07 de Mayo de 2014

MEMORIA DE CÁLCULO

Predimensionadode Estructura

Escuela: Masjoan

Ubicación: Córdoba Capital– Pvcia. de Córdoba

Memoria descriptiva:

El proyecto se compone de una ampliación a construir nueva y la incorporación a la edificación existente de un ascensor planteando las modificaciones necesarias. Para el primer caso la estructura se planteó en función del proyecto arquitectónico propuesto. Se analizaron 2 bloques por separados, uno conformado por la ampliación de aulas y el otro por la galería. En el segundo caso se incorporaron 2 losas y la estructura portante del ascensor. Para ambos casos se realizó el análisis de carga considerando las cargas correspondientes según el caso, haciendo uso del reglamento CIRSOC 101(Reglamento argentino de cargas permanentes y sobrecargas mínimas de diseño para edificios y otras estructuras) y CIRSOC 102 (Reglamento argentino de acción del viento sobre las construcciones). Se cuantificaron igualmente las acciones sísmicas especificadas en la norma CIRSOC 103 (Normas argentinas para construcciones sismorresistentes) propias al caso.

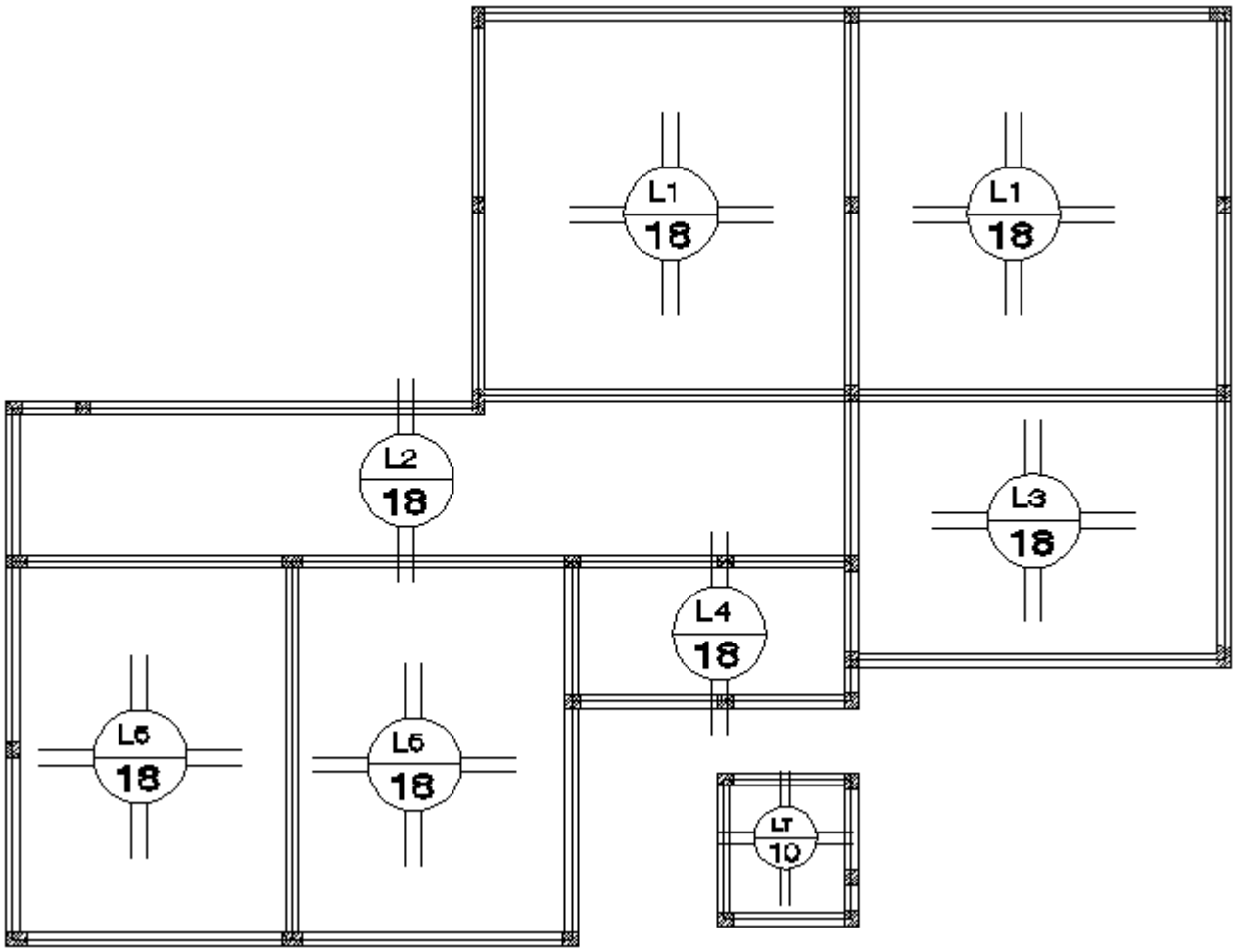
Para el dimensionado de la estructura se utilizó la herramienta de cálculo RAM Elements, considerando la normativa vigente, la cual corresponde a los siguientes reglamentos:

- CIRSOC 103: Normas argentinas para construcciones sismorresistentes.
- CIRSOC 201: Reglamento argentino de estructuras de hormigón.
- CIRSOC 301: Reglamento argentino de estructuras de acero para edificios.
- CIRSOC 303: Reglamento argentino de elementos estructurales de acero de sección abierta conformados en frio.

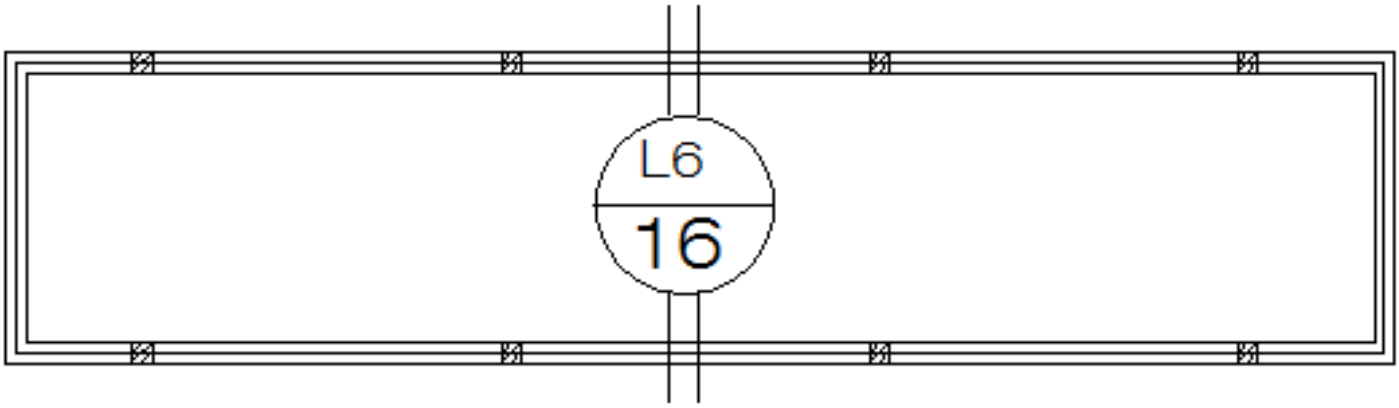
Para definir la fundación se analizó la solución más conveniente según la información relevada a través del estudio de suelo. Se optó por definir una fundación con pilotes a -9.5 m, definiendo 3 tipologías.

1-<u>Análisis de carga:</u>

Bloque A:



Bloque B:



2- Losas

- Dimensionado Losas:

Losa	Lx [m]	Ly [m]	β	Dirección de armado	ϒ	Espesor [cm]	Espesor adop [cm]
L1	7.20	7.40	1.03	2 D	41.15	18	18
L2	16.20	3.25	4.98	Y	20.00	17	18
L3	7.20	5.15	1.40	2 D	44.18	12	18
L4	5.40	2.70	2.00	Y	20.00	14	18
L5	5.40	7.30	1.35	2 D	43.77	17	18
L6	13.75	2.90	4.74	Y	20.00	15	16

Losa	Lx [m]	Ly [m]	β	Dirección de armado	ϒ	Espesor [cm]	Espesor adop [cm]
LT	2.55	2.70	1.06	2 D	41.40	7	10

Losa	Sobrecarga [tn/m2]	Cubierta [tn/m2]	Peso propio [tn/m2]	L [tn/m2]	D [tn/m2]	1.2D+1.6L	1.4D	Qu [tn/m2]
L1	0.30	0.30	0.43	0.3	0.73	1.36	1.02	1.36
L2	0.30	0.30	0.43	0.3	0.73	1.36	1.02	1.36
L3	0.30	0.30	0.43	0.3	0.73	1.36	1.02	1.36
L4	0.30	0.30	0.43	0.3	0.73	1.36	1.02	1.36
L5	0.30	0.30	0.43	0.3	0.73	1.36	1.02	1.36
L6	0.30	0.30	0.38	0.3	0.68	1.30	0.96	1.30

Losa	Sobrecarga [tn/m2]	Agua [tn/m2]	Peso propio [tn/m2]	L [tn/m2]	D [tn/m2]	1.2D+1.6L	1.4D	Qu [tn/m2]
LT	0.10	0.40	0.24	0.1	0.64	0.93	0.90	0.93

- Condiciones de borde (Método de Marcus)

Losa N°	Tipo de losa	L x [m]	L y [m]	e Adop [cm]	Lme/Lma	α x	α y	Qu [kg/m2]	M x [kgm/m]	M y [kgm/m]
1	L1	7.20	7.40	18	0.97		836	1358.4	0	5887
2	L1	7.20	7.40	18	0.97	691	691	1358.4	4866	4866
3	L2	16.20	3.25	18	0.20			1358.4	0	0
4	L3	7.20	5.15	18	0.72	1090		1358.4	3927	0
5	L4	5.40	2.70	18	0.50	1210		1358.4	1198	0
6	L5	5.40	7.30	18	0.74		562	1358.4	0	2226
7	L5	5.40	7.30	18	0.74		562	1358.4	0	2226
8	L6	16.30	2.95	16	0.18			1300.8	0	0

- Armado de Losas : Calculo de momento solicitante y armadura necesaria

Losa N°	Lx [m]	Ly [m]	Lmen/Lmay	e [cm]	Qu [kg/m2]	α x Tramo	α y tramo	α x Borde	α y borde
1	7.20	7.40	0.97	18	1358.4	446	318		920
2	7.20	7.40	0.97	18	1358.4	306	367	731	309
3	16.20	3.25	0.20	18	1358.4				
4	7.20	5.15	0.72	18	1358.4	562	318	1090	
5	5.40	2.70	0.50	18	1358.4				
6	5.40	7.30	0.74	18	1358.4	318	562		1090
7	5.40	7.30	0.74	18	1358.4	318	562		1090
8	13.75	2.90	0.21	16	1300.8				
LT	2.55	2.70	0.94	10	928				

					Tramo		Borde	
Losa N°	Mx tramo [kg.m/m]	My tramo [kg.m/m]	Mx borde [kg.m/m]	My borde [kg.m/m]	As x Nec [cm2]	As y Nec [cm2]	As x Nec [cm2]	As y Nec [cm2]
1	3140.71	2239.34	0.00	6478.59	3.82	5.36	11.06	0.00
2	2154.84	2584.39	5147.66	2175.96	4.41	3.68	3.71	8.79
3	551.85	0.00	0.00	0.00	3.60	3.60	0.00	0.00
4	2024.78	1145.70	3927.07	0.00	3.60	3.60	0.00	6.70
5	696.286125	0.00	1237.84	0.00	3.60	3.60	0.00	2.11
6	9048.64	0.00	0.00	0.00	3.60	15.44	0.00	0.00
7	9048.64	0.00	0.00	0.00	3.60	15.44	0.00	0.00
8	471.54	0.00	0.00	0.00	3.20	3.20	0.00	0.00
LT	845.64	0.00	0.00	0.00	2.00	2.98	0.00	0.00

3- <u>Vigas:</u>

- Distribución de cargas en losas según dirección:

LOSA	L	D	Lx	Ly	Ly/Lx	K marcus	Lx	Ly	Dx	Dy
	[kg/m2]	[kg/m2]	[m]	[m]			[kg/m2]	[kg/m2]	[kg/m2]	[kg/m2]
1	0.30	0.73	7.20	7.40	1.03	0.738	0.22	0.08	0.54	0.19
2	0.30	0.73	7.20	7.40	1.03	0.529	0.16	0.14	0.39	0.34
3	0.30	0.73	16.20	3.25	0.20	1	0.03	0.30	0.07	0.73
4	0.30	0.73	7.20	5.15	0.72	0.402	0.12	0.18	0.29	0.44
5	0.30	0.73	5.40	2.70	0.50	1	0.03	0.30	0.07	0.73
6	0.30	0.73	5.40	7.30	1.35	0.892	0.27	0.03	0.65	0.08
7	0.30	0.73	5.40	7.30	1.35	0.892	0.27	0.03	0.65	0.08
8	0.30	0.68	13.75	2.90	0.21		0.03	0.30	0.00	0.68
LT	0.10	0.64	2.55	2.70	1.06	0.558	0.06	0.04	0.36	0.28

- Distribución de cargas de losas sobre Vigas:

Bloque A:

Vigas en X	Losa					Losa					L viga	D viga
Nivel	N°	l	%	L	D	N°	l	%	L	D		
		[m]		[kg/m2]	[kg/m2]		[m]		[kg/m2]	[kg/m2]	[kg/m]	[kg/m]
1	1	7.4	0.5	0.079	0.192						0.291	0.711
1	2	7.4	0.4	0.141	0.345						0.418	1.021
1	1	7.4	0.5	0.079	0.192	3	3.25	0.5	0.300	0.732	0.779	1.900
1	2	7.4	0.6	0.141	0.345	4	5.15	0.6	0.179	0.438	1.182	2.883
1	3	3.25	0.5	0.300	0.732						0.488	1.190
1	3	3.25	0.5	0.300	0.732	6	7.3	0.5	0.032	0.079	0.606	1.478
1	3	3.25	0.5	0.300	0.732	7	7.3	0.5	0.032	0.079	0.606	1.478
1	3	3.25	0.5	0.300	0.732	5	2.7	0.6	0.300	0.732	0.974	2.375
1	3	3.25	0.5	0.300	0.732	5	2.7	0.6	0.300	0.732	0.974	2.375
1	4	5.15	0.4	0.179	0.438						0.370	0.902
1	5	2.7	0.4	0.300	0.732						0.324	0.791
1	5	2.7	0.4	0.300	0.732						0.324	0.791
1	6	7.3	0.5	0.032	0.079						0.118	0.289
1	7	7.3	0.5	0.032	0.079						0.118	0.289
2	LT	2.7	0.5	0.044	0.283						0.060	0.382
2	LT	2.7	0.5	0.044	0.283						0.060	0.382

Vigas en Y	Losa					Losa					L viga	D viga
Nivel	N°	l	%	L	D	N°	l	%	L	D		
		[m]		[kg/m2]	[kg/m2]		[m]		[kg/m2]	[kg/m2]	[kg/m]	[kg/m]
1	6	5.4	0.4	0.268	0.653						0.578	1.410
1	3	16.2	0.5	0.030	0.073						0.243	0.593
1	6	5.4	0.6	0.268	0.653	7	5.4	0.6	0.268	0.653	1.734	4.231

1	1	7.2	0.4	0.221	0.540						0.637	1.555
1	7	5.4	0.4	0.268	0.653						0.578	1.410
1	7	5.4	0.4	0.268	0.653	5	5.4	0.5	0.030	0.073	0.659	1.608
1	5	5.4	0.5	0.030	0.073	4	7.2	0.5	0.121	0.294	0.515	1.257
1	3	16.2	0.5	0.030	0.073	4	7.2	0.5	0.121	0.294	0.677	1.652
1	1	7.2	0.6	0.221	0.540	2	7.2	0.6	0.159	0.387	1.641	4.005
1	4	7.2	0.5	0.121	0.294						0.434	1.059
1	2	7.2	0.4	0.159	0.387						0.457	1.115
2	LT	2.55	0.5	0.056	0.357						0.071	0.455
2	LT	2.55	0.5	0.056	0.357						0.071	0.455

- Cargas de Muro:

Υ	e	Altura	q
[tn/m3]	[m]	[m]	[tn/m]
1.70	0.30	3.30	1.68
1.70	0.30	1.00	0.51
1.70	0.30	2.00	1.02
1.70	0.15	3.30	0.84

Bloque B:

Vigas en X		Losa					L viga	D viga
Nivel	Número	N°	l	%	L	D		
			[m]		[kg/m2]	[kg/m2]	[kg/m]	[kg/m]
1	1	L6	2.9	0.5	0.300	0.684	0.435	0.992
1	2	L6	2.9	0.5	0.300	0.684	0.435	0.992
1	3	L6	2.9	0.5	0.300	0.684	0.435	0.992
1	4	L6	2.9	0.5	0.300	0.684	0.435	0.992
1	5	L6	2.9	0.5	0.300	0.684	0.435	0.992
1	6	L6	2.9	0.5	0.300	0.684	0.435	0.992
1	7	L6	2.9	0.5	0.300	0.684	0.435	0.992
1	8	L6	2.9	0.5	0.300	0.684	0.435	0.992
1	9	L6	2.9	0.5	0.300	0.684	0.435	0.992
1	10	L6	2.9	0.5	0.300	0.684	0.435	0.992

Vigas en Y		Losa					L viga	D viga
Nivel	Número	N°	l	%	L	D		
			[m]		[kg/m2]	[kg/m2]	[kg/m]	[kg/m]
1	15	L6	13.75	0.5	0.030	0.068	0.206	0.470
1	16	L6	13.75	0.5	0.030	0.068	0.206	0.470

4 -Verificación de los elementos más cargados:

Se adjuntan en forma anexa la salida del programa RAM Elements, mediante el cual se verificó la estructura. Se presenta solamente el resultado obtenido para la viga de fundación, columna y viga superior mas cargada.

5-Dimensionamiento de Fundaciones:

Para el dimensionamiento de fundaciones, se obtuvieron las reacciones en la base de cada columna y se dividieron las cargas en 4 rangos, con el fin de definir 3tipologías de pilotes que sinteticen las necesidades estructurales de todo el edificio, utilizando dichas tipologías individualmente y en grupos. De esta manera se definió:

Tipología 1: Pilote de 0.5 m de diámetro, con una campana de 1m de diámetro y un largo de 9.5 metros, alcanzando una capacidad de soporte total igual a 28.9 tn. Cuando se lo utiliza en grupo de 2 pilotes la capacidad se duplica alcanzando las 57.8 tn.

Tipología 2: Pilote de 0.6 m de diámetro, con una campana de 1.2m de diámetro y un largo de 9.5 metros, alcanzando una capacidad de soporte total igual a 37.4 tn. Cuando se lo utiliza en grupo de 2 pilotes la capacidad se duplica alcanzando las 74.8 tn.

Tipología 3: Pilote de 0.5 m de diámetro y un largo de 9.5 metros, alcanzando una capacidad de soporte total igual a 17.12 tn.

Ø	campana	lt	lf	σp	σf	qp	qf	pp	qtotal	qtotal x 2	As p=0.01	As adop
0.5	1	9.5	7.5	20	1.5	15.71	17.67	4.48	28.90	57.81	19.625	18 Ø 12
0.6	1.2	9.5	7.5	20	1.5	22.62	21.21	6.45	37.38	74.76	28.26	15 Ø 16
0.5	0.5	9.5	7.5	20	1.5	3.93	17.67	4.48	17.12	34.24	19.625	18 Ø 12

6-Anexo:

Viga de fundación mas cargada:

Current Date: 06/05/2014 11:01 p.m.
Units system: Metric

Design Results

Reinforced concrete beams

GENERAL INFORMATION:

Design Code : ACI 318-2005

Load conditions included in the design:

id1	=	1.4DL
id2	=	1.2DL+0.5LL+EQxpo+0.5EQzpo
id3	=	1.2DL+0.5LL+EQxpo+0.5EQzne
id4	=	1.2DL+0.5LL+EQxne+0.5EQzpo
id5	=	1.2DL+0.5LL+EQxne+0.5EQzne
id6	=	0.9DL+EQxpo+0.5EQzpo
id7	=	0.9DL+EQxpo+0.5EQzne
id8	=	0.9DL+EQxne+0.5EQzpo
id9	=	0.9DL+EQxne+0.5EQzne
id11	=	1.2DL+1.6LL
id12	=	0.9DL+1.5V
id13	=	1.2DL+0.5LL+0.5EQxpo+EQzpo
id14	=	1.2DL+0.5LL+0.5EQxpo+EQzne
id15	=	1.2DL+0.5LL+0.5EQxne+EQzpo
id16	=	1.2DL+0.5LL+0.5EQxne+EQzne
id17	=	0.9DL+0.5EQxpo+EQzpo
id18	=	0.9DL+0.5EQxpo+EQzne
id19	=	0.9DL+0.5EQxne+EQzpo
id20	=	0.9DL+0.5EQxne+EQzne

Moment frame : Ordinary

Materials

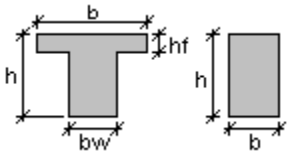
Concrete, f'c	: 0.21 [Ton/cm2]	Longitudinal reinforcement, fy	: 4.22 [Ton/cm2]
Concrete type	: Normal	Transversal reinforcement, fyt	: 4.22 [Ton/cm2]
Concrete elasticity modulus	: 219.50 [Ton/cm2]	Steel elasticity modulus	: 2038.89 [Ton/cm2]
Unit weight	: 2.40 [Ton/m3]	Epoxy coated	: No

DATA AND RESULTS

Status : OK

Geometry

Axis	Col position	Bottom width [cm]	Top width [cm]	Dist x [m]
1	Center	0.00	40.00	0.00
2	Center	0.00	25.00	7.20
3	Center	0.00	25.00	14.40

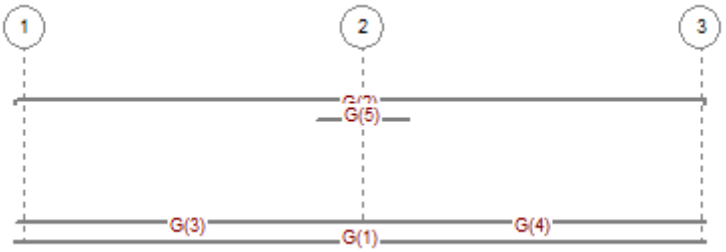


Span	Dist between axes [m]	Member No	Section	b [cm]	h [cm]	bw [cm]	hf [cm]
1-2	7.20	2	•	25.00	70.00	--	--
2-3	7.20	1	•	25.00	70.00	--	--

Rebar

Free cover : 2.00 [cm]

Longitudinal reinforcement



Group	Quantity	Diameter	Pos	Ref. Axis 1	Dist1 [m]	Ref. Axis 2	Dist2 [m]	Hook1	Hook2
1	2	12mm	Bottom	1	-0.20	3	0.12	Yes	Yes
2	2	20mm	Top	1	-0.18	3	0.10	Yes	Yes
3	3	12mm	Bottom	1	-0.20	2	0.00	No	No
4	3	12mm	Bottom	2	0.00	3	0.10	No	No
5	1	20mm	Top	2	-1.00	2	1.00	No	No

Development and splice lengths

Group	Diameter	Ld [cm]	Ldh [cm]	Splice L. [cm]	Total L [m]
1	12mm	54.00	20.00	70.00	15.06
2	20mm	114.00	32.00	150.00	15.22
3	12mm	54.00	20.00	70.00	7.40
4	12mm	54.00	20.00	70.00	7.30
5	20mm	114.00	32.00	150.00	2.00

Transverse reinforcement

Span	Diameter	Quantity	c/ [cm]	Legs	Closed
1-2	6mm	72	10.00	2	Yes
2-3	6mm	72	10.00	2	Yes

Initial spacing of stirrups:

Span	Initial S [cm]	Sin lim [cm]
0-1	5.00	34.00
1-2	5.00	34.00

FLEXURE

Span: 1-2 **Member No: 2**

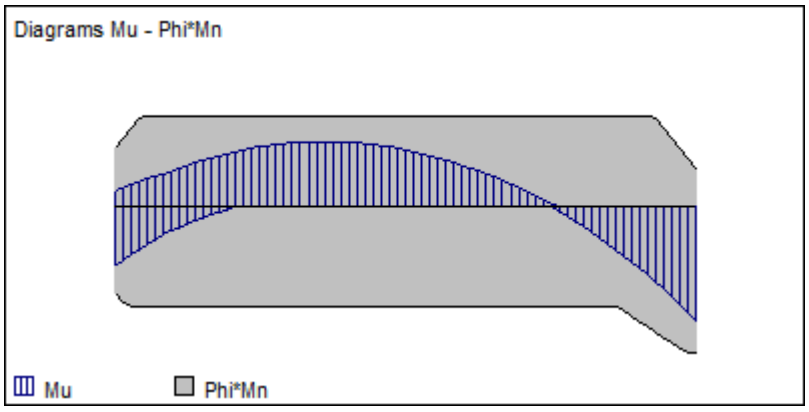
Percentage of moment redistribution	Support A = 0.00%	Support B = 0.00%
Code specified max Rho:	ρ maxtop= 1.55%	ρ maxbot= 1.55%
Limit spacing between bars for cracking control:	sblim = 30.48 [cm]	

Positive bending moments

Station No.	Dist	**d**[cm]	**Mu**[Ton*m]	**ϕ*Mn**[Ton*m]	**Asreq**[cm2]	**Asprov**[cm2]	**ρ (%)**	**sb**[cm]	**Mu/(ϕ*Mn)**
1	0%	66.80	2.42	8.78	1.28	3.55	0.21	3.15	0.69
2	10%	66.80	5.40	13.76	2.88	5.65	0.34	3.15	0.39
3	20%	66.80	8.14	13.76	4.38	5.65	0.34	3.15	0.59
4	30%	66.80	9.58	13.76	5.18	5.65	0.34	3.15	0.70
5	40%	66.80	9.72	13.76	5.25	5.65	0.34	3.15	0.71
6	50%	66.80	8.54	13.76	4.60	5.65	0.34	3.15	0.62
7	60%	66.80	6.15	13.76	3.29	5.65	0.34	3.15	0.45
8	70%	66.80	2.56	13.76	1.35	5.65	0.34	3.15	0.19
9	80%	66.80	0.00	13.76	0.00	5.65	0.34	3.15	0.19
10	90%	66.80	0.00	13.76	0.00	5.65	0.34	3.15	0.53
11	100%	66.80	0.00	5.64	0.00	2.26	0.14	3.15	0.78
C	100%	66.80	0.00	5.64	0.00	2.26	0.14	3.15	0.78

Negative bending moments

Station No.	Dist	**d**[cm]	**Mu**[Ton*m]	**ϕ*Mn**[Ton*m]	**Asreq**[cm2]	**Asprov**[cm2]	**ρ (%)**	**sb**[cm]	**Mu/(ϕ*Mn)**
1	0%	66.40	-9.05	-13.03	4.91	5.37	0.32	15.40	0.69
2	10%	66.40	-3.67	-15.13	1.96	6.28	0.38	15.40	0.39
3	20%	66.40	-0.36	-15.13	0.19	6.28	0.38	15.40	0.59
4	30%	66.40	0.00	-15.13	0.00	6.28	0.38	15.40	0.70
5	40%	66.40	0.00	-15.13	0.00	6.28	0.38	15.40	0.71
6	50%	66.40	0.00	-15.13	0.00	6.28	0.38	15.40	0.62
7	60%	66.40	0.00	-15.13	0.00	6.28	0.38	15.40	0.45
8	70%	66.40	0.00	-15.13	0.00	6.28	0.38	15.40	0.19
9	80%	66.40	-2.82	-15.13	1.50	6.28	0.38	15.40	0.19
10	90%	66.40	-9.22	-17.41	5.01	7.28	0.44	6.70	0.53
11	100%	66.40	-17.35	-22.16	7.26	9.42	0.57	6.70	0.78
C	100%	66.40	-17.35	-22.16	7.26	9.42	0.57	6.70	0.78



Span: 2-3 **Member No: 1**

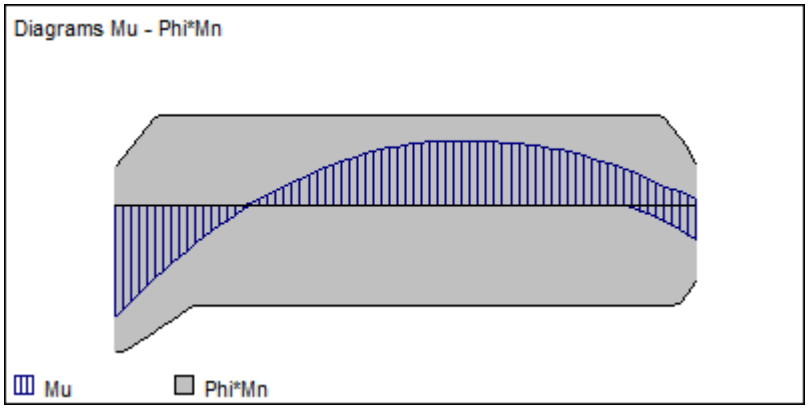
Percentage of moment redistribution	Support A = 0.00%	Support B = 0.00%
Code specified max Rho:	ρ maxtop= 1.55%	ρ maxbot= 1.55%
Limit spacing between bars for cracking control:	sblim = 30.48 [cm]	

Positive bending moments

Station No.	Dist	d[cm]	Mu[Ton*m]	ϕ*Mn[Ton*m]	Asreq[cm2]	Asprov[cm2]	ρ (%)	sb[cm]	Mu/(ϕ*Mn)
1	0%	66.80	0.00	5.64	0.00	2.26	0.14	3.15	0.77
2	10%	66.80	0.00	13.76	0.00	5.65	0.34	3.15	0.50
3	20%	66.80	0.00	13.76	0.00	5.65	0.34	3.15	0.13
4	30%	66.80	3.25	13.76	1.73	5.65	0.34	3.15	0.24
5	40%	66.80	6.97	13.76	3.74	5.65	0.34	3.15	0.51
6	50%	66.80	9.16	13.76	4.94	5.65	0.34	3.15	0.67
7	60%	66.80	9.82	13.76	5.31	5.65	0.34	3.15	0.71
8	70%	66.80	9.32	13.76	5.04	5.65	0.34	3.15	0.68
9	80%	66.80	7.63	13.76	4.10	5.65	0.34	3.15	0.55
10	90%	66.80	4.64	13.76	2.47	5.65	0.34	3.15	0.34
11	100%	66.80	1.03	6.55	0.54	2.63	0.16	3.15	0.45
C	0%	66.80	0.00	5.64	0.00	2.26	0.14	3.15	0.77

Negative bending moments

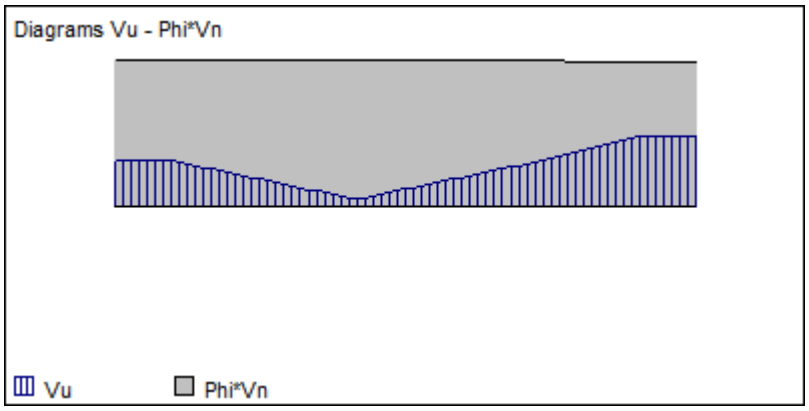
Station No.	Dist	d[cm]	Mu[Ton*m]	ϕ*Mn[Ton*m]	Asreq[cm2]	Asprov[cm2]	ρ (%)	sb[cm]	Mu/(ϕ*Mn)
1	0%	66.40	-17.02	-22.16	7.11	9.42	0.57	6.70	0.77
2	10%	66.40	-8.74	-17.41	4.74	7.28	0.44	6.70	0.50
3	20%	66.40	-1.98	-15.13	1.05	6.28	0.38	15.40	0.13
4	30%	66.40	0.00	-15.13	0.00	6.28	0.38	15.40	0.24
5	40%	66.40	0.00	-15.13	0.00	6.28	0.38	15.40	0.51
6	50%	66.40	0.00	-15.13	0.00	6.28	0.38	15.40	0.67
7	60%	66.40	0.00	-15.13	0.00	6.28	0.38	15.40	0.71
8	70%	66.40	0.00	-15.13	0.00	6.28	0.38	15.40	0.68
9	80%	66.40	0.00	-15.13	0.00	6.28	0.38	15.40	0.55
10	90%	66.40	-0.73	-15.13	0.39	6.28	0.38	15.40	0.34
11	100%	66.40	-5.28	-11.69	2.84	4.80	0.29	15.40	0.45
C	0%	66.40	-17.02	-22.16	7.11	9.42	0.57	6.70	0.77



SHEAR AND TORSION

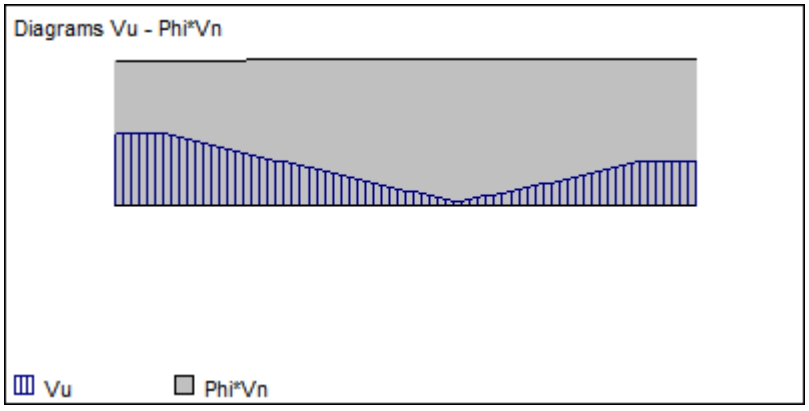
Span: 1-2 **Member No: 2**

Station		Stirrups		Spcprov	Spclim	Tu	ϕ*Tn	Al	Vu	Vs	Vc	ϕ*Vn	Vu/(ϕ*Vn)
No.	Dist	Diam	VCT	[cm]	[cm]	[Ton*m]	[Ton*m]	[cm2]	[Ton]	[Ton]	[Ton]	[Ton]	
1	0%	6mm	V	10.00	27.17	0.00	2.03	0.00	6.88	15.95	12.86	21.61	0.32
2	10%	6mm	V	10.00	27.17	0.00	2.03	0.00	6.74	15.95	12.86	21.61	0.31
3	20%	6mm	V	10.00	27.17	0.00	2.03	0.00	4.93	15.95	12.86	21.61	0.23
4	30%	6mm		10.00	27.17	0.00	2.03	0.00	3.12	15.95	12.86	21.61	0.14
5	40%	6mm		10.00	27.17	0.00	2.03	0.00	1.30	15.95	12.86	21.61	0.06
6	50%	6mm		10.00	27.17	0.00	2.03	0.00	2.54	15.95	12.86	21.61	0.12
7	60%	6mm		10.00	27.17	0.00	2.03	0.00	4.35	15.95	12.86	21.61	0.20
8	70%	6mm	V	10.00	27.17	0.00	2.03	0.00	6.17	15.95	12.86	21.61	0.29
9	80%	6mm	V	10.00	27.17	0.00	2.03	0.00	8.16	15.85	12.78	21.48	0.38
10	90%	6mm	V	10.00	27.17	0.00	1.91	0.00	10.28	15.85	12.78	21.48	0.48
11	100%	6mm	V	10.00	27.17	0.00	1.89	0.00	10.43	15.85	12.78	21.48	0.49
C	92%	6mm	V	10.00	27.17	0.00	1.89	0.00	10.43	15.85	12.78	21.48	0.49



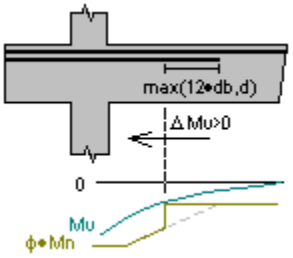
Span: 2-3 **Member No: 1**

Station		Stirrups		Spcprov	Spclim	Tu	ϕ*Tn	Al	Vu	Vs	Vc	ϕ*Vn	Vu/(ϕ*Vn)
No.	Dist	Diam	VCT	[cm]	[cm]	[Ton*m]	[Ton*m]	[cm2]	[Ton]	[Ton]	[Ton]	[Ton]	
1	0%	6mm	V	10.00	27.17	0.01	1.86	0.00	10.60	15.85	12.78	21.48	0.49
2	10%	6mm	V	10.00	27.17	0.01	1.88	0.00	10.45	15.85	12.78	21.48	0.49
3	20%	6mm	V	10.00	27.17	0.01	2.03	0.00	8.33	15.85	12.78	21.48	0.39
4	30%	6mm	V	10.00	27.17	0.01	2.03	0.00	6.21	15.95	12.86	21.61	0.29
5	40%	6mm		10.00	27.17	0.01	2.03	0.00	4.10	15.95	12.86	21.61	0.19
6	50%	6mm		10.00	27.17	0.01	2.03	0.00	2.19	15.95	12.86	21.61	0.10
7	60%	6mm		10.00	27.17	0.01	2.03	0.00	0.66	15.95	12.86	21.61	0.03
8	70%	6mm		10.00	27.17	0.01	2.03	0.00	2.47	15.95	12.86	21.61	0.11
9	80%	6mm		10.00	27.17	0.01	2.03	0.00	4.37	15.95	12.86	21.61	0.20
10	90%	6mm	V	10.00	27.17	0.01	2.03	0.00	6.49	15.95	12.86	21.61	0.30
11	100%	6mm	V	10.00	27.17	0.01	2.03	0.00	6.64	15.95	12.86	21.61	0.31
C	0%	6mm	V	10.00	27.17	0.01	1.86	0.00	10.60	15.85	12.78	21.48	0.49



Notes

* Only the design bending forces (Mu), shear forces (Vu) and torsion moments (Tu) are considered in the design.
* Values shown in red are not in compliance with a provision of the code
* The positive and negative flexural reinforcement includes the longitudinal reinforcement required to resist torsion. Refer to the note below on the VCT column to determine when torsion and compression bars are provided. The longitudinal reinforcement area considers the minimum area required by Code (10.5).
* When the moments diagram increases in the same direction of the development length of the bars, the bars will not contribute to the member strength for a Code specified distance equal to max(12*db,d).



* If the section at which member flexural strength is being calculated is within the development length of a group of bars, the bars will contribute to the bending capacity an amount proportional to their actual length / their full development length.
* The transverse reinforcement is ordered from left to right.
* The program does not consider ACI318-05 section 12.11.3 whereby the bar diameter is limited according to the location of the bar cut-off.
* Asprov is the provided reinforcement, considering the reduction due to the development length as described previously.
* "C" shows the span critical station.
* Ld,Ldh = Development length of each bar. If the bar ends with a hook, it considers the Ldh length.
* Splice lengths shown are not reduced by the factor Asreq/Asprov.
* sb = Free distance between top or bottom bars corresponding to the layer closest to the extreme face of the beam (layer1). It is not calculated when there is only one bar.
* Stirrups VCT = Flag that determines if stirrups are required to resist shear forces (V), torsion (T) or to confine the the longitudinal compression bars from buckling (C).
* Closed = Flag that indicates if the stirrups are closed (yes) or open (no).
* Mu/(ϕ*Mn) = Critical strength ratio for the station. If the value is in red, it is larger than 1.0
* Al = Total additional longitudinal reinforcement required by torsion.
* Spa = stirrup spacing provided by the user.
* Spa lim = spacing limits due to geometry. (11.5.5.1, 11.5.5.3, 21.3.3.2, 21.12.4.2)

Columna máscargada:

Current Date: 06/05/2014 11:04 p.m.
Units system: Metric

Design Results

Reinforced Concrete Columns

GENERAL INFORMATION:

Design Code : ACI 318-2005

Load Conditions included in design:

id1	:	1.4DL
id2	:	1.2DL+0.5LL+EQxpo+0.5EQzpo
id3	:	1.2DL+0.5LL+EQxpo+0.5EQzne
id4	:	1.2DL+0.5LL+EQxne+0.5EQzpo
id5	:	1.2DL+0.5LL+EQxne+0.5EQzne
id6	:	0.9DL+EQxpo+0.5EQzpo
id7	:	0.9DL+EQxpo+0.5EQzne
id8	:	0.9DL+EQxne+0.5EQzpo
id9	:	0.9DL+EQxne+0.5EQzne
id11	:	1.2DL+1.6LL
id12	:	0.9DL+1.5V
id13	:	1.2DL+0.5LL+0.5EQxpo+EQzpo
id14	:	1.2DL+0.5LL+0.5EQxpo+EQzne
id15	:	1.2DL+0.5LL+0.5EQxne+EQzpo
id16	:	1.2DL+0.5LL+0.5EQxne+EQzne
id17	:	0.9DL+0.5EQxpo+EQzpo
id18	:	0.9DL+0.5EQxpo+EQzne
id19	:	0.9DL+0.5EQxne+EQzpo
id20	:	0.9DL+0.5EQxne+EQzne

Moment frame : Ordinary

Materials

Concrete, f'c	:	0.21 [Ton/cm2]	Steel, fy	:	4.22 [Ton/cm2]
Concrete type	:	Normal	Steel, fyt	:	4.22 [Ton/cm2]
Modulus of elasticity	:	219.50 [Ton/cm2]	Type of splices	:	Tangential
Unit weight	:	2.40 [Ton/m3]	Minimum provided Rho	:	0.010
Epoxy coated	:	No	Maximum provided Rho	:	0.080

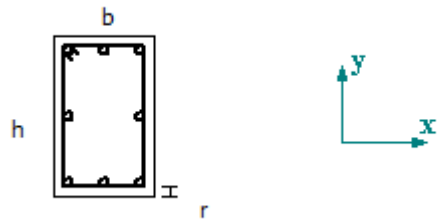
General status : OK

COLUMN DATA : 1

Geometry

Section type	:	Rectangular
Column location	:	Center
Distance between levels	:	3.30 [m]
Width b (// to axis x)	:	25.00 [cm]
Height h (// to axis y)	:	40.00 [cm]

Rebar



Longitudinal	:	8-20mm
Free cover	:	2.50 [cm]
As provided	:	25.12 [cm2]
Provided Rho	:	0.025
Number of bars // to axis x	:	3
Spacing between bars	:	6.40 [cm]
Number of bars // to axis y	:	3
Spacing between bars	:	13.90 [cm]
Transverse	:	25 6mm c/ 11.00cm
Number of legs // to axis x	:	2
Number of legs // to axis y	:	2
Initial spacing (Sini)	:	0.00 [cm]

Design parameters

Slenderness	Axis yy	Axis xx
Lu[cm]	330.00	330.00
K	1.00	1.00
Klu/r	45.73	28.58
Cm	0.00	0.00
Pc[Ton]	259.03	663.10
Sway	Yes	Yes

Forces

Condition	Position	Pu	Muxx	Muyy	Vx	Vy	Transverse load
		[Ton]	[Ton*m]	[Ton*m]	[Ton]	[Ton]	xx
yy							
id1	Top	-10.21	5.30	1.52	-0.91	3.50	No
No							
	Bottom	-11.32	-6.26	-1.48	-0.91	3.50	No
No							
id2	Top	-11.08	7.22	4.01	-2.43	4.64	No
No							
	Bottom	-12.03	-8.08	-4.02	-2.43	4.64	No
No							
id3	Top	-10.34	7.13	1.88	-1.11	4.58	No
No							
	Bottom	-11.29	-8.00	-1.79	-1.11	4.58	No
No							
id4	Top	-9.38	2.86	0.99	-0.56	1.77	No
No							
	Bottom	-10.33	-3.00	-0.85	-0.56	1.77	No
No							
id5	Top	-8.64	2.77	-1.13	0.76	1.72	No
No							
	Bottom	-9.59	-2.91	1.38	0.76	1.72	No
No							
id6	Top	-7.79	5.63	3.55	-2.18	3.71	No
No							

	Bottom	-8.50	-6.61	-3.65	-2.18	3.71	No
No							
id7	Top	-7.04	5.54	1.42	-0.86	3.66	No
No							
	Bottom	-7.75	-6.53	-1.42	-0.86	3.66	No
No							
id8	Top	-6.08	1.27	0.53	-0.31	0.85	No
No							
	Bottom	-6.80	-1.52	-0.48	-0.31	0.85	No
No							
id9	Top	-5.34	1.18	-1.59	1.01	0.79	No
No							
	Bottom	-6.05	-1.44	1.75	1.01	0.79	No
No							
id11	Top	-12.30	5.98	1.73	-0.96	3.56	No
No							
	Bottom	-13.25	-5.78	-1.43	-0.96	3.56	No
No							
id12	Top	-6.56	3.41	0.98	-0.58	2.25	No
No							
	Bottom	-7.28	-4.03	-0.95	-0.58	2.25	No
No							
id13	Top	-11.03	6.17	4.31	-2.62	3.95	No
No							
	Bottom	-11.98	-6.85	-4.34	-2.62	3.95	No
No							
id14	Top	-9.54	5.99	0.07	0.02	3.84	No
No							
	Bottom	-10.49	-6.68	0.12	0.02	3.84	No
No							
id15	Top	-10.18	3.99	2.81	-1.69	2.52	No
No							
	Bottom	-11.13	-4.31	-2.76	-1.69	2.52	No
No							
id16	Top	-8.69	3.81	-1.44	0.95	2.41	No
No							
	Bottom	-9.64	-4.14	1.71	0.95	2.41	No
No							
id17	Top	-7.73	4.59	3.85	-2.37	3.02	No
No							
	Bottom	-8.45	-5.38	-3.97	-2.37	3.02	No
No							
id18	Top	-6.24	4.41	-0.39	0.27	2.91	No
No							
	Bottom	-6.96	-5.21	0.49	0.27	2.91	No
No							
id19	Top	-6.88	2.41	2.35	-1.44	1.59	No
No							
	Bottom	-7.60	-2.84	-2.39	-1.44	1.59	No
No							
id20	Top	-5.39	2.23	-1.90	1.20	1.48	No
No							
	Bottom	-6.11	-2.67	2.08	1.20	1.48	No
No							

RESULTS OF COLUMN: 1

Column status : OK

Biaxial compression

Controlling condition	:	id2
Stress in bars	:	fs<0
Dowel splice length	:	50.00 [cm]
Bar clear spacing at splices	:	4.40 [cm]

Condition	Pos.	Pu [Ton]	Mcxx [Ton*m]	Mcyy [Ton*m]	δnsxx	δnsyy	Cmxx	Cmyy
id1	Top	-10.21	5.30	1.52	1.00	1.00	0.400	0.400
	Bot.	-11.32	-6.26	-1.48	1.00	1.00	0.400	0.400
id2	Top	-11.08	7.22	4.01	1.00	1.00	0.400	0.400
	Bot.	-12.03	-8.08	-4.02	1.00	1.00	0.400	0.400
id3	Top	-10.34	7.13	1.88	1.00	1.00	0.400	0.400
	Bot.	-11.29	-8.00	-1.79	1.00	1.00	0.400	0.400
id4	Top	-9.38	2.86	0.99	1.00	1.00	0.400	0.400
	Bot.	-10.33	-3.00	-0.85	1.00	1.00	0.400	0.400
id5	Top	-8.64	2.77	-1.13	1.00	1.00	0.400	0.400
	Bot.	-9.59	-2.91	1.38	1.00	1.00	0.400	0.400
id6	Top	-7.79	5.63	3.55	1.00	1.00	0.400	0.400
	Bot.	-8.50	-6.61	-3.65	1.00	1.00	0.400	0.400
id7	Top	-7.04	5.54	1.42	1.00	1.00	0.400	0.400
	Bot.	-7.75	-6.53	-1.42	1.00	1.00	0.400	0.400
id8	Top	-6.08	1.27	0.53	1.00	1.00	0.400	0.400
	Bot.	-6.80	-1.52	-0.48	1.00	1.00	0.400	0.400
id9	Top	-5.34	1.18	-1.59	1.00	1.00	0.400	0.400
	Bot.	-6.05	-1.44	1.75	1.00	1.00	0.400	0.400
id11	Top	-12.30	5.98	1.73	1.00	1.00	0.400	0.400
	Bot.	-13.25	-5.78	-1.43	1.00	1.00	0.400	0.400
id12	Top	-6.56	3.41	0.98	1.00	1.00	0.400	0.400
	Bot.	-7.28	-4.03	-0.95	1.00	1.00	0.400	0.400
id13	Top	-11.03	6.17	4.31	1.00	1.00	0.400	0.400
	Bot.	-11.98	-6.85	-4.34	1.00	1.00	0.400	0.400
id14	Top	-9.54	5.99	0.07	1.00	1.00	0.400	0.825
	Bot.	-10.49	-6.68	0.12	1.00	1.00	0.400	0.825
id15	Top	-10.18	3.99	2.81	1.00	1.00	0.400	0.400
	Bot.	-11.13	-4.31	-2.76	1.00	1.00	0.400	0.400
id16	Top	-8.69	3.81	-1.44	1.00	1.00	0.400	0.400
	Bot.	-9.64	-4.14	1.71	1.00	1.00	0.400	0.400
id17	Top	-7.73	4.59	3.85	1.00	1.00	0.400	0.400
	Bot.	-8.45	-5.38	-3.97	1.00	1.00	0.400	0.400
id18	Top	-6.24	4.41	-0.39	1.00	1.00	0.400	0.400
	Bot.	-6.96	-5.21	0.49	1.00	1.00	0.400	0.400
id19	Top	-6.88	2.41	2.35	1.00	1.00	0.400	0.400
	Bot.	-7.60	-2.84	-2.39	1.00	1.00	0.400	0.400
id20	Top	-5.39	2.23	-1.90	1.00	1.00	0.400	0.400
	Bot.	-6.11	-2.67	2.08	1.00	1.00	0.400	0.400

Condition	Pos.	ϕ*Mnxx [Ton*m]	ϕ*Mnyy [Ton*m]	Mc/(ϕ*Mn)	Pu/(ϕ*Pn)	Asreq/Asprov	Demand: Capacity Ratio
id1	Top	11.68	3.35	0.45	0.07	0.87	0.45
	Bot.	-12.46	-2.94	0.50	0.08	0.87	0.50
id2	Top	8.74	4.85	0.83	0.08	0.87	0.83
	Bot.	-9.24	-4.59	0.87	0.08	0.87	0.87
id3	Top	12.03	3.18	0.59	0.07	0.87	0.59
	Bot.	-12.68	-2.83	0.63	0.08	0.87	0.63
id4	Top	10.85	3.77	0.26	0.06	0.87	0.26
	Bot.	-11.73	-3.32	0.26	0.07	0.87	0.26
id5	Top	10.14	-4.14	0.27	0.06	0.87	0.27

	Bot.	-9.44	4.49	0.31	0.07	0.87	0.31
id6	Top	8.18	5.15	0.69	0.05	0.87	0.69
	Bot.	-8.77	-4.84	0.75	0.06	0.87	0.75
id7	Top	12.22	3.14	0.45	0.05	0.87	0.45
	Bot.	-12.87	-2.80	0.51	0.05	0.87	0.51
id8	Top	10.05	4.19	0.13	0.04	0.87	0.13
	Bot.	-11.31	-3.57	0.13	0.05	0.87	0.13
id9	Top	5.01	-6.73	0.24	0.04	0.87	0.24
	Bot.	-5.37	6.54	0.27	0.04	0.87	0.27
id11	Top	11.59	3.36	0.52	0.08	0.87	0.52
	Bot.	-12.23	-3.02	0.47	0.09	0.87	0.47
id12	Top	11.74	3.37	0.29	0.04	0.87	0.29
	Bot.	-12.56	-2.96	0.32	0.05	0.87	0.32
id13	Top	7.70	5.39	0.80	0.08	0.87	0.80
	Bot.	-8.14	-5.16	0.84	0.08	0.87	0.84
id14	Top	16.22	0.19	0.37	0.07	0.87	0.37
	Bot.	-16.21	0.30	0.41	0.07	0.87	0.41
id15	Top	7.68	5.40	0.52	0.07	0.87	0.52
	Bot.	-8.10	-5.18	0.53	0.08	0.87	0.53
id16	Top	10.50	-3.96	0.36	0.06	0.87	0.36
	Bot.	-10.09	4.16	0.41	0.07	0.87	0.41
id17	Top	6.90	5.80	0.66	0.05	0.87	0.66
	Bot.	-7.46	-5.51	0.72	0.06	0.87	0.72
id18	Top	15.13	-1.34	0.29	0.04	0.87	0.29
	Bot.	-15.15	1.43	0.34	0.05	0.87	0.34
id19	Top	6.27	6.11	0.38	0.05	0.87	0.38
	Bot.	-6.89	-5.80	0.41	0.05	0.87	0.41
id20	Top	6.84	-5.83	0.33	0.04	0.87	0.33
	Bot.	-7.23	5.63	0.37	0.04	0.87	0.37

Shear

S provided	:	11.00 [cm]	S required	:	11.25 [cm]
Sini provided	:	0.00 [cm]	Sini required	:	5.63 [cm]

Dir	Condition Gob.	Pos.	Vu [Ton]	Vc [Ton]	Vs [Ton]	ϕ*Vn [Ton]	Vu/(ϕ*Vn)
2	id2	Top	4.64	7.79	8.14	11.95	0.39
		Bot.	4.64	7.84	8.14	11.98	0.39
3	id13	Top	2.62	7.48	4.88	9.27	0.28
		Bot.	2.62	7.52	4.88	9.30	0.28

Notes

* Torsion is not considered for design.

* Only columns with rectangular or circular sections are designed.

* Each column is verified considering only the forces at the ends of the member.

* The transverse reinforcement is ordered from bottom to top of the column.

* Lu = Unsupported length.

* K = Effective length factor.

* Cm = A factor relating actual moment diagram to an equivalent uniform moment diagram.

* Sway = True if column is considered unbraced in its local axis.

* Mc = Factored moment to be used for design. Considers the slenderness effects of the column. Mc = Mu*δns.

* δn2 = Amplification factor to account for small P-delta effects (P-δ).

* Mn = Nominal moment strength.

* Mc/(ϕ*Mn) = Strength ratio. The bar graphs indicate the relative ratio of Mc/(ϕ*Mn) for each load condition. If a bar is shown in red the ratio is greater than one.

Viga mas cargada:

Current Date: 06/05/2014 11:06 p.m.
Units system: Metric

Design Results

Reinforced concrete beams

GENERAL INFORMATION:

Design Code : ACI 318-2005

Load conditions included in the design:

id1 = 1.4DL
id2 = 1.2DL+0.5LL+EQxpo+0.5EQzpo
id3 = 1.2DL+0.5LL+EQxpo+0.5EQzne
id4 = 1.2DL+0.5LL+EQxne+0.5EQzpo
id5 = 1.2DL+0.5LL+EQxne+0.5EQzne
id6 = 0.9DL+EQxpo+0.5EQzpo
id7 = 0.9DL+EQxpo+0.5EQzne
id8 = 0.9DL+EQxne+0.5EQzpo
id9 = 0.9DL+EQxne+0.5EQzne
id11 = 1.2DL+1.6LL
id12 = 0.9DL+1.5V
id13 = 1.2DL+0.5LL+0.5EQxpo+EQzpo
id14 = 1.2DL+0.5LL+0.5EQxpo+EQzne
id15 = 1.2DL+0.5LL+0.5EQxne+EQzpo
id16 = 1.2DL+0.5LL+0.5EQxne+EQzne
id17 = 0.9DL+0.5EQxpo+EQzpo
id18 = 0.9DL+0.5EQxpo+EQzne
id19 = 0.9DL+0.5EQxne+EQzpo
id20 = 0.9DL+0.5EQxne+EQzne

Moment frame : Ordinary

Materials

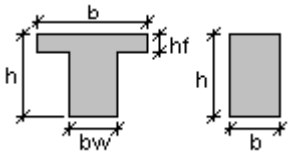
Concrete, f'c	: 0.21 [Ton/cm2]	Longitudinal reinforcement, fy	: 4.22 [Ton/cm2]
Concrete type	: Normal	Transversal reinforcement, fyt	: 4.22 [Ton/cm2]
Concrete elasticity modulus	: 219.50 [Ton/cm2]	Steel elasticity modulus	: 2038.89 [Ton/cm2]
Unit weight	: 2.40 [Ton/m3]	Epoxy coated	: No

DATA AND RESULTS

Status : OK

Geometry

Axis	Col position	Bottom width [cm]	Top width [cm]	Dist x [m]
1	Center	25.00	0.00	0.00
2	Center	25.00	0.00	7.30

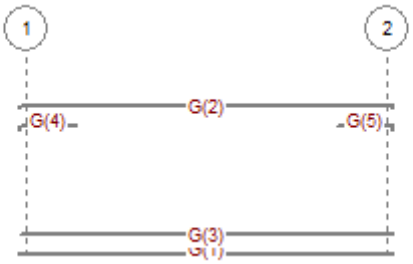


Span	Dist between axes [m]	Member No	Section	b [cm]	h [cm]	bw [cm]	hf [cm]
1-2	7.30	42	•	30.00	90.00	--	--

Rebar

Free cover : 2.00 [cm]

Longitudinal reinforcement



Group	Quantity	Diameter	Pos	Ref. Axis 1	Dist1 [m]	Ref. Axis 2	Dist2 [m]	Hook1	Hook2
1	2	20mm	Bottom	1	-0.11	2	0.11	Yes	Yes
2	2	12mm	Top	1	-0.11	2	0.11	Yes	Yes
3	4	20mm	Bottom	1	-0.11	2	0.11	No	No
4	1	12mm	Top	1	-0.11	1	1.00	Yes	No
5	1	12mm	Top	2	-1.00	2	0.11	No	Yes

Development and splice lengths

Group	Diameter	Ld [cm]	Ldh [cm]	Splice L. [cm]	Total L [m]
1	20mm	88.00	32.00	114.00	8.06
2	12mm	70.00	20.00	90.00	7.84
3	20mm	88.00	32.00	114.00	7.52
4	12mm	70.00	20.00	90.00	1.28
5	12mm	70.00	20.00	90.00	1.28

Transverse reinforcement

Span	Diameter	Quantity	c/ [cm]	Legs	Closed
1-2	6mm	48	15.00	2	Yes

Initial spacing of stirrups:

Span	Initial S [cm]	Sin lim [cm]
0-1	0.00	44.00

FLEXURE

Span: 1-2 **Member No: 42**

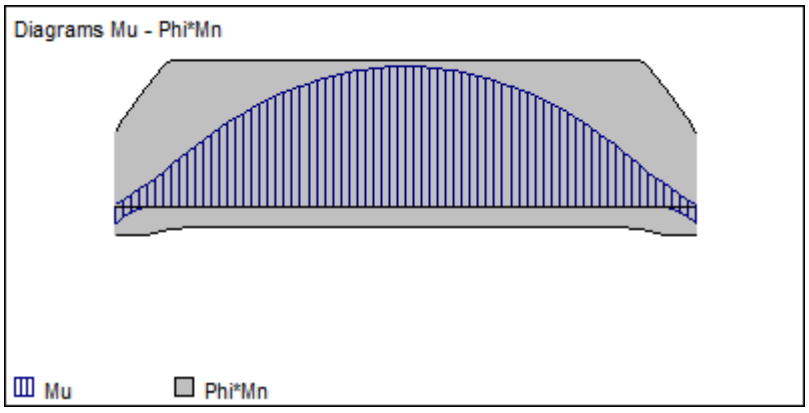
Percentage of moment redistribution	Support A = 0.00%	Support B = 0.00%
Code specified max Rho:	ρ maxtop= 1.55%	ρ maxbot= 1.55%
Limit spacing between bars for cracking control:	sblim = 30.48 [cm]	

Positive bending moments

Station No.	Dist	**d**[cm]	**Mu**[Ton*m]	**ϕ*Mn**[Ton*m]	**Asreq**[cm2]	**Asprov**[cm2]	**ρ (%)**	**sb**[cm]	**Mu/(ϕ*Mn)**
1	0%	84.89	0.83	27.88	0.34	9.03	0.35	5.47	0.60
2	10%	84.89	16.32	55.43	6.92	18.84	0.74	5.47	0.29
3	20%	84.89	32.43	55.43	10.58	18.84	0.74	5.47	0.59
4	30%	84.89	43.94	55.43	14.62	18.84	0.74	5.47	0.79
5	40%	84.89	50.86	55.43	17.14	18.84	0.74	5.47	0.92
6	50%	84.89	53.18	55.43	18.00	18.84	0.74	5.47	0.96
7	60%	84.89	50.89	55.43	17.15	18.84	0.74	5.47	0.92
8	70%	84.89	44.01	55.43	14.65	18.84	0.74	5.47	0.79
9	80%	84.89	32.52	55.43	10.61	18.84	0.74	5.47	0.59
10	90%	84.89	16.45	55.43	6.97	18.84	0.74	5.47	0.30
11	100%	84.89	0.90	27.88	0.37	9.03	0.35	5.47	0.59
C	50%	84.89	53.18	55.43	18.00	18.84	0.74	5.47	0.96

Negative bending moments

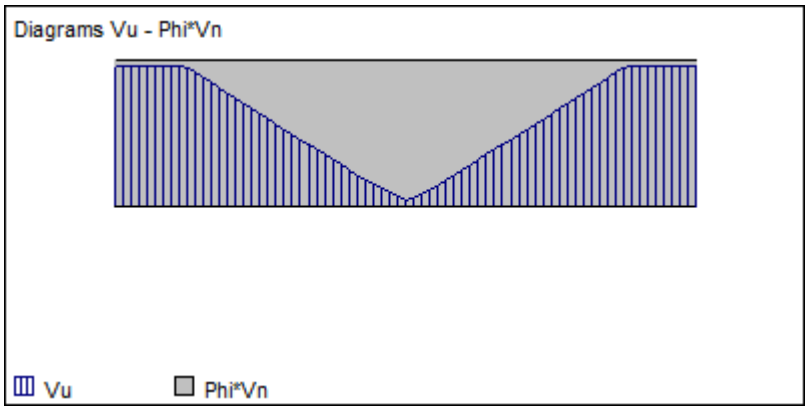
Station No.	Dist	**d**[cm]	**Mu**[Ton*m]	**ϕ*Mn**[Ton*m]	**Asreq**[cm2]	**Asprov**[cm2]	**ρ (%)**	**sb**[cm]	**Mu/(ϕ*Mn)**
1	0%	86.80	-6.60	-11.00	2.69	3.39	0.13	10.00	0.60
2	10%	86.80	0.00	-8.55	0.00	2.63	0.10	10.00	0.29
3	20%	86.80	0.00	-7.37	0.00	2.26	0.09	21.20	0.59
4	30%	86.80	0.00	-7.37	0.00	2.26	0.09	21.20	0.79
5	40%	86.80	0.00	-7.37	0.00	2.26	0.09	21.20	0.92
6	50%	86.80	0.00	-7.37	0.00	2.26	0.09	21.20	0.96
7	60%	86.80	0.00	-7.37	0.00	2.26	0.09	21.20	0.92
8	70%	86.80	0.00	-7.37	0.00	2.26	0.09	21.20	0.79
9	80%	86.80	0.00	-7.37	0.00	2.26	0.09	21.20	0.59
10	90%	86.80	0.00	-8.55	0.00	2.63	0.10	10.00	0.30
11	100%	86.80	-6.47	-11.00	2.64	3.39	0.13	10.00	0.59
C	50%	86.80	0.00	-7.37	0.00	2.26	0.09	21.20	0.96



SHEAR AND TORSION

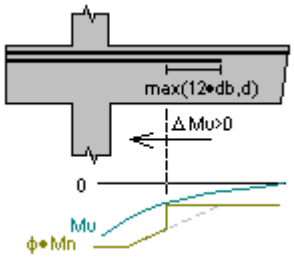
Span: 1-2 **Member No: 42**

Station		Stirrups		Spcprov	Spclim	Tu	ϕ*Tn	Al	Vu	Vs	Vc	ϕ*Vn	Vu/(ϕ*Vn)
No.	Dist	Diam	VCT	[cm]	[cm]	[Ton*m]	[Ton*m]	[cm2]	[Ton]	[Ton]	[Ton]	[Ton]	
1	0%	6mm	V	15.00	16.48	0.01	0.88	0.00	23.93	13.51	19.61	24.84	0.96
2	10%	6mm	V	15.00	16.48	0.01	0.88	0.00	23.93	13.51	19.61	24.84	0.96
3	20%	6mm	V	15.00	22.64	0.01	1.29	0.00	18.92	13.51	19.61	24.84	0.76
4	30%	6mm	V	15.00	22.64	0.01	2.20	0.00	12.62	13.51	19.61	24.84	0.51
5	40%	6mm		15.00	22.64	0.01	2.20	0.00	6.32	13.51	19.61	24.84	0.25
6	50%	6mm		15.00	22.64	0.01	2.20	0.00	0.87	13.51	19.61	24.84	0.04
7	60%	6mm		15.00	22.64	0.01	2.20	0.00	6.28	13.51	19.61	24.84	0.25
8	70%	6mm	V	15.00	22.64	0.01	2.20	0.00	12.58	13.51	19.61	24.84	0.51
9	80%	6mm	V	15.00	22.64	0.01	1.30	0.00	18.88	13.51	19.61	24.84	0.76
10	90%	6mm	V	15.00	16.56	0.01	0.88	0.00	23.89	13.51	19.61	24.84	0.96
11	100%	6mm	V	15.00	16.56	0.01	0.88	0.00	23.89	13.51	19.61	24.84	0.96
C	0%	6mm	V	15.00	16.48	0.01	0.88	0.00	23.93	13.51	19.61	24.84	0.96



Notes

* Only the design bending forces (Mu), shear forces (Vu) and torsion moments (Tu) are considered in the design.
* Values shown in red are not in compliance with a provision of the code
* The positive and negative flexural reinforcement includes the longitudinal reinforcement required to resist torsion. Refer to the note below on the VCT column to determine when torsion and compression bars are provided. The longitudinal reinforcement area considers the minimum area required by Code (10.5).
* When the moments diagram increases in the same direction of the development length of the bars, the bars will not contribute to the member strength for a Code specified distance equal to max(12*db,d).



* If the section at which member flexural strength is being calculated is within the development length of a group of bars, the bars will contribute to the bending capacity an amount proportional to their actual length / their full development length.
* The transverse reinforcement is ordered from left to right.
* The program does not consider ACI318-05 section 12.11.3 whereby the bar diameter is limited according to the location of the bar cut-off.
* Asprov is the provided reinforcement, considering the reduction due to the development length as described previously.
* "C" shows the span critical station.
* Ld,Ldh = Development length of each bar. If the bar ends with a hook, it considers the Ldh length.
* Splice lengths shown are not reduced by the factor Asreq/Asprov.
* sb = Free distance between top or bottom bars corresponding to the layer closest to the extreme face of the beam (layer1). It is not calculated when there is only one bar.
* Stirrups VCT = Flag that determines if stirrups are required to resist shear forces (V), torsion (T) or to confine the the longitudinal compression bars from buckling (C).
* Closed = Flag that indicates if the stirrups are closed (yes) or open (no).

* Mu/(ϕ*Mn) = Critical strength ratio for the station. If the value is in red, it is larger than 1.0
* Al = Total additional longitudinal reinforcement required by torsion.
* Spa = stirrup spacing provided by the user.
* Spa lim = spacing limits due to geometry. (11.5.5.1, 11.5.5.3, 21.3.3.2, 21.12.4.2)