Anexo 2. Análisis Estructural

DATOS DE ENTRADA

GENERAL INPUT DATA

Structure type: Continuous Beam

Number of Spans . . . . . = 7

Total Beam length . . . . = 18.38 m

Bay	Span
1-2	3.99
2-3	3.71
3-4	2.05
4-5	3.10
5-6	0.50
6-7	5.03

* Span in (m)

N O D E D A T A

Axis	Floor	X	Y	Z	Axis	Floor	X	Y	Z
A-1	1	0.00	0.00	0.00	A-2	1	3.99	0.00	0.00
A-3	1	7.70	0.00	0.00	A-4	1	9.75	0.00	0.00
A-5	1	12.85	0.00	0.00	A-6	1	13.35	0.00	0.00
A-7	1	18.38	0.00	0.00					

M A T E R I A L S

Number of materials = 1

REINFORCED CONCRETE

Mat	Name	f'c (MPa)	fy (MPa)	fys1 (MPa)	fys2 (MPa)	E (MPa)	G (MPa)	w (N/m3)
1	RConcrete1	21	420	420	420	21538	8743	24000.0

M E M B E R D A T A

Total number of beams..... = 5

B E A M S E C T I O N S

Number of prismatic sections = 3

Sec	Name	Shape	b (mm)	h (mm)	tw (mm)	tf (mm)	P1 (mm)	P2 (mm)	A (mm2)	I2 (mm4)	I3 (mm4)	J (mm4)
1	Beam1	Rectang	300	450	-	-	-	-	135000	2.28E+09	1.01E+09	2.35E+09
2	30X30	Rectang	300	300	-	-	-	-	90000	6.75E+08	6.75E+08	9.99E+08
3	30X40	Rectang	300	400	-	-	-	-	120000	1.60E+09	9.00E+08	1.90E+09

BEAMS

Beam	Floor	L (m)	Lu (m)	a (m)	c (m)	Sec -	Mat -	System -
A(1-2)	1	3.99	3.99	0.00	0.00	2	1	G&L
A(2-3)	1	3.71	3.71	0.00	0.00	2	1	G&L
A(3-4)	1	2.05	2.05	0.00	0.00	2	1	G&L
A(4-5)	1	3.10	3.10	0.00	0.00	2	1	G&L
A(6-7)	1	5.03	5.03	0.00	0.00	3	1	G&L

G R O U N D S U P P O R T D A T A

Total number of ground supports = 7

K = Spring constant(kN/mm)

Characteristics for All Degrees of Freedom

Value = K Dash = free C = constrained

Support	Type	Uy	Uz	TetX
A-1	Hinge	C	C	-
A-2	Hinge	C	C	-
A-3	Hinge	C	C	-
A-4	Hinge	C	C	-
A-5	Hinge	C	C	-
A-6	Hinge	C	C	-
A-7	Hinge	C	C	-

S U M M A R Y O F T O T A L F L O O R L O A D S

LOAD CASE 1 : SELFW (D0)

	Force (kN)			Moment (kN-m)		
Floor	Px	Py	Pz	Mx	My	Mz
1	0.00	0.00	42.24	0.0	0.0	0.0
Total	0.00	0.00	42.24	0.0	0.0	0.0

L O A D S

Total number of load cases = 3

LOAD CASE 1 : SELFW (D0)

Number of nodal loads .... = 0

Number of beam loads ..... = 5

Beam Loads (D0)

Class = F: Force M: Moment

System = L: Local Force/Moment referred to local coordinates (1, 2, 3)

G: Global Force/Moment referred to global coordinates (X, Y, Z)

Axis = (1, 2, 3) if System = L, or (X, Y, Z) if System = G

Units = Distributed Force: (kN/m), Distributed Moment: (kN-m/m)

Concentrated Force: (kN), Concentrated Moment: (kN-m)

		Distributed Force/Moment							Concentrated Force/Moment					
Beam	Floor	Class	Sys	Axis	A/L	B/L	Wi	Wj	Class	Sys	A/L	P1\Px	P2\Py	P3\Pz
A(1-2)	1	F	G	Z	0.00	1.00	2.2	2.2	-	-	-	-	-	-
A(2-3)	1	F	G	Z	0.00	1.00	2.2	2.2	-	-	-	-	-	-
A(3-4)	1	F	G	Z	0.00	1.00	2.2	2.2	-	-	-	-	-	-
A(4-5)	1	F	G	Z	0.00	1.00	2.2	2.2	-	-	-	-	-	-
A(6-7)	1	F	G	Z	0.00	1.00	2.9	2.9	-	-	-	-	-	-

LOAD CASE 2 : MUERTA (DL)

Number of nodal loads .... = 0

Number of beam loads ..... = 5

Beam Loads (DL)

Class = F: Force M: Moment

System = L: Local Force/Moment referred to local coordinates (1, 2, 3)

G: Global Force/Moment referred to global coordinates (X, Y, Z)

Axis = (1, 2, 3) if System = L, or (X, Y, Z) if System = G

Units = Distributed Force: (kN/m), Distributed Moment: (kN-m/m)

Concentrated Force: (kN), Concentrated Moment: (kN-m)

		Distributed Force/Moment							Concentrated Force/Moment					
Beam	Floor	Class	Sys	Axis	A/L	B/L	Wi	Wj	Class	Sys	A/L	P1\Px	P2\Py	P3\Pz
A(1-2)	1	F	G	Z	0.00	1.00	9.0	9.0	-	-	-	-	-	-
A(2-3)	1	F	G	Z	0.00	1.00	9.0	9.0	-	-	-	-	-	-
A(3-4)	1	F	G	Z	0.00	1.00	9.0	9.0	-	-	-	-	-	-
A(4-5)	1	F	G	Z	0.00	1.00	9.0	9.0	-	-	-	-	-	-
A(6-7)	1	F	G	Z	0.00	1.00	9.0	9.0	-	-	-	-	-	-

LOAD CASE 3 : VIVA (LL)

Number of nodal loads .... = 0

Number of beam loads ..... = 5

Beam Loads (LL)

Class = F: Force M: Moment

System = L: Local Force/Moment referred to local coordinates (1, 2, 3)

G: Global Force/Moment referred to global coordinates (X, Y, Z)

Axis = (1, 2, 3) if System = L, or (X, Y, Z) if System = G

Units = Distributed Force: (kN/m), Distributed Moment: (kN-m/m)

Concentrated Force: (kN), Concentrated Moment: (kN-m)

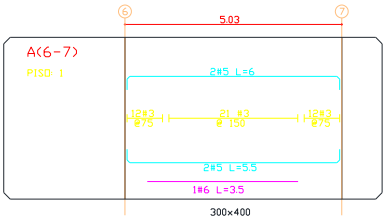
		Distributed Force/Moment							Concentrated Force/Moment					
Beam	Floor	Class	Sys	Axis	A/L	B/L	Wi	Wj	Class	Sys	A/L	P1\Px	P2\Py	P3\Pz
A(1-2)	1	F	G	Z	0.00	1.00	6.0	6.0	-	-	-	-	-	-
A(2-3)	1	F	G	Z	0.00	1.00	6.0	6.0	-	-	-	-	-	-
A(3-4)	1	F	G	Z	0.00	1.00	6.0	6.0	-	-	-	-	-	-
A(4-5)	1	F	G	Z	0.00	1.00	6.0	6.0	-	-	-	-	-	-
A(6-7)	1	F	G	Z	0.00	1.00	6.0	6.0	-	-	-	-	-	-

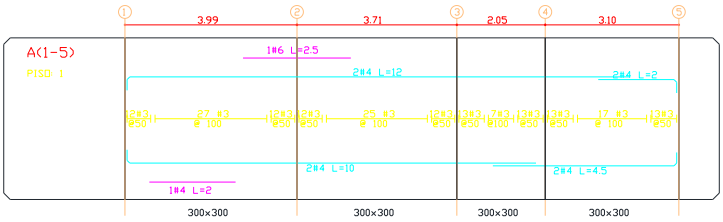
SUMMARY QUANTITY OF MATERIALS

B E A M S

Item	Section	Material	Length	Weight/Len	Total Weight
-	-	-	m	kN/m	kN
1	30X30	RConcrete1	12.85	2.160	27.76
2	30X40	RConcrete1	5.03	2.880	14.49
				TOTAL =	42.24

DESPIECE DE VIGAS





REACCIÓN EN LOS APOYOS

Linear Analysis- Support Reactions

Support	Load	Force (kN)	Moment (kN-m)

Axis	Floor	LdComb	Fx	Fy	Fz	Mx	My	Mz
A-1	1	1	0.00	0.00	24.48	0.00	0.00	0.00
	2		0.00	0.00	36.03	0.00	0.00	0.00
A-2	1	1	0.00	0.00	71.48	0.00	0.00	0.00
	2		0.00	0.00	105.19	0.00	0.00	0.00
A-3	1	1	0.00	0.00	38.83	0.00	0.00	0.00
	2		0.00	0.00	57.14	0.00	0.00	0.00
A-4	1	1	0.00	0.00	45.83	0.00	0.00	0.00
	2		0.00	0.00	67.44	0.00	0.00	0.00
A-5	1	1	0.00	0.00	20.15	0.00	0.00	0.00
	2		0.00	0.00	29.65	0.00	0.00	0.00
A-6	1	1	0.00	0.00	41.83	0.00	0.00	0.00
	2		0.00	0.00	60.00	0.00	0.00	0.00
A-7	1	1	0.00	0.00	41.83	0.00	0.00	0.00
	2		0.00	0.00	60.00	0.00	0.00	0.00

LOAD COMBINATIONS

No	Load combination

1	1.4D0 + 1.4DL
2	1.2D0 + 1.2DL + 1.6LL

RESULTADOS DE DISEÑO

LOAD COMBINATIONS

No	Load combination
1	1.4D0 + 1.4DL
2	1.2D0 + 1.2DL + 1.6LL

M A T E R I A L S

Number of materials = 1

REINFORCED CONCRETE

Mat	Name	f'c (MPa)	fy (MPa)	fys1 (MPa)	fys2 (MPa)	E (MPa)	G (MPa)	w (N/m3)
1	RConcrete1	21	420	420	420	21538	8743	24000.0

B E A M S E C T I O N S

Number of prismatic sections = 3

Sec Name Shape b h tw tf P1 P2 A I2 I3 J

(mm) (mm) (mm) (mm) (mm) (mm) (mm2) (mm4) (mm4) (mm4)

___ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____

1 Beam1 Rectang 300 450 - - - - 135000 2.28E+09 1.01E+09 2.35E+09

2 30X30 Rectang 300 300 - - - - 90000 6.75E+08 6.75E+08 9.99E+08

3 30X40 Rectang 300 400 - - - - 120000 1.60E+09 9.00E+08 1.90E+09

Design Results - Beams (DMO)

BEAM: A(1-2) FLOOR: 1

==========

Length: L = 3.99 m a = 0.00 m Section: b = 300.00 mm Sec: 30X30

Lu = 3.99 m c = 0.00 m h = 300.00 mm Mat: RConcrete1

X, m: 0.00 0.40 0.80 1.20 1.60 2.00 2.39 2.79 3.19 3.59 3.99

Mu(-), kN-m: -7.85 -7.85 -7.85 -7.85 -7.85 -7.85 -7.85 -7.85 -7.85 -18.87 -39.27

Mu(+), kN-m: 7.85 12.54 21.43 26.65 28.22 26.12 20.36 10.95 7.85 7.85 13.09

As(-), mm2: 236 236 236 236 236 236 236 236 236 236 469

As(+), mm2: 236 236 246 309 329 303 236 236 236 236 236

Vu, kN: 36.67 33.58 25.85 18.11 10.51 19.24 26.97 34.71 42.45 50.19 53.27

Tu, kN-m: 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

Stirrup: #3 #3 #3 #3 #3 #3 #3 #3 #3 #3 #3

Spacing, mm: 50 50 100 100 100 100 100 100 100 50 50

DESIGN

A-1 12 #3 @ 50 27 #3 @ 100 12 #3 @ 50 A-2

BEAM: A(2-3) FLOOR: 1

==========

Length: L = 3.71 m a = 0.00 m Section: b = 300.00 mm Sec: 30X30

Lu = 3.71 m c = 0.00 m h = 300.00 mm Mat: RConcrete1

X, m:	0.00	0.37	0.74	1.11	1.48	1.86	2.23	2.60	2.97	3.34	3.71
Mu(-), kN-m:	-39.27	-22.49	-8.88	-7.85	-7.85	-7.85	-7.85	-7.85	-7.85	-7.85	-13.93
Mu(+), kN-m:	13.09	7.85	7.85	7.85	8.84	12.96	13.91	11.69	7.85	7.85	7.85
As(-), mm2:	469	259	236	236	236	236	236	236	236	236	236
As(+), mm2:	236	236	236	236	236	236	236	236	236	236	236
Vu, kN:	50.23	47.69	39.25	30.72	22.19	13.66	8.53	17.06	25.59	34.12	37.13
Tu, kN-m:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stirrup:	#3	#3	#3	#3	#3	#3	#3	#3	#3	#3	#3
Spacing, mm:	50	50	100	100	100	100	100	100	100	50	50

DESIGN

A-2 12 #3 @ 50 25 #3 @ 100 12 #3 @ 50 A-3

BEAM: A(3-4) FLOOR: 1

==========

Length: L = 2.05 m a = 0.00 m Section: b = 300.00 mm Sec: 30X30

Lu = 2.05 m c = 0.00 m h = 300.00 mm Mat: RConcrete1

X, m:	0.00	0.21	0.41	0.62	0.82	1.03	1.23	1.44	1.64	1.85	2.05
Mu(-), kN-m:	-13.93	-10.05	-7.13	-5.17	-4.19	-4.17	-5.11	-7.02	-9.90	-13.74	-18.55
Mu(+), kN-m:	4.64	3.71	3.71	3.71	3.71	3.71	3.71	3.71	3.71	3.71	6.18
As(-), mm2:	236	236	236	236	236	236	236	236	236	236	236
As(+), mm2:	236	236	236	236	236	236	236	236	236	236	236
Vu, kN:	18.05	18.05	14.14	9.43	4.71	4.51	9.22	13.93	18.65	22.55	22.55
Tu, kN-m:	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stirrup:	#3	#3	#3	#3	#3	#3	#3	#3	#3	#3	#3

Spacing, mm: 50 50 50 100 100 100 100 100 50 50 50

DESIGN

A-3 13 #3 @ 50 7 #3 @ 100 13 #3 @ 50 A-4

BEAM: A(4-5) FLOOR: 1

==========

Length: L = 3.10 m a = 0.00 m Section: b = 300.00 mm Sec: 30X30

Lu = 3.10 m c = 0.00 m h = 300.00 mm Mat: RConcrete1

X, m: 0.00 0.31 0.62 0.93 1.24 1.55 1.86 2.17 2.48 2.79 3.10

Mu(-), kN-m: -18.55 -6.75 -3.71 -3.71 -3.71 -3.71 -3.71 -3.71 -3.71 -3.71 -3.71

Mu(+), kN-m: 6.18 3.71 3.71 10.21 15.38 18.34 19.09 17.63 13.97 8.09 3.71

As(-), mm2: 236 236 236 236 236 236 236 236 236 236 236

As(+), mm2: 236 236 236 236 236 236 236 236 236 236 236 236

Vu, kN: 37.10 35.74 29.73 23.72 17.71 11.70 7.13 13.63 19.64 25.65 27.01

Tu, kN-m: 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

Stirrup: #3 #3 #3 #3 #3 #3 #3 #3 #3 #3 #3

Spacing, mm: 50 50 100 100 100 100 100 100 100 50 50

DESIGN

A-4 13 #3 @ 50 17 #3 @ 100 13 #3 @ 50 A-5

BEAM: A(6-7) FLOOR: 1

==========

Length: L = 5.03 m a = 0.00 m Section: b = 300.00 mm Sec: 30X40

Lu = 5.03 m c = 0.00 m h = 400.00 mm Mat: RConcrete1

X, m: 0.00 0.50 1.01 1.51 2.01 2.51 3.02 3.52 4.02 4.53 5.03

Mu(-), kN-m: 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

Mu(+), kN-m: 0.00 27.16 48.29 63.38 72.43 75.45 72.43 63.38 48.29 27.16 0.00

As(-), mm2: 335 335 335 335 335 335 335 335 335 335 335

As(+), mm2: 335 335 394 525 606 633 606 525 394 335 335

Vu, kN: 51.89 48.00 36.00 24.00 12.00 0.00 12.00 24.00 36.00 48.00 51.89

Tu, kN-m: 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

Stirrup: #3 #3 #3 #3 #3 #3 #3 #3 #3 #3 #3

Spacing, mm: 75 75 150 150 150 150 150 150 150 75 75

DESIGN

A-6 12 #3 @ 75 21 #3 @ 150 12 #3 @ 75 A-7

LONG-TERM BEAM DEFLECTIONS

PERMISSIBLE DEFLECTIONS

Immediate deflection due to Live Load . . . . . = L/360

Long-term deflection due to Sustained loads . . = L/480

TYPE OF DEFLECTION LOAD COMBINATION

Immediate due to Dead load (DLs) D0 + DL

Immediate due to Live load (LLs)* LL

Immediate due to Sus. load (SLds) D0 + DL + .25LL

Long-term due to Sus. load (SLds) D0 + DL + .25LL

* Computed as Defl(DLS + LLs) - Defl(DLs)

Units: Defl: Max. deflection (mm), L: Beam length (m), h: Beam depth (mm)

							IMMEDIATE DEFLECTIONS			ADDITIONAL LONG-TERM DEFLEC. Sus.Lds	
							DLs	Live	Sut.Lds	6 months	1-year	5-years
Beam	Floor	h	L	L/h	Beam Type		Deflc	Deflc	Deflc	Deflc	Deflc	Deflc
A(1-2)	1	300	3.99	13	EndJContin		1.46	3.92	2.22	2.28	2.66	3.81
A(2-3)	1	300	3.71	12	BothEndCnt		0.38	0.74	0.44	0.45	0.52	0.75
A(3-4)	1	300	2.05	7	BothEndCnt		0.11	0.06	0.12	0.13	0.15	0.21

A(4-5)	1	300	3.10	10	EndIContin	0.55	0.55	0.63	0.64	0.75	1.07
A(6-7)	1	400	5.03	13	SimpSupprt	6.55	6.80	8.30	8.55	9.98	14.25*

NOTE: * Deflections on marked beams are greater than maximum permissible deflection

Depth, H, of all beams is larger than that recomemenden in Table 9.5(a)

Immediate deflections are computed according to 9.5.2.3 with:

Effective stiffness: E I = Ec . Ie

$$Ie = (Mcr/Ma)^3 \, Ig + [1 - (Mcr/Ma)^3] \, Icr$$

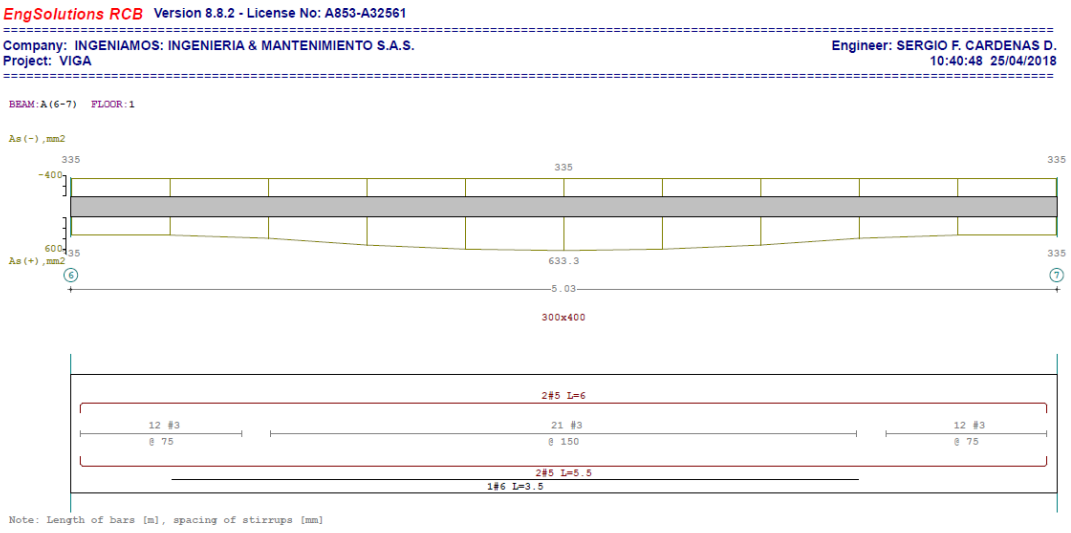
$$Mcr = fr \, Ig/Yt$$

$$Icr = b(kd)^3/3 + n \, As(d-kd)^1 + (n-1)A's(kd-d')^2$$

$$n = Es/Ec$$

Long-term deflections are computed according to 9.5.2.5

VIGA 1 LUZ

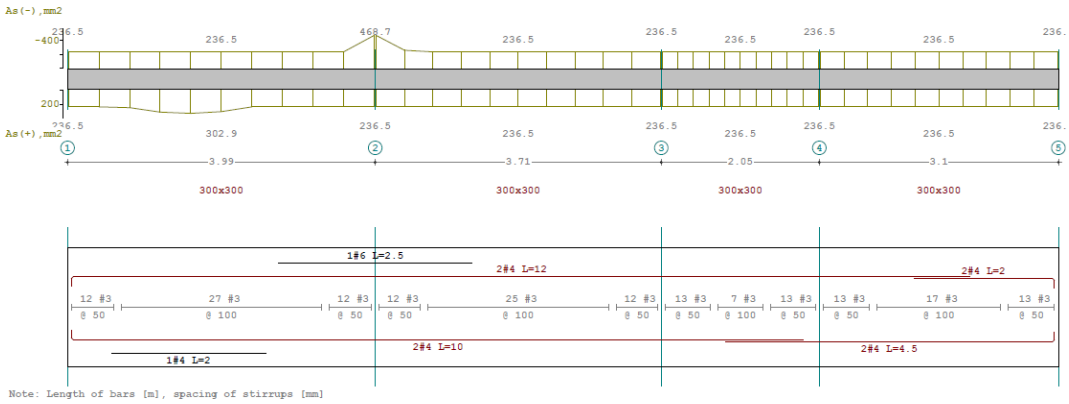


VIGA 4 LUZ

EngSolutions RCB **Version 8.8.2 - License No: A853-A32561**

Company: INGENIAMOS: INGENIERIA & MANTENIMIENTO S.A.S. **Engineer: SERGIO F. CARDENAS D.**
Project: VIGA **10:40:39 25/04/2018**

BEAM:A(1-5) FLOOR:1



Note: Length of bars [m], spacing of stirrups [mm]