cable Assembly attachment to the roof structure. (Refer to DETAIL “C” on page QBC36-3)

- a. Mark the location on the overhead structural steel for the hole to be drilled for anchorage of each of the (4) Stake Eye & Cable Assemblies as shown in Detail “C” on page QBC36-3.

NOTE: It is very important to maintain the proper angles for the braces.

In the Plan View (See page QBC36-2), the angle must be as close as possible to 45° from the two sides at the corner of the enclosure. This can be checked by measuring to be sure that the dimensions horizontally from both sides of the enclosure are close to equal.

In the Elevation View (See page QBC36-2), the angle must be 45° or greater from vertical. This can be checked by measuring to be sure that the dimension from the top of the Quake Brake™ to the point of connection to the structure measured horizontally is greater than the dimension measured vertically from the top of the Quake Brake™ to the elevation of the connection to the structure.

- b. Drill a 9/16” hole at each of the (4) marked locations on the structure steel.
- c. Insert a ½ “ hex head cap screw through a Stake Eye on one of the Cable Assemblies and through one of the (4) holes drilled in the structural steel.
- d. Place a ½ ” flat washer, ½ ” lock washer and ½ “ hex nut on the ½ ” x 1” hex head cap screw and finish tightening the hex nut.
- f. Repeat b. through d. at each of the remaining connections to the structural steel.

STEP 4. Stake Eye & Cable Assembly attachment to the Quake Brake™. (Refer to DETAIL “B” on page QBC36-3)

- a. Slide an oval sleeve onto the plain end of the cable and pass the end of the cable through ONE ear of the URC Clip on top of the Quake Brake™ and then back through the other side of the oval sleeve.
- b. Adjust the cable to remove excessive slack by pulling the cable through the URC Clip and Oval sleeve.
- c. Crimp the oval sleeve three times (slightly separated) with the Locoloc No. 1-SBHS Hand Swager.
- d. Trim any excess cable with the Felco C-9 Cable Cutter.
- e. Repeat a. through d. on each of the remaining (3) cables.

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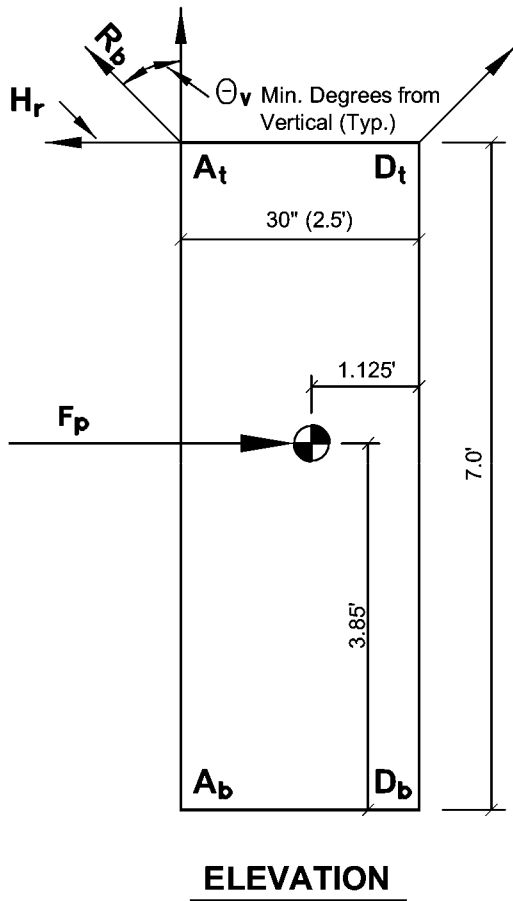
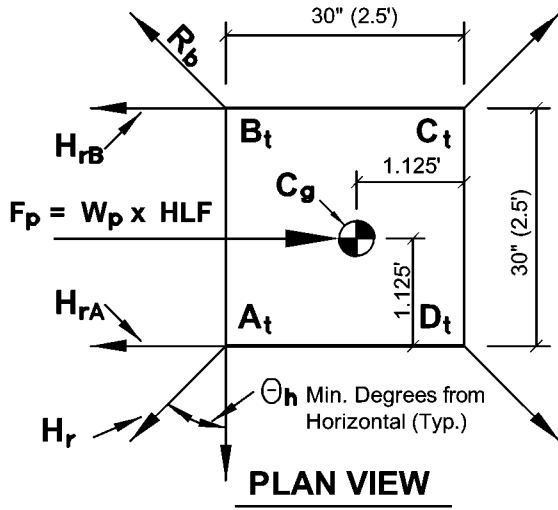
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SEISMIC LOAD DESIGN ASSUMPTIONS

for

QBC-36 QUAKE BRAKE™

Seismic Sway Bracing Kit



1. 2275 lbs. Max. Total Wt. per enclosure (including contents) for a 1.33 g Design or other combination of factors resulting in a maximum horizontal earthquake force F_p of 3,026 lbs.
2. 30" L x 30" W x 7'-0" H per enclosure.
3. Center of Gravity (enclosure and contents) no higher than 55 % of enclosure height and offset no more than 55 % from front to back as well as side to side (all criteria simultaneous); i.e., 5 % off of the geometric center of gravity in all directions. Equipment should be installed in the enclosure with the heaviest at the bottom and to the lightest at the top, in order to keep the center of gravity as low as possible.
4. Contents of the rack are fastened to the enclosure.
5. 90% of the weight of the enclosure and its contents considered to resist overturning.
6. Each enclosure is or will be adequately anchored to the floor as determined by these calculations.
7. Enclosures are strong enough to transfer the loads to the points of anchorage and sway bracing without excessive deformation.
8. Enclosures are rigidly supported at the floor (not on vibration isolators).

NOTE:

The QBC-36 Seismic Sway Bracing Kit may also be adequate for enclosure configurations that do not precisely meet the above assumptions. The calculations are particularly sensitive to the seismic load as a % of the actual weight, the geometric center of gravity, the shape of the enclosure, the Code to be satisfied, the geographic location of the enclosure, etc. If the actual conditions vary from these assumptions in a way that could make the loading more severe, in particular enclosures with an operating weight greater than 2,275 lbs. or different geometry, the adequacy of this kit should be verified by customizing the calculations.

Refer to the pages that follow for supporting calculations and installation instructions.

CALCULATIONS

Reference Sketches on Page QBC36-7

Seismic/Earthquake Load Condition No 1. for QBC-36 Kit

Center of Gravity (C_g) 5% Off Geometric Center of Enclosure in directions
1g Design; i.e., $HLF = 1.0$ $F_p = W_p \times HLF = 2275 \text{ lbs.} \times 1 = 2275 \text{ lbs.}$

Check worst case Overturning Moment (OM) about $C_b - D_b$

$$\begin{aligned} OM &= 2275^{\#} \times 3.85^{\text{Ft}} = 8758.8^{\text{Ft}\#} \\ \text{Stabilizing Mom. by } 90\% \text{ of } W_p &= 0.9 \times 2275 \times 1.125 = 2303.4^{\text{Ft}\#} \\ \text{OM that must be provided by Sway Braces} &= 6455.4^{\text{Ft}\#} \end{aligned}$$

Horizontal force parallel to F_p that
Sway Braces at A_t & B_t must resist = $\frac{6,455.4^{\text{Ft}\#}}{7^{\text{Ft}}} = 922^{\#}$

Distribution of $922^{\#}$ to Sway Braces:
 $45\% = 922^{\#} \times .45 = 414.9^{\#}$ at B_t $H_{tB} = 414.9^{\#}$
 $55\% = 922^{\#} \times .55 = 507.1^{\#}$ at A_t $H_{tA} = 507.1^{\#}$
Worst location is sway brace at A_t where $H_{tA} = 507.1^{\#}$

Check Sway Braces Installed at $45^\circ \pm 15^\circ$ From Horizontal as well as $45^\circ \pm 10^\circ$ From Vertical $\theta_h = 30^\circ$ Minimum $\theta_v = 35^\circ$ Minimum

Required Horizontal Resistance (H_r) if Sway Brace at A_t turned
out at 30° from Horizontal θ_h (See Detail Plan View):

$$H_r \text{ at } 30^\circ \theta_h = \frac{507.1^{\#}}{\sin 30^\circ} = \frac{507.1^{\#}}{0.5} = 1014.2^{\#}$$

Required Sway Brace Reaction R_b (Applied load on brace) if
sway brace at A_t is installed 35° from vertical (θ_v)
 R_b (Applied load on Sway Brace) = $\frac{1014.2^{\#}}{\sin 35^\circ} = \frac{1014.2^{\#}}{0.574} = 1767^{\#}$

❖ **Size 36 (RED) Seismic Wire Rope/Cable™ OK**
Safe Load = $2,667^{\#}$

↑ Vertical Reaction (V_r) at A_t = $\frac{1014.2^{\#}}{\tan 35^\circ} = \frac{1014.2^{\#}}{0.7} = 1449^{\#}$

Anchorage of Enclosure

Amount of effective weight W_p Distributed to Anchorage at A_b :
 $90\% W_p \times .55$ to side $A_b - D_b = 0.9 \times 2275^{\#} \times .55 = 1126.1^{\#}$
 45% of $1126.1^{\#}$ Distributed to $A_b = 0.45 \times 1126.1^{\#} = 506.8^{\#}$

Where $\theta_h = 30^\circ$ Minimum and $\theta_v = 35^\circ$ Minimum:

$$\begin{aligned} \uparrow \text{Vertical Reaction along } A_t - A_b &= 1449.0^{\#} \\ \downarrow \text{Portion of effective } W_p \text{ distributed to } A_b &= 506.8^{\#} \\ \uparrow \text{Net Uplift at } A_b &= 942.2^{\#} \end{aligned}$$

Additional anchorage needed to resist the Greater of
Simultaneous Vertical Load of $1/3 F_p$ (OSHPD) or
 $0.2 S_{DS} W_p$ (2000 International Code)
Use $S_{DS} = 2.0$ where $S_s = 300$

$$\begin{aligned} 1/3 F_p &= 1/3 \times 2275^{\#} = 758^{\#} \text{ vs } 0.2 S_{DS} W_p = 0.2 \times 2 \times 2275^{\#} = 910^{\#} \\ 910^{\#} &\text{ will distribute to } A_b \text{ the same as } W_p; \\ \text{i.e., } 0.55 \times 0.45 \times 910^{\#} &= 225.25^{\#} \text{ at } A_b \\ \text{ANCHORAGE AT } A_b &\text{ MUST RESIST } 942.2^{\#} + 225.25^{\#} = 1168^{\#} \end{aligned}$$

❖ **MAX. TENSION ON ANCHORS = 1168[#]**

Shear

Assume anchors at C_b and D_b resist all shear.
→ F_p Distributed to side $A_b - D_b = 2275 \times .55 = 1251.3^{\#}$
← Horizontal Brace resistance $H_{tA} = 507.1^{\#}$
→ Net shear along side $A_b - D_b = 744.2^{\#}$
Shear at $A_b = 0$ and shear at $D_b = 744.2^{\#}$

❖ **MAX. SHEAR ON ANCHORS = 744[#]**

NOTE: If external angle iron clips are used the Tension load on
concrete anchor bolts should be doubled for prying action.

$1/2''$ ITW Trubolt with $3''$ Embedment and Safety Factor of 4
2000 lb. Stone Aggregate Concrete ($2\frac{1}{4}''$ Embedment)
Ultimate Tension = $4660^{\#}$ Ultimate Shear = $4760^{\#}$
Allowable Tension = $4660^{\#} / 4 = 1165^{\#}$
Allowable Shear = $4760^{\#} / 4 = 1190^{\#}$
3000 lb. Lightweight Concrete ($3''$ Embedment)
Ultimate Tension = $4720^{\#}$ Ultimate Shear = $6620^{\#}$
Allowable Tension = $4720^{\#} / 4 = 1180^{\#}$
Allowable Shear = $6620^{\#} / 4 = 1655^{\#}$

❖ **$1/2''$ ITW Trubolt with $3''$ Embedment OK**

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CALCULATIONS

Reference Sketches on Page QBC36-7

Seismic/Earthquake Load Condition No 2. for QBC-36 Kit

Center of Gravity (C_g) 5% Off Geometric Center of Enclosure in All Directions

1.33g Design; i.e., HLF = 1.33 $F_p = W_p \times HLF = 2275 \text{ lbs.} \times 1.33 = 3,026 \text{ lbs.}$

Check worst case Overturning Moment (OM) about C_b - D_b

$$\begin{aligned} \text{OM} &= 3026^{\#} \times 3.85^{\text{Ft}} = 11650.1^{\text{Ft}\#} \\ \text{Stabilizing Mom. by } 90\% \text{ of } W_p &= 0.9 \times 2275 \times 1.125 = 2303.4^{\text{Ft}\#} \\ \text{OM that must be provided by Sway Braces} &= 9346.7^{\text{Ft}\#} \end{aligned}$$

Horizontal force parallel to F_p that
Sway Braces at A_t & B_t must resist = $\frac{9,346.7^{\text{Ft}\#}}{7^{\text{Ft}}} = 1335.2^{\#}$

Distribution of 1335.2[#] to Sway Braces:
45% = 1335.2[#] x .45 = 600.8[#] at B_t H_{tB} = 600.8[#]
55% = 1335.2[#] x .55 = 734.4[#] at A_t H_{tA} = 734.4[#]
Worst location is sway brace at A_t where H_{tA} = 734.4[#]

Check Sway Braces Installed at 45° ± 10° From Horizontal as well Minimum 45° From Vertical

$\theta_h = 35^\circ$ Minimum
 $\theta_v = 45^\circ$ Minimum

Required Horizontal Resistance (H_r) if Sway Brace at A_t turned out at 35° from Horizontal θ_h (See Detail Plan View):

$$H_r \text{ at } 35^\circ \theta_h = \frac{734.4^{\#}}{\sin 35^\circ} = \frac{734.4^{\#}}{0.574} = 1279^{\#}$$

Required Sway Brace Reaction R_b (Applied load on brace) if sway brace at A_t is installed 45° from vertical (θ_v)
R_b (Applied load on Sway Brace) = $\frac{1279^{\#}}{\sin 45^\circ} = \frac{1279^{\#}}{0.707} = 1809^{\#}$

❖ **Size 36 (BLUE) Seismic Wire Rope/Cable™ OK**
Safe Load = 2,667[#]

$$\uparrow \text{ Vertical Reaction (V}_r\text{) at A}_t = \frac{1279^{\#}}{\tan 45^\circ} = \frac{1279^{\#}}{1.0} = 1279^{\#}$$

Anchorage of Enclosure

Amount of effective weight W_p Distributed to Anchorage at A_b:
90% W_p x .55 to side A_b - D_b = 0.9 x 2275[#] x .55 = 1126.1[#]
45% of 1126.1[#] Distributed to A_b = 0.45 x 1126.1[#] = 506.8[#]

Where $\theta_h = 35^\circ$ Minimum and $\theta_v = 45^\circ$ Minimum:

$$\begin{aligned} \uparrow \text{ Vertical Reaction along A}_t - \text{A}_b &= 1279.0^{\#} \\ \downarrow \text{ Portion of effective W}_p \text{ distributed to A}_b &= 506.8^{\#} \\ \uparrow \text{ Net Uplift at A}_b &= 772.2^{\#} \end{aligned}$$

Additional anchorage needed to resist the Greater of Simultaneous Vertical Load of 1/3 F_p (OSHPD) or 0.2 S_{DS} W_p (2000 International Code)
Use S_{DS} = 2.0 where S_S = 300

1/3 F_p = 1/3 x 3026[#] = 1009[#] vs 0.2 S_{DS} W_p = 0.2 x 2 x 2275[#] = 910[#]
1009[#] will distribute to A_b the same as W_p;
i.e., 0.55 x 0.45 x 1009[#] = 249.7[#] at A_b
ANCHORAGE AT A_b MUST RESIST 772.2[#] + 249.7[#] = 1022[#]

❖ **MAX. TENSION ON ANCHORS = 1022[#]**

Shear

Assume anchors at C_b and D_b resist all shear.
→ F_p Distributed to side A_b - D_b = 3026 x .55 = 1664.3[#]
← Horizontal Brace resistance H_{tA} = 734.4[#]
→ Net shear along side A_b - D_b = 929.9[#]
Shear at A_b = 0 and shear at D_b = 929.9[#]

❖ **MAX. SHEAR ON ANCHORS = 930[#]**

NOTE: If external angle iron clips are used the Tension load on concrete anchor bolts should be doubled for prying action.

1/2" ITW Trubolt with 3" Embedment and Safety Factor of 4
2000 lb. Stone Aggregate Concrete (2 1/4" Embedment)
Ultimate Tension = 4660[#] Ultimate Shear = 4760[#]
Allowable Tension = 4660[#] / 4 = 1165[#]
Allowable Shear = 4760[#] / 4 = 1190[#]
3000 lb. Lightweight Concrete (3" Embedment)
Ultimate Tension = 4720[#] Ultimate Shear = 6620[#]
Allowable Tension = 4720[#] / 4 = 1180[#]
Allowable Shear = 6620[#] / 4 = 1655[#]

❖ **1/2" ITW Trubolt with 3" Embedment OK**

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