

Company: Company

Project: IE HECTOR MANUEL VIDES BALLESTEROS (MÓDULO 2)

File: C:\IE REGIDOR\MOD2.rcb

Engineer: Name

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SEISMIC DESIGN CODE: COLNSR-10

SEISMIC BASE LEVEL: 1

SEISMIC FORCE RESISTING SYSTEM

System X-Direction: C: Moment Res.Frame

System Y-Direction: C: Moment Res.Frame

Energy dissip capacity: 2: Moderate-DMO

RESPONSE SPECTRUM EARTHQUAKE FORCES COLNSR-10

Elastic Modal Base Shear

$V_m = S_{am} W_m'$

S_{am} = Spectral modal acceleration

W_m' = Effective modal weight

ANALYSIS PARAMETERS

Number of modes to be included ... = 3

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

SPECTRAL MODAL ACCELERATION

$S_{am} = 2.5 A_a F_a I [0.4 + 0.6 T / T_o]$ For $T_m \leq T_o$

$S_{am} = 2.5 A_a F_a I$ For $T_o < T_m \leq T_c$

$S_{am} = 1.2 A_v F_v I / T_m$ For $T_c < T_m < T_l$

$S_{am} = 1.2 A_v F_v T_l I / T_m^2$ For $T_m > T_l$

Eff. peak acceleration & veloc., $A_a = .15$ $A_v = .15$

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

LOCATION	A_a	A_v	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 = 1.25

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 = D

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	

SPECTRAL MODAL ACCELERATION

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 = 0.15 Av = 0.15

Site coefficients (Tables below), Fa = 1.50 Fv = 2.20

Design response parameters, Aa Fa = 0.23 Av Fv= 0.33

Long-period transition period, Tl sec = 5.28 (2.4 Fv)

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
1aP	Torsional	0.9
1bP	Torsional Extrme	0.8
2P	Reentrant corners	0.9
3P	Diaph. discontin.	0.9
4P	Plane shifting	0.8
5P	Unparallel grid	0.9

ELEVATION IRREGULARITIES

Type	Description	Øa
1aA	Flexible	0.9
1bA	Flexible Extrme	0.8
2A	Mass	0.9
3A	Geometrical	0.9
4A	Plane shifting	0.8
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 = 1

1

R = (Øp Øa) Ør Ro

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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) = 181.99

Peak Acceleration Coeffi., $A_a F_a$ = .23
 Peak Velocity Coefficient, $A_v F_v$ = .33
 Importance factor, I = 1.25
 Site class, S = D
 Coeff. for upper limit period, C_u = 1.354

	X-direction	Y-direction
Computed Period	= 0.296	0.218
$T_a = C_t (H)^x$	= 0.047 $H^{0.9}$	0.047 $H^{0.9}$
	= 0.151	0.151
$T_{max} = C_u T_a$	= 0.204	0.204
Fundamental Period	= 0.204	0.204
Energ-Disspst coeff, R	= 5	5
$1.2 A_v F_v I / T$	= 2.426	2.426
$2.5 A_a F_a I$	= .719	.719
S_a	= .719	.719
Base Shear, V_o	= 130.81	130.81

Static Shear, $.8V_o$ (ton) = 104.65 104.65

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

MODE No	PERIOD (sec)	S_a (g)
1	.296	.719
2	.218	.719
3	.116	.636

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			Y - D I R E C T I O N		
	S_{ax} (g)	$W'x$ (ton)	V_x (ton)	S_{ay} (g)	$W'y$ (ton)	V_y (ton)
1	.719	181.92	130.8	.719	0	0
2	.719	0	0	.719	181.99	130.85
3	.636	.07	.05	.636	0	0

ELASTIC V_e (combined): 130.8 130.85
 STATIC $0.8 S_a(T_1)W$: 104.65 104.65

Design Base Shear: 130.80 130.85

Total Building Weight, W = 181.99 ton
 Participating Mass, $\Sigma W'/W$ = 100% in X, 100% in Y
 $W'_{xm} = \{\Sigma W_j \phi_{xjm}\}^2 / \Sigma W_j \phi_{xjm}^2$ $W'_{ym} = \{\Sigma W_j \phi_{yjm}\}^2 / \Sigma W_j \phi_{yjm}^2$
 Combination of Modal Response: SRSS $V = (\Sigma V_i^2)^{1/2}$

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

ACCIDENTAL ECCENTRICITY:

Level	X - D I R E C T I O N (EQY)			Y - D I R E C T I O N (EQX)		
	$\delta\epsilon^X_o$ (m)	A_x -	$\delta\epsilon^X$ (m)	$\delta\epsilon^Y_o$ (m)	A_y -	$\delta\epsilon^Y$ (m)
2	1.69	1.00	1.69	0.57	1.00	0.57

Ax: Amplification factor for accidental eccentricity

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

DESIGN ECCENTRICITY : $E = \epsilon + \delta\epsilon$

Level	X - D I R E C T I O N (EQY)				Y - D I R E C T I O N (EQX)			
	Center Mass CMx	Inherent Eccent. ϵ^{x*}	Accident. Eccent. $\delta\epsilon^x$	Design Eccent. E^x	Center Mass CMy	Inherent Eccent. ϵ^{y*}	Accident. Eccent. $\delta\epsilon^y$	Design Eccent. E^y
2	16.86	0.00	1.69	-1.699	5.85	0.50	0.57	1.0707

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

DESIGN ECCENTRICITY : $E = \epsilon - \delta\epsilon$

Level	X - D I R E C T I O N (EQY)				Y - D I R E C T I O N (EQX)			
	Center Mass CMx	Inherent Eccent. ϵ^{x*}	Accident. Eccent. $\delta\epsilon^x$	Design Eccent. E^x	Center Mass CMy	Inherent Eccent. ϵ^{y*}	Accident. Eccent. $\delta\epsilon^y$	Design Eccent. E^y
2	16.86	0.00	1.69	1.6969	5.85	0.50	0.57	-0.077

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

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Modal nodal force:

$$F_{im} = V_m \quad W_{im} \quad \phi_{im} / \sum W_j \quad \phi_{jm}$$

$$V_m = S_{am} W'_m$$

$$W'_m = \{ \sum W_j \quad \phi_{jm} \}^2 / \sum W_j \quad \phi_{jm}^2$$

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

Floor k -	Weight W (ton)	X - DIRECTION		Torsion T=F(E-ε) (ton-m)
		Force F (ton)	Shear V (ton)	
2	181.9	130.8	130.8	75.02

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

Floor k -	Weight W (ton)	Y - DIRECTION		Torsion T=F(E-ε) (ton-m)
		Force F (ton)	Shear V (ton)	
2	181.9	130.8	130.8	221.1

ACCELERATIONS ON NON-STRUCTURAL ELEMENTS- NSR-10

F L O O R A C C E L E R A T I O N S			
Level	hx	hx/heq	ax
2	3.65	1.33	0.959

Seismic base level = 1
 Height above seismic base, hn = 3.65 m
 Equivalent height, heq = 0.75 hn = 2.74 m
 Ground acceleration, As = Aa Fa I = 0.288
 Spectral acceleration, Sa = 0.719

ax = Sa hx/heq for hx > heq
 ax = As + (Sa -As) hx/heq for hx < heq

Force on structural non-seismic element : Fp = ax Wp / Ro
 Force on nonstructural element : Fp = ax ap Wp / Rp
 > 0.5 Aa I Wp

ap : component amplification factor