2009 IBC SEISMIC BRACING CALCULATIONS

(ASCE 7-05, CBC 2010, FEMA, TI-809-4 & UFGS) **Calculation ID: 1**

for

Seismic Wire Rope/Cable™ Bracing

SEISMIC DESIGN GROUP, LLC

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9/9/2011

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Calculation of APPLICABLE Seismic Design Category

The Building **OCCUPANCY CATEGORY = III** The **SITE CLASS = D**

Short Period (0.2 sec) MAX. CONSIDERED Spectral Response Acceleration (S_{MS})	Long Period (1 sec) MAX. CONSIDERED Spectral Response Acceleration (S_{M1})
F_a = 1.32 S_S = 0.6	F_v = 1.90 S_1 = 0.25
$S_{MS} = F_a S_S$ = 1.32 x 0.6 = 0.792	$S_{M1} = F_v S_1$ = 1.90 x 0.25 = 0.475
Short Period (0.2 sec) DESIGN Spectral Response Acceleration (S_{DS})	**Long Period (1 sec) DESIGN Spectral Response Acceleration (S_{D1})**
$S_{DS} = 2/3\ S_{MS}$ = (2 x 0.792) / 3 = 0.528	$S_{D1} = 2/3\ S_{M1}$ = (2 x 0.475) / 3 = 0.317
Short Period Seismic Design Category = D	**Long Period Seismic Design Category = D**

The APPLICABLE Seismic Design Category is "D"

Calculation of APPLICABLE Horizontal Load Factor (HLF)

The BRACED COMPONENTdescription is:

Non-ASME Steel or Copper Piping, including in-line components, w/ Joints Made by Threading, Bonding or Compression/Grooved Couplings

The Component Importance Factor (I_p) = **1.0**

The Component Amplification Factor (a_p) = **2.5**

The Component Response Factor (R_p) = **4.5**

Anchorage of the Braced Component is in the in the TOP 1/3 OF THE BUILDING.. (z) = **3** and (h) = **3**

MAX. Seismic Design Force (F_p) Formula:

$F_p = 1.6\ S_{DS}\ I_P\ W_P$ = 1.6 x 0.528 x 1.0 x W_p = **$0.84W_p$**

BASE Seismic Design Force (F_p) Formula:

$$F_p = \frac{0.4 a_p S_{DS} W_P}{R_p / I_p}\left(1 + 2\frac{z}{h}\right) = \frac{0.4 \times 2.5 \times 0.528 \times W_p}{4.5 / 1.0}\left(1 + 2\frac{3}{3}\right) = \mathbf{0.35}W_p$$

MIN. Seismic Design Force (F_p) Formula:

$F_p = 0.3\ S_{DS}\ I_P\ W_P$ = 0.3 x 0.528 x 1.0 x W_p = **$0.16W_p$**

The APPLICABLE (F_p) is $0.35W_p$.
The ASD (Allowable Stress Design) HLF = 0.7 F_p ;
THEREFORE, the Horizontal Load Factor (HLF) = 0.25

9/9/2011

Seismic Bracing Calculation For 4-Way Brace on TRAPEZE SUPPORTED PIPING weighing <= 38.36 lbs/ft at <= 40 Ft. Brace Spacing.

Calculation ID: 1

Horizontal Earthquake Load (*Fpw*)

Braced Component wt/ft (lbs) = 38.36

Brace Zone of Influence (ZOI) Wt. =
40 ft spacing x 38.36 lbs/ft = 1534.4 lbs

Horizontal Load factor (HLF) = 0.25

Horizontal Earthquake Load (*Fpw*) =
Zone of Inzluence Wt x HLF =
1534.4 lbs x 0.25 = 368 lbs *Fpw* = **368 lbs**

ZONE OF INFLUENCE CALCULATION for Trapeze Supported Piping

Qty	DESCRIPTION	Unit Lbs/Ft	Total Lbs/Ft
1	4" Uninsulated Sch. 40 Steel Pipe	16.52	16.52
3	1 1/4" Uninsulated Sch. 40 Steel Pipe	2.92	8.76
2	2" INSULATED Sch. 40 Steel Pipe	6.54	13.08
	TOTAL Zone of Influence Weight (lbs)		38.36

LOOS & CO. Seismic Wire Rope/Cable™ Brace Size

The **LOAD RATING** for **Size 12 Seismic Wire Rope/Cable™** is **600 lbs**.
The Allowable Horizontal Earthquake Load on the Seismic Wire Rope/Cable™ = LOAD RATING x sin Brace Angle from Vertical.

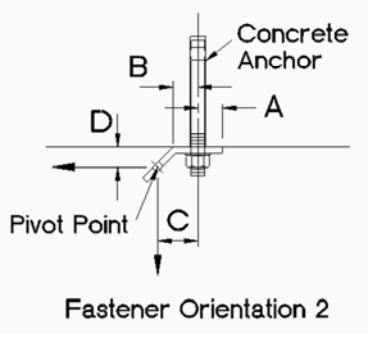
The Allowable Horizontal Earthquake Load on Size 12 Cable = 600 x sin 45 = 600 x 0.707 = **424 lbs.**
424 lbs > 368 lbs *Fpw* ;
THEREFORE; **Size 12 Cable** at a **Brace Angle of 45 degrees** or more from Vertical **OK**.

Anchorage in 3000 psi SAND-LIGHTWEIGHT CONCRETE over METAL DECK using the URC or Stake Eye End Fitting

The Allowable Horizontal Load Carrying Capacity of the **1/2" x 4 1/2 Powers SD2** is based on 3.75 " Embedment, Fastener Orientation 2 and a Brace Angle of 45 Degrees From Vertical.

Concrete Anchor Allowable Horizontal Load Carrying Capacity Formula:
(*T Pr* / *Tallow*) + (*V* / *Vallow*) <= 1.2

Where:
T = Applied Service Tension Load
Pr = Prying Factor*
Tallow = Allowable Service Tension Load
V = Applied Service Shear Load
Vallow = Allowable Service Shear Load
*Prying Factor N/A when NO-Pry Clip is used.



Fastener Orientation 2

Fastener Orientation 2 Prying Factor Formula
***Pr* = (((C + A) / *Tan* Θ) - D) / A**

Where:
Pr = Prying Factor
Tan Θ = Tangent of Brace Angle from Vertical
A = 0.6880
B = 0.6880
C = 1.1630
D = 0.4622

Pr = (((C + A) / *Tan* Θ) - D) / A
Pr = (((1.1630 + 0.6880) / tan 45) - 0.4622) / 0.6880
Pr = ((1.8510 / 1.0000) - 0.4622) / 0.6880
Pr = (1.8510 - 0.4622) / 0.6880 **= 2.019**

HORIZONTAL EARTHQUAKE LOAD CARRYING CAPACITY OF THE 1/2" x 4 1/2 Powers SD2

Where:
Allowable Horizontal Earthquake Load (Fpw) = 569 lbs per Anchor
Allowable Seismic Tension Load (Per ICC-ES Report 2502) = 1206 lbs
Allowable Seismic Shear Load (Per ICC-ES Report 2502) = 2340 lbs

(*T Pr* / *Tallow*) + (*V* /*Vallow*) <= 1.2
(569 x 2.019 / 1206) + (569 / 2340)
(1149 / 1206) + (569 / 2340)
0.9527 + 0.2433 = **1.196 <= 1.2**

569 lb Allowable *Fpw* on (**1**) **1/2" x 4 1/2 Powers SD2** Concrete Anchor > 479 lbs *Fpw* * ;
THEREFORE, **1/2" x 4 1/2 Powers SD2 at a Brace Angle of 45 degrees or more from Vertical OK.**

* Fpw in the Concrete Anchor Calculation has been increased by 1.3 per Section 13.4.2 of ASCE 7.

ROD STIFFENER REQUIREMENTS

Calculation ID: 1

Upward Vertical Earthquake Load Formula: Fvs = ((HLF / $Tan\Theta$ + $Fvsx$) Wp)

Where:
HLF = The Horizontal Load Factor
$Tan\Theta$ = Tangent of Sway Brace Angle from Vertical
$Fvsx$ = 0.7 x 0.2S_{DS}
Wp = Operating Weight of Braced Component (Dead Load)

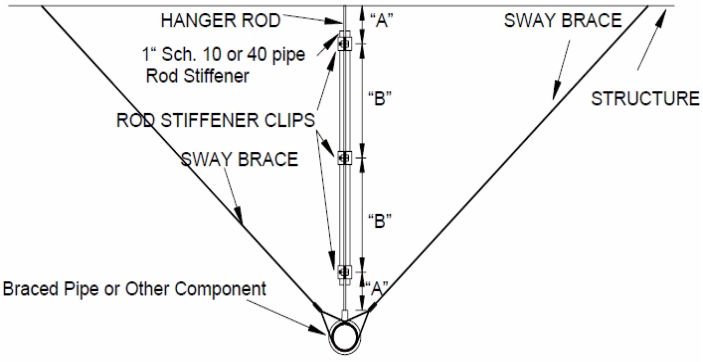
UPWARD VERTICAL LOAD CALCULATION

Fvs = ((HLF / $Tan\Theta$ + $Fvsx$) Wp)
Fvs = (((0.25 / 1.0000) + (0.7 x 2.0 x 0.528)) x 1534.4)
Fvs = ((0.245+0.074) x 1534.4) = 489 lbs.
The Net Upward Vertical Load is 489 lbs.

Maximum Length of Un-Braced 1/2" Dia. Hanger Rod Formula is: Kl/r <= 200

Where:
K = ASD Factor for the Buckled Shape = 1.00
l = Maximum Length of unbraced rod or maximum Rod Stiffener Clip Spacing = 20 "
r = The hanger rod Least Radius OF Gyration = 0.1063 (Based on the Root Properties of 1/2" dia. Rod)
THEREFORE, Kl/r = 188.15

If Kl/r <= Cc , use Formula E2-1
If Kl/r > Cc , use Formula E2-2
The Cc Formula is: = SQRT((2 x π ^2 x E) / Fy)
Where:
E = Modulus of Elasticity = 29,000 ksi
Fy = Specified Minimum Yield Strength = 36 ksi
Cc = SQRT((2 x π = SQRT((2 x x E) / Fy)
Cc = SQRT((2 x 3.1416^2 x 29000) / 36)
Cc = SQRT((2 x 9.87 x 29000) / 36)
Cc = SQRT(572460) / 36) **= 126.102**



ROD STIFFENER DETAIL

The Maximum "A" Dimension = 3" and Maximum "B" Dimension = 20 ".

Kl/r > Cc ; THEREFORE, use Formula E2-2 = Fa x 1000 x Ag
Fa = (12 π^2 E) / (23 Kl/r^2)

Fa = (12 x 3.1416^2 x 29000) / 23 x 188.146754468485 ^2)
Fa = (3433676.379 / 814181.628) = 4.217

E2-2 = **Fa x 1000 x Ag** = 4.217 x 1000 x 0.129 **= 544 lbs.**

544 lbs. Allowable Compression Load on a 0.500 in. dia. Hanger Rod at a 20" Length > 489 lbs. Fvs ; THEREFORE, a Maximum Unbraced Rod Length or Rod Stiffener Clip Spacing of 20" OK

Remarks:
This Calculation is Applicable for Seismic Wire Rope/Cable(TM) Brace Model 12-C63