

Company: Company

Project: IE HECTOR MANUEL VIDES BALLESTEROS (MÓDULO 9)

File: C:\IE REGIDOR\MOD9.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

Vm = Sam Wm'

Sam = Spectral modal acceleration

Wm' = Effective modal weight

ANALYSIS PARAMETERS

Number of modes to be included ... = 3

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

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

Eff. peak acceleration & veloc., Aa = .15 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 = 1.25

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	

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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

$S_{am} = 2.5 A_a F_a I$ [0.4+0.6T/To] 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 $T_m > T_l$

DESIGN SPECTRAL RESPONSE ACCELERATION PARAMETERS

Short Periods Long Periods

 Effect. peak acceleration & velc., $A_a = 0.15$ $A_v = 0.15$
 Site coefficients (Tables below), $F_a = 1.50$ $F_v = 2.20$
 Design response parameters, $A_a F_a = 0.23$ $A_v F_v = 0.33$
 Long-period transition period, T_l sec = 5.28 (2.4 F_v)

Site Coefficient F_a

Site Class	$A_a \leq 0.1$	$A_a = 0.2$	$A_a = 0.3$	$A_a = 0.4$	$S_s \geq 0.5$
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 F_v

Site Class	$A_v \leq 0.1$	$A_v = 0.2$	$A_v = 0.3$	$A_v = 0.4$	$A_v \geq 0.5$
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			ELEVATION IRREGULARITIES		
Type	Description	$\emptyset_p$	Type	Description	$\emptyset_a$
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 $(\emptyset_p \cdot \emptyset_a) = 1.0$

X - D I R E C T I O N Y - D I R E C T I O N

 Reduct. factor, $(\emptyset_p \cdot \emptyset_a) = 0.9$ 0.9
 Redundancy factor, $\emptyset_r = 1$ 1
 R = $(\emptyset_p \cdot \emptyset_a) \cdot \emptyset_r \cdot R_o$

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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) = 52.06

Peak Acceleration Coeffi., Aa Fa = .23
 Peak Velocity Coefficient, Av Fv = .33
 Importance factor, I = 1.25
 Site class, S = D
 Coeff. for upper limit period, Cu = 1.354

	X-direction	Y-direction
	-----	-----
Computed Period	= 0.200	0.191
Ta = Ct (H)^x	= 0.047 H^0.9	0.047 H^0.9
	= 0.138	0.138
Tmax = Cu Ta	= 0.186	0.186
Fundamental Period	= 0.186	0.186
Energ-Disspst coeff, R	= 4.5	4.5
1.2 Av Fv I / T	= 2.656	2.656
2.5 Aa Fa I	= .719	.719
Sa	= .719	.719
Base Shear, Vo	= 37.42	37.42
Static Shear, .9Vo (ton)	= 33.68	33.68

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)
-----	-----	-----
1	.2	.719
2	.191	.719
3	.11	.618

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		
	Sax (g)	W'x (ton)	Vx (ton)	Say (g)	W'y (ton)	Vy (ton)
-----	-----	-----	-----	-----	-----	-----
1	.719	51.68	37.16	.719	0	0
2	.719	0	0	.719	51.91	37.32
3	.618	.38	.24	.618	.05	.03
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ELASTIC Ve (combined):	37.16			37.32		
STATIC(IREG) 0.9Sa(T1)W:	33.68			33.68		
Design Base Shear:	37.16			37.32		

Total Building Weight, W = 52.06 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 $V = (\text{Sum } V_i^2)^{1/2}$

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

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

Level	X - D I R E C T I O N (EQY)			Y - D I R E C T I O N (EQX)		
	$\delta\epsilon^{\circ}$ (m)	A_x -	$\delta\epsilon^x$ (m)	$\delta\epsilon^{\circ}$ (m)	A_x -	$\delta\epsilon^y$ (m)
2	0.49	1.00	0.49	0.31	1.00	0.31

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) $E^y = \epsilon^y - \delta\epsilon^y$

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

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	4.94	0.20	0.49	0.6969	3.08	0.41	0.31	0.7272

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

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

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	4.94	0.20	0.49	-0.299	3.08	0.41	0.31	0.1010

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	52.06	37.15	37.15	11.65

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	52.06	37.31	37.31	18.29

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	3.29	1.33	0.956

Seismic base level = 1
 Height above seismic base, hn = 3.30 m
 Equivalent height, heq = 0.75 hn = 2.48 m
 Ground acceleration, As = Aa Fa I = 0.288
 Spectral acceleration, Sa = 0.717

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