Company: PDelta Ingenieria Estructural S.A.S **Engineer:** Ing. Osvaldo Guzman A
Project: P046-2024 - PLAZA DOÑA CEIBA (LOCALES) 6:01:09 p. m. 26/06/2024
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S E I S M I C D E S I G N C O D E : COL NSR-10

S E I S M I C B A S E L E V E L : 1

S E I S M I C F O R C E R E S I S T I N G S Y S T E M

System X-Direction: C: Moment Res.Frame
System Y-Direction: C: Moment Res.Frame

Energy dissip capacity: 2: Moderate-DMO

RESPONSE SPECTRUM EARTHQUAKE FORCES COL NSR-10

Elastic Modal Base Shear
Vm = Sam Wm'
Sam = Spectral modal acceleration
Wm' = Effective modal weight

A N A L Y S I S P A R A M E T E R S

Number of modes to be included ... = 3

	X-direction	Y-direction
Energy dissipation coefficient, Ro =	5	5

S P E C T R A L M O D A L A C C E L E R A T I O N

Sam = 2.5 Aa Fa I [0.4+0.6T/To] For Tm <= To
Sam = 2.5 Aa Fa I For To < Tm <= Tc
Sam = 1.2 Av Fv I/Tm For Tc < Tm < Tl
Sam = 1.2 Av Fv Tl I/Tm² For Tm > Tl

Eff. peak acceleration & veloc., Aa = .10 Av = .15

Region:	10	9	8	7	6	5	4	3	2	1
Aa or Av	0.50	0.45	0.40	0.35	0.30	0.25	0.20	0.15	0.10	0.05

LOCATION	Aa	Av	Menace
Barranquilla, Cartagena, San Andres, Valledupar	0.10	0.10	Low
Bogota, Medellin	0.15	0.20	Interm
Armenia, Bucaramanga, Cali, Manizalez, Pereira	0.25	0.25	High
Cucuta, Villavicencio	0.35	0.30	High
Quibdo	0.35	0.35	High

Importance coefficient, I ..... = 1.0

GROUP	COEFFICIENT
IV - Essential facilities	1.50
III- Public assistance facilities	1.25
II - Especial occupancy buildings	1.10
I - Normal occupancy buildings	1.00

Site profile type, S ..... = E

TYPE	SOIL PROFILE TYPE	Shear Wave Velocity
A	Hard Rock	> 1500 m/s
B	Rock	1500 - 760 m/s
C	Very Dense Soil & Soft Rock	760 - 360 m/s
D	Stiff Soil Profile	360 - 180 m/s
E	Soft Soil Profile	< 180 m/s
F	Soils requiring site-specific evaluations	

S P E C T R A L M O D A L A C C E L E R A T I O N

```
  Sam = 2.5 Aa Fa I [0.4+0.6T/To]  For Tm <= To
  Sam = 2.5 Aa Fa I                For To < Tm <= Tc
  Sam = 1.2 Av Fv I/Tm             For Tc < Tm < Tl
  Sam = 1.2 Av Fv Tl I/Tm²         For Tm > Tl
DESIGN SPECTRAL RESPONSE ACCELERATION PARAMETERS

                                   Short Periods   Long Periods
                                   -------------   ----------------
Effect. peak acceleration & velc., Aa = 0.10       Av = 0.15
Site coefficients (Tables below),  Fa = 2.50       Fv = 3.35

Design response parameters,     Aa Fa =   0.25  Av Fv=   0.50

Long-period transition period, Tl sec =   8.04   (2.4 Fv)
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Site Coefficient Fa

Site Class	Aa<=0.1	Aa=0.2	Aa=0.3	Aa=0.4	Ss>=0.5
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	a	a	a	a	a

Site Coefficient Fv

Site Class	Av<=0.1	Av=0.2	Av=0.3	Av=0.4	Av>=0.5
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	a	a	a	a	a

a: Site-specific geotechnical investigation required

Reduction in R for Irregularity and Lack of Redundancy:

PLAN IRREGULARITIES Type	Description	Øp	ELEVATION IRREGULARITIES Type	Description	Øa
1aP	Torsional	0.9	1aA	Flexible	0.9
1bP	Torsional Extrme	0.8	1bA	Flexible Extrme	0.8
2P	Reentrant corners	0.9	2A	Mass	0.9
3P	Diaph. discontin.	0.9	3A	Geometrical	0.9
4P	Plane shifting	0.8	4A	Plane shifting	0.8
5P	Unparallel grid	0.9	5aA	Weak Story	0.9
			5bA	Weak Story Extr	0.8

NOTE: EngSolutions RCB assumes irregular building.
For regular buildings make (Øp . Øa)= 1.0

	X - D I R E C T I O N	Y - D I R E C T I O N
Reduct. factor, (Øp.Øa) =	1	1
Redundancy factor, Ør =	.75	.75

R = (Øp Øa) Ør Ro

S T A T I C E Q U I V A L E N T B A S E S H E A R

Building Weight, W, (ton) = 10.56

Peak Acceleration Coeffi., Aa Fa = .25
Peak Velocity Coefficient, Av Fv = .5
Importance factor, I . . . . . = 1
Site class, S . . . . . = E
Coeff. for upper limit period, Cu = 1.2

		X-direction	Y-direction
Computed Period	=	0.144	0.133
Ta = Ct (H)^x	=	0.047 H^0.9	0.047 H^0.9
	=	0.103	0.103
Tmax = Cu Ta	=	0.124	0.124
Fundamental Period	=	0.124	0.124
Energ-Disspst coeff, R	=	3.75	3.75
1.2 Av Fv I / T	=	4.838	4.838
2.5 Aa Fa I	=	.625	.625
Sa	=	.625	.625
Base Shear, Vo	=	6.6	6.6
Static Shear, .8Vo (ton)	=	5.28	5.28

S P E C T R A L A C C E L E R A T I O N

MODE No	PERIOD (sec)	Sa (g)	Damping Ratio
1	.144	.625	.05
2	.133	.625	.05
3	.065	.372	.05

M O D A L B A S E S H E A R

MODE No	X - D I R E C T I O N Sax (g)	W'x (ton)	Vx (ton)	Y - D I R E C T I O N Say (g)	W'y (ton)	Vy (ton)
1	.625	10.56	6.6	.625	0	0
2	.625	0	0	.625	10.56	6.6
3	.372	0	0	.372	0	0
ELASTIC Ve (combined):			6.6			6.6
STATIC 0.8 Sa(T1)W:			5.28			5.28
Design Base Shear:			6.60			6.60

Total Building Weight, W = 10.56 ton
Participating Mass, ΣW'/W = 100% in X, 100% in Y
W'xm={ΣWj ϕxjm}²/ΣWj ϕxjm² W'ym={ΣWj ϕyjm}²/ΣWj ϕyjm²
Combination of Modal Response: SRSS V = (Sum Vi²)½

A C C I D E N T A L T O R S I O N

	X-direction	Y-direction
Accidental eccentricity as a percentage of building dimension, (%)=	5	5

A C C I D E N T A L E C C E N T R I C I T Y:

	X - D I R E C T I O N (EQY)			Y - D I R E C T I O N (EQX)		
Level -	δεxo (m)	Ax -	δεx (m)	δεyo (m)	Ax -	δεy (m)
2	0.20	1.00	0.20	0.12	1.00	0.12

Ax: Amplification factor for accidental eccentricity

EQY: Envelope (1) $E^x = \varepsilon^x$ (2) $E^x = \varepsilon^x + \delta\varepsilon^x$ (3) $E^x = \varepsilon^x - \delta\varepsilon^x$

EQX: Envelope (1) $E^y = \varepsilon^y$ (2) $E^y = \varepsilon^y + \delta\varepsilon^y$ (3) $E^y = \varepsilon^y - \delta\varepsilon^y$

D E S I G N E C C E N T R I C I T Y : $E = \varepsilon + \delta\varepsilon$

	X - D I R E C T I O N (EQY)				Y - D I R E C T I O N (EQX)			
Level -	Center Mass CMx	Inherent Eccent. ε^{x*}	Accident Eccent. $\delta\varepsilon^x$	Design Eccent. E^x	Center Mass CMy	Inherent Eccent. ε^{y*}	Accident Eccent. $\delta\varepsilon^y$	Design Eccent. E^y
2	2.02	0.00	0.20	0.2020	1.20	0.00	0.12	0.1212

Note: * Inherent eccentricity: ε^x = CMx - CRx and ε^y = CMy - CRy
All values are in meters

D E S I G N E C C E N T R I C I T Y : $E = \varepsilon - \delta\varepsilon$

	X - D I R E C T I O N (EQY)				Y - D I R E C T I O N (EQX)			
Level -	Center Mass CMx	Inherent Eccent. ε^{x*}	Accident Eccent. $\delta\varepsilon^x$	Design Eccent. E^x	Center Mass CMy	Inherent Eccent. ε^{y*}	Accident Eccent. $\delta\varepsilon^y$	Design Eccent. E^y
2	2.02	0.00	0.20	-0.200	1.20	0.00	0.12	-0.122

Note: * Inherent eccentricity: ε^x = CMx - CRx and ε^y = CMy - CRy
All values are in meters

Modal nodal force:

$$Fim = Vm \; Wim \; \phi im / \Sigma \; Wj \; \phi jm$$
$$Vm = Sam \; W'm$$
$$W'm = \{\Sigma \; Wj \; \phi jm\}^2 / \Sigma \; Wj \; \phi jm^2$$

C O M B I N E D M O D A L F O R C E

X - DIRECTION

Floor k -	Weight W (ton)	Force F (ton)	Shear V (ton)	Torsion T=F(E-ε) (ton-m)
2	10.56	6.59	6.59	0.79

C O M B I N E D M O D A L F O R C E

Y - DIRECTION

Floor k -	Weight W (ton)	Force F (ton)	Shear V (ton)	Torsion T=F(E-ε) (ton-m)
2	10.56	6.59	6.59	1.32

ACCELERATIONS ON NON-STRUCTURAL ELEMENTS - ASCE7-02

F L O O R A C C E L E R A T I O N S

Level	Z	Z/h	ai
2	2.40	1.00	0.300

Seismic base level . . . . . = 1
Height above seismic base, hn . . . . . = 2.40 m
Spectral acceleration, Sds . . . . . = 0.25
Ground acceleration, As = 0.4 Sds . . . . . = 0.10

ai = As (1 + 2 Z / h)

Force on element: Fp = ai ap Ip Wp / Rp
> 0.3 Sds Ip Wp