UNTAR
Universitas Tarumanagara

UNTAR untuk INDONESIA

SURAT TUGAS
Nomor: 24-R/UNTAR/Pengabdian/II/2023

Rektor Universitas Tarumanagara, dengan ini menugaskan kepada saudara:

1. HENDY WIJAYA, S.T., M.T.
2. EDISON LEO., S.T., M.T.

Untuk melaksanakan kegiatan pengabdian kepada masyarakat dengan data sebagai berikut:

Judul	:	Review Desain Perencanaan Balok Prategang Pada Proyek Erha Semarang
Mitra	:	Ir Mulyani
Periode	:	I/2022-2023/September 2022
URL Repository	:	-

Demikian Surat Tugas ini dibuat, untuk dilaksanakan dengan sebaik-baiknya dan melaporkan hasil penugasan tersebut kepada Rektor Universitas Tarumanagara

16 Februari 2023
Rektor

Prof. Dr. Ir. AGUSTINUS PURNA IRAWAN

Print Security : ea7d891b170254a5dc5d70bc45031d78

Disclaimer: Surat ini dicetak dari Sistem Layanan Informasi Terpadu Universitas Tarumanagara dan dinyatakan sah secara hukum.

LAPORAN KEGIATAN PENGABDIAN KEPADA MASYARAKAT (PKM) DOSEN

REVIEW DESAIN PERENCANAAN BALOK PRATEGANG PADA PROYEK ERHA SEMARANG

SEMESTER GANJIL 2022/2023

Oleh:
Hendy Wijaya, S.T., M.T. [0323019101]
Anggota:
Edison Leo, S.T., M.T. [0310107904]
Darryl Sebastian [325200022]

Program Studi Sarjana Teknik Sipil
Fakultas Teknik
Universitas Tarumanagara
Jakarta
Desember 2022

SURAT PERMOHONAN

PT. FURTALI MOELLIA
CONTRACTOR / LEVERANSIR & PERDAGANGAN UMUM
Gading Griya Lestari Blok D.1 / 31, Telp. 4403457
Jakarta - Utara 14140

Kepada Yth.
Bapak Hendy Wijaya, S.T., M.T.
Bapak Edison Leo, S.T., M.T.
Dosen Universitas Tarumanagara
Jakarta

Dengan hormat,

Bersama surat ini, kami mengajukan permohonan dukungan tenaga ahli bidang Struktur dari tim Bapak Hendy Wijaya dan Bapak Edison Leo, untuk membantu melakukan review desain perencanaan balok prategang pada proyek Erha, Semarang. Pekerjaan ini agar dapat dilaksanakan selama 2 (dua) bulan dimulai dari tanggal 05 September 2022 hingga 05 November 2022.

Demikian surat ini disampaikan, atas perhatian dan kerjasamanya diucapkan banyak terima kasih.

Jakarta, 01 September 2022

PT. FURTALI MOELLIA

Ir. Mulyani

RINGKASAN

Proyek Erha merupakan bangunan kantor 4 lantai yang berlokasi di kota Semarang, Jawa Tengah. Sebelum kegiatan PKM ini berlangsung, pihak Mitra selaku kontraktor telah melakukan review desain struktur yang diterima dari konsultan perencana. Dikarenakan terdapat balok-balok kantilever yang panjang di lantai dua dan lantai tiga pada desain bangunan ini, menyebabkan adanya kebutuhan balok prategang agar mampu memikul beban-beban pada bentangan balok kantilever tersebut. Adanya kebutuhan tenaga ahli di bidang Teknik Sipil dalam membantu melakukan evaluasi desain perencanaan balok prategang, maka pihak Mitra menghubungi tim PKM untuk ikut terlibat dalam kegiatan pembangunan ini. Kegiatan yang dipercayakan kepada tim PKM ini meliputi evaluasi desain balok prategang berdasarkan Standar Nasional Indonesia (SNI) yang akan digunakan sebagai acuan kerja kontraktor pembangunan.

Lama pekerjaan 2 bulan dimulai dari tanggal 05 September 2022 sampai dengan tanggal 05 November 2022.

KATA PENGANTAR

Puji syukur dipanjatkan kehadirat Tuhan Yang Maha Esa, dengan telah terlaksananya kegiatan Pengabdian Kepada Masyarakat berupa *Review* Desain Perencanaan Balok Prategang pada Proyek Erha Semarang, sesuai bidang keahlian ilmu Teknik Sipil. Kegiatan Pengabdian Masyarakat ini berupa pekerjaan evaluasi disain struktur balok prategang yang sesuai Standar Nasional Indonesia yang berlaku.

Waktu pelaksanaan dimulai dari tanggal 05 September 2022 sampai dengan 05 November 2022. Pelaksanaan kegiatan ini melibatkan tim dosen terdiri dari 2 dosen Program Studi Sarjana Teknik Sipil Universitas Tarumanagara yang terdiri dari ketua Hendy Wijaya, S.T., M.T., dan anggota Edison Leo, S.T., M.T., yang secara bersama-sama bertugas melakukan evaluasi disain struktur balok prategang, serta satu mahasiswa atas nama Darryl Sebastian (325200022) yang bertugas untuk mengumpulkan data-data perencanaan dan membantu menyusun laporan.

Pemberi tugas adalah Ir. Mulyani selaku kontraktor pembangunan bangunan ini.

Terima kasih kami ucapkan kepada Pimpinan Fakultas Teknik Universitas Tarumanagara dan Pimpinan Program Studi Sarjana Teknik Sipil, yang telah memberi kesempatan kepada tim dosen dan mahasiswa Program Studi Studi Sarjana Teknik Sipil Fakultas Teknik Universitas Tarumanagara untuk melaksanakan kegiatan Pengabdian Kepada Masyarakat.

Jakarta, Desember 2022

DAFTAR ISI

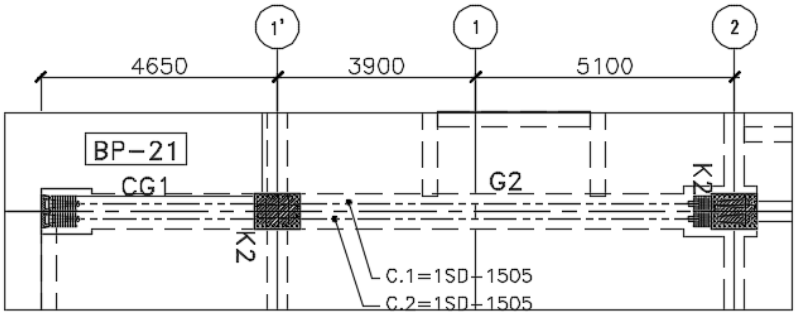
LOSSES AND BALANCING LOAD CALCULATION

2^{ND} AND 3^{RD} FLOOR PRESTRESS BEAM

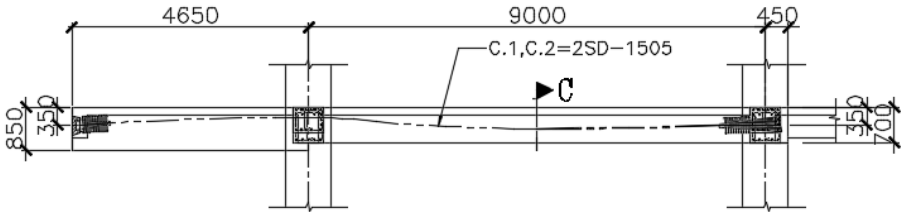
BALANCING LOAD

2ND AND 3RD FLOOR PRESTRESS BEAM

1. BP – 21 AND BP - 31

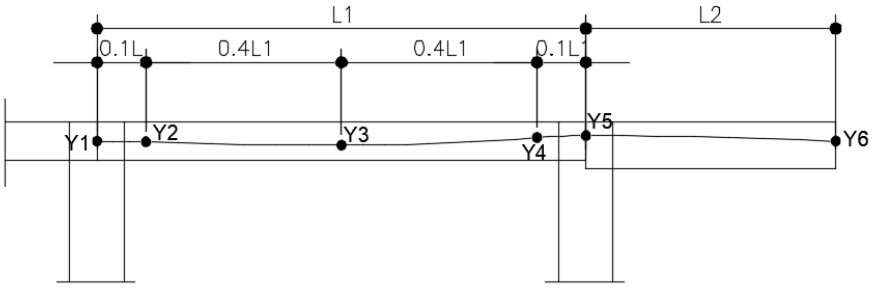


PLAN VIEW BP-21 (700x850/700)



CABLE PROFILE BP-21 (700x850/700)

Cable Profile Type :



Cable Coordinate :

Cable No.	Strand	Cable Coordinate from Top of Beam(mm)					
		Y1	Y2	Y3	Y4	Y5	Y6
C1	15SD05	350	365	425	245	200	350
C2	15SD05	350	365	425	245	200	350
Average Coordinate		**350**	**365**	**425**	**245**	**200**	**350**

1.1. Beam Section Properties :

- Slab Thickness = 150 mm
- Back Span
  - Beam Dimension
    - Width = 700 mm
    - Height = 700 mm
  - Beam Length

    Prismatic Section (Total Length = 9.00 m)
    - Section 1 (T-Beam)

      Effective Width (Beff) = 2250 mm

Section	b (mm)	h (mm)	ytop (mm)	A (mm^2)	A.y (mm^3)	I (mm^4)	
1	2250	150	75	337,500	25,312,500	6.33E+08	1.17E+10
2	700	550	425	385,000	163,625,000	9.71E+09	1.03E+10
Total				**722,500**	**188,937,500**	**3.24E+10**	

ytop	261.51	mm
ybottom	438.49	mm
Area	7.23E+05	mm^2
Inertia	3.24E+10	mm^4

- Cantilever
  - Beam Dimension
    - Width = 700 mm
    - Height = 850 mm
    -
  - Beam Length

    Prismatic Section (Total Length = 4.65 m)
    - Section 1 (T-Beam)

      Effective Width (Beff) = 1170 mm

Section	b (mm)	h (mm)	ytop (mm)	A (mm^2)	A.y (mm^3)	I (mm^4)	
1	1170	150	75	175,500	13,162,500	3.29E+08	1.72E+10
2	700	700	500	490,000	245,000,000	2.00E+10	6.16E+09
Total				**665,500**	**258,162,500**	**4.37E+10**	

ytop	387.92	mm
ybottom	462.08	mm
Area	6.66E+05	mm^2
Inertia	4.37E+10	mm^4

Resume Beam Section Properties

	Length (m)	ytop (mm)	ybot (mm)	Area (mm^2)	Inertia (mm^4)
Back Span	0.00 ~ 9.00	261.51	438.49	7.23E+05	3.24E+10
Cantilever	9.00 ~ 13.65	387.92	462.08	6.66E+05	4.37E+10

1.2. Force

Strand yang digunakan yaitu Uncoated Stress-Relieved Seven Wire Strand Grade 270-ASTM A416-90a, Low Relaxation Steel

- Diameter Strand = 12.70 mm
- Minimum Breaking Load = 184 kN
- Ultimate Tensile Strength, fpu = 1860 MPa
- Jumlah Strand = 30
- Konfigurasi Strand = 2x15SD05
- Koefisien service
  - Koefisien service back span = 0.58

    Fs $= 0.56 \times 30 \times 184$

    $= 3091.2$ kN

  - Koefisien service cantilever = 0.57

    Fs $= 0.57 \times 30 \times 184$

    $= 3146.4$ kN

1.3. Cable Eccentricity

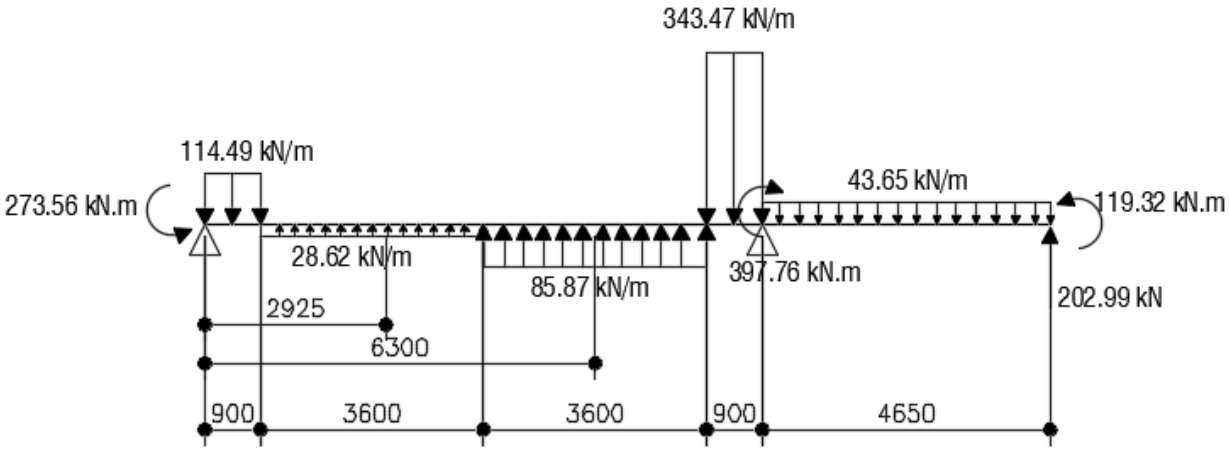
ec = ycable – ytopbeam

	Back Span					Cantilever	
x (m)	0.00	0.90	4.50	8.10	9.00	9.00	13.65
ycable (mm)	350	365	425	245	200	200	350
ytopbeam (mm)	261.51	261.51	261.51	261.51	261.51	387.92	387.92
ec (mm)	88.49	103.49	163.49	-16.51	-61.51	-187.92	-37.92

Transformed Section

x (m)	ycable (mm)	ytop from left section (mm)	ytop from right section (mm)	ec from left section (mm)	ec from right section (mm)	Δec (mm)
9	-187.92261	261.51	387.92	-449.43	-575.85	126.42

1.4. Balancing Load



Span	W	F	M	a	b
	kN/m	kN	kN-m	m	m
Back Span	-114.49			0.00	0.90
Back Span	28.62			0.90	4.50
Back Span	85.87			4.50	8.10
Back Span	-343.47			8.10	9.00
Back Span			-273.56	0.00	
Back Span			397.76	9.00	
Cantilever	-43.65			0.00	4.65
Cantilever		-202.99		4.65	
Cantilever			119.32	4.65	

Prestress Losses Calculation
Project Title : PC-Beam Erha Ultimate SMG
Girder/Beam/Slab ID : BP-21
Reference : Average Tendon Losses

Number of Turning Points = 6
Stressing Mode = One End Stressing 1

01 Material Properties

UTS	=	1860	N/mm2	% Jacking Force	=	75	% UTS
Friction Coef	=	0.22		Wobble	=	0.0033	
Es	=	194	kN/mm2	Eci	=	25.63547	kN/mm^2
fci	=	29.75	N/mm2	Wedge Draw - in	=	6	mm
Ft	=	3532.8	kN	Cross Section Area	=	6.94E+05	mm^2
Ft / Area	=	5.09	N/mm2				

02 Tendon Coordinates (All in meters)

X	0.00	0.90	4.50	8.10	9.00	13.65
Y	0.50	0.49	0.43	0.61	0.65	0.50

03 Prestress Losses

Elastic Deformation Loss	=	19.30	MPa
Shrinkage Loss	=	38.80	MPa
Creep Loss	=	69.30	MPa

1st End Stressing

Average Wegde Set Distance	=	8.20	m
Average Wedge Set Loss	=	288.00	N/mm^2

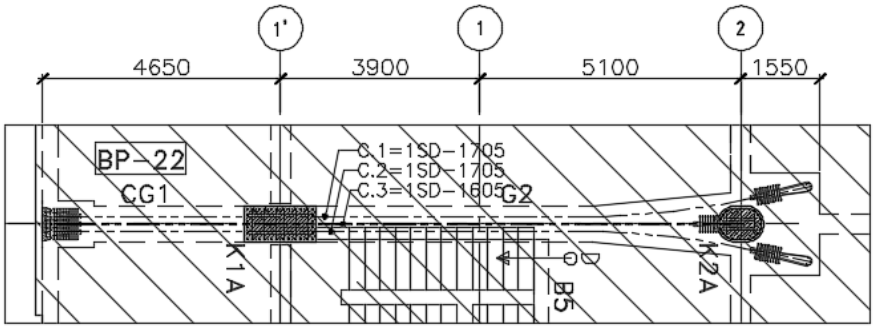
Point No.	x [m]	y [m]	friction [N/mm^2]	Wset [N/mm^2]	Relax [N/mm^2]	Total [N/mm^2]	Effective Prestress [N/mm^2]
1	0.00	0.500	233.40	0.00	208.00	381.60	1013.40
2	0.90	0.485	221.40	0.00	22.70	371.40	1023.60
3	4.50	0.425	189.80	0.00	27.80	345.00	1050.00
4	8.10	0.605	120.70	92.00	24.10	364.20	1030.80
5	9.00	0.650	59.60	123.80	28.90	339.70	1055.30
6	13.65	0.500	0.00	288.00	15.50	430.90	964.10

Coefficients of effective force & Expected Elongations

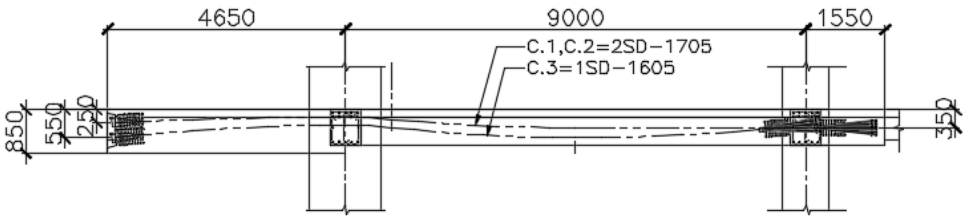
Point No.	x [m]	y [m]	L. Angle (rad)	R. Angle (rad)	L. Extn (mm)	R. Extn (mm)	Transfer Coef	Service Coef
1	0.00	0.500	0.00000	0.00000	0.00	5.40	0.61	0.54
2	0.90	0.485	0.03330	0.03300	0.00	22.10	0.62	0.55
3	4.50	0.425	0.03330	0.09970	0.00	23.00	0.64	0.56
4	8.10	0.605	0.09970	0.09970	0.00	6.10	0.63	0.55
5	9.00	0.650	0.09970	0.06440	0.00	32.70	0.64	0.57
6	13.65	0.500	0.06440	0.00000	0.00	0.00	0.58	0.52

Total Elongation	=	89.30	mm	Total Angular Change =	0.62720	rad
- 7 %	=	83.05	mm			
+ 7 %	=	95.55	mm			

2. BP – 22 AND BP – 32

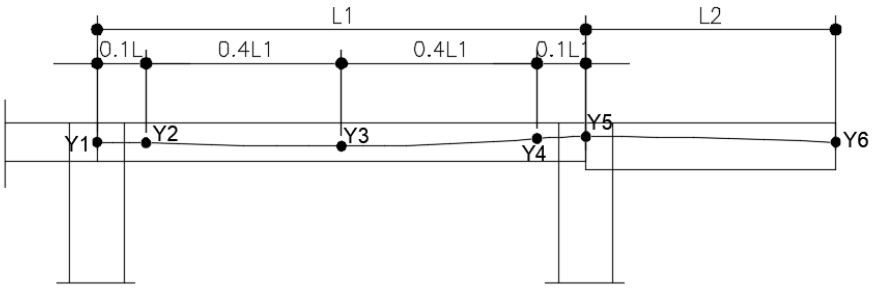


PLAN VIEW BP-22 (700x850/700)



CABLE PROFILE BP-22 (700x850/700)

Cable Profile Type :



Cable Coordinate :

Cable No.	Strand	Cable Coordinate from Top of Beam(mm)					
		Y1	Y2	Y3	Y4	Y5	Y6
C1	17SD05	350	350	350	190	150	250
C2	17SD05	350	350	350	190	150	250
C3	16SD05	350	390	550	350	300	550
Average Coordinate		350	362.8	414	241.2	198	346

2.1. Beam Section Properties :

- Slab Thickness = 150 mm
- Back Span
  - Beam Dimension
    - Width = 700 mm

- Height = 700 mm

- Beam Length
  Non – Prismatic Section (Total Length = 9.00 m)
  - Section 1 (T-Beam)
    Length = 4.050 m
    Effective Width (Beff) = 2250 mm

Section	b (mm)	h (mm)	ytop (mm)	A (mm^2)	A.y (mm^3)	I (mm^4)	
1	2250	150	75	337,500	25,312,500	6.33E+08	1.17E+10
2	700	550	425	385,000	163,625,000	9.71E+09	1.03E+10
Total				**722,500**	**188,937,500**	**3.24E+10**	

ytop	261.51	mm
ybottom	438.49	mm
Area	7.23E+05	mm^2
Inertia	3.24E+10	mm^4

  - Section 2 (L-Beam)
    Length = 4.950 m
    Effective Width (Beff) = 1450 mm

Section	b (mm)	h (mm)	ytop (mm)	A (mm^2)	A.y (mm^3)	I (mm^4)	
1	1450	150	75	217,500	16,312,500	4.08E+08	1.09E+10
2	700	550	425	385,000	163,625,000	9.71E+09	6.15E+09
Total				**602,500**	**179,937,500**	**2.71E+10**	

ytop	298.65	mm
ybottom	401.35	mm
Area	6.03E+05	mm^2
Inertia	2.71E+10	mm^4

- Cantilever
  - Beam Dimension
    - Width = 700 mm
    - Height = 850 mm
  - Beam Length
    Prismatic Section (Length = 4.575 m)
    Effective Width = 1150 mm

Section	b (mm)	h (mm)	ytop (mm)	A (mm^2)	A.y (mm^3)	I (mm^4)	
1	1150	150	75	172,500	12,937,500	3.23E+08	1.70E+10
2	700	700	500	490,000	245,000,000	2.00E+10	6.00E+09
Total				**662,500**	**257,937,500**	**4.34E+10**	

ytop	389.34	mm
ybottom	460.66	mm
Area	6.63E+05	mm^2
Inertia	4.34E+10	mm^4

Resume Beam Section Properties

	Length (m)	ytop (mm)	ybot (mm)	Area (mm^2)	Inertia (mm^4)
Back Span	0.00 ~ 4.05	261.51	438.49	7.23E+05	3.24E+10
	4.05 ~ 9.00	298.65	401.35	6.03E+05	2.71E+10
Cantilever	9.00 ~ 13.58	389.34	460.66	6.63E+05	4.34E+10

2.2. Force

Strand yang digunakan yaitu Uncoated Stress-Relieved Seven Wire Strand Grade 270-ASTM A416-90a, Low Relaxation Steel

- Diameter Strand = 12.70 mm
- Minimum Breaking Load = 184 kN
- Ultimate Tensile Strength, fpu = 1860 MPa
- Jumlah Strand = 50
- Konfigurasi Strand = 2x17SD05 + 1x16SD05
- Koefisien service
  - Koefisien service back span = 0.53

    Fs $= 0.53 \times 50 \times 184$

    $= 4876$ kN

  - Koefisien service cantilever = 0.53

    Fs $= 0.53 \times 50 \times 184$

    $= 4876$ kN

2.3. Cable Eccentricity

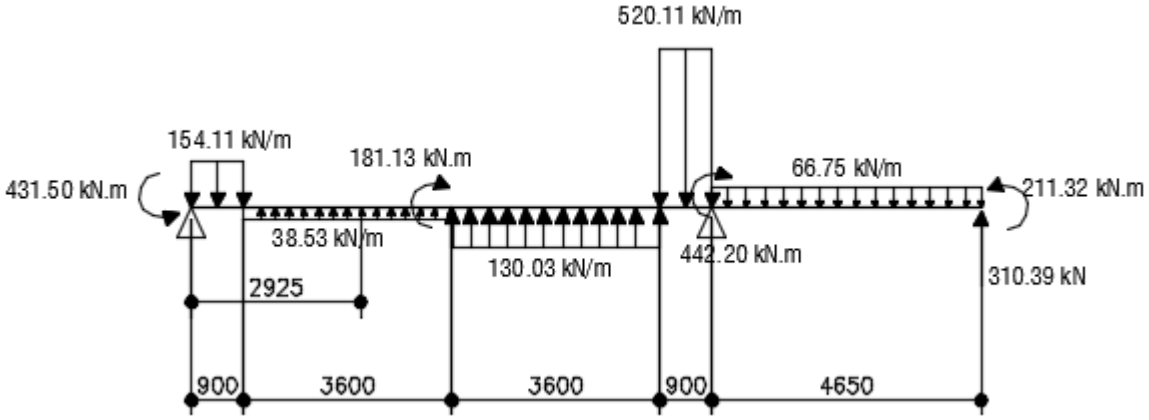
ec = ycable – ytopbeam

	Back Span					Cantilever	
x (m)	0.00	0.90	4.50	8.10	9.00	9.00	13.65
ycable (mm)	350	362.8	414	241.2	198	198	346
ytopbeam (mm)	261.51	261.51	261.51	261.51	261.51	389.34	389.34
Ec (mm)	88.49	101.29	152.49	-20.31	-63.51	-191.34	-43.34

Transformed Section

x (m)	**ycable (mm)**	**ytop from left section (mm)**	**ytop from right section (mm)**	**ec from left section (mm)**	**ec from right section (mm)**	**Δec (mm)**
4.05	413.20	261.51	298.65	151.69	114.55	37.15
9	198	298.65	389.34	-100.65	-191.34	90.69

2.4. Balancing Load



Span	W	F	M	a	b
	kN/m	kN	kN-m	m	m
Back Span	-154.11			0.00	0.90
Back Span	38.53			0.90	4.50
Back Span	130.03			4.50	8.10
Back Span	-520.11			8.10	9.00
Back Span			-431.50	0.00	
Back Span			181.13	4.05	
Back Span			442.20	9.00	
Cantilever	-66.75			0.00	4.65
Cantilever		-310.39		4.65	
Cantilever			211.32	4.65	

Prestress Losses Calculation
Project Title : PC-Beam Erha Ultimate SMG
Girder/Beam/Slab ID : BP-22
Reference : Average Tendon Losses

Number of Turning Points = 6
Stressing Mode = One End Stressing 1

01 Material Properties

UTS	=	1860	N/mm2	% Jacking Force	=	75	% UTS
Friction Coef	=	0.22		Wobble	=	0.0033	
Es	=	194	kN/mm2	Eci	=	25.63547	kN/mm^2
fci	=	29.75	N/mm2	Wedge Draw - in	=	6	mm
Ft	=	5796	kN	Cross Section Area	=	6.63E+05	mm^2
Ft / Area	=	8.75	N/mm2				

02 Tendon Coordinates (All in meters)

X	0.00	0.90	4.50	8.10	9.00	13.65
Y	0.50	0.49	0.44	0.61	0.65	0.50

03 Prestress Losses

Elastic Deformation Loss	=	33.10	MPa
Shrinkage Loss	=	38.80	MPa
Creep Loss	=	119.20	MPa

1st End Stressing
Average Wegde Set Distance = 8.30 m
Average Wedge Set Loss = 284.40 N/mm^2

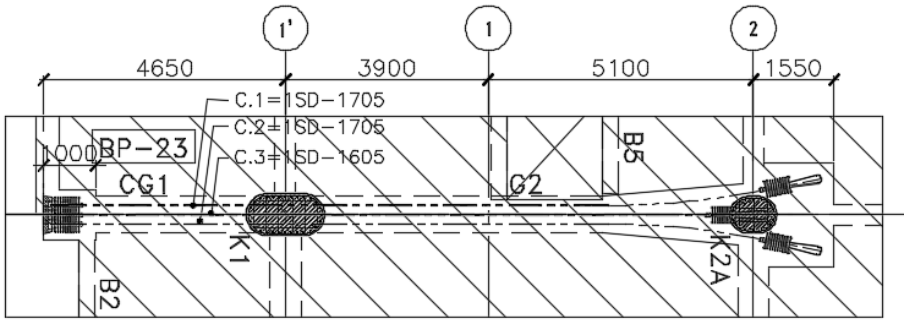
Point No.	x [m]	y [m]	friction [N/mm^2]	Wset [N/mm^2]	Relax [N/mm^2]	Total [N/mm^2]	Effective Prestress [N/mm^2]
1	0.00	0.500	225.10	0.00	19.90	436.10	958.90
2	0.90	0.487	214.30	0.00	21.60	427.00	968.00
3	4.50	0.436	185.10	0.00	26.30	402.50	992.50
4	8.10	0.609	118.00	93.20	22.10	424.40	970.60
5	9.00	0.652	59.10	124.20	26.60	401.00	994.00
6	13.65	0.504	0.00	284.40	15.00	490.50	904.50

Coefficients of effective force & Expected Elongations

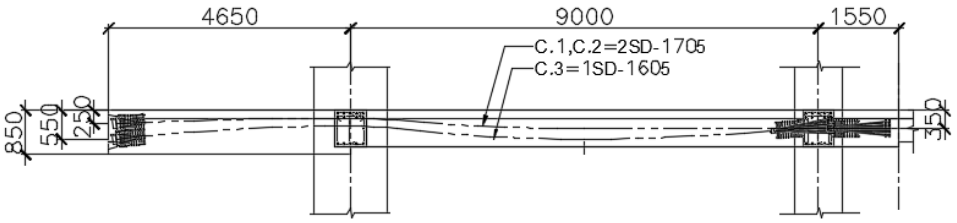
Point No.	x [m]	y [m]	L. Angle (rad)	R. Angle (rad)	L. Extn (mm)	R. Extn (mm)	Transfer Coef	Service Coef
1	0.00	0.500	0.00000	0.00000	0.00	5.50	0.61	0.52
2	0.90	0.487	0.02840	0.02840	0.00	22.20	0.62	0.52
3	4.50	0.436	0.02840	0.09570	0.00	23.10	0.63	0.53
4	8.10	0.609	0.09570	0.09570	0.00	6.10	0.62	0.52
5	9.00	0.652	0.09570	0.06360	0.00	32.70	0.63	0.53
6	13.65	0.504	0.06360	0.00000	0.00	0.00	0.58	0.49

Total Elongation = 89.60 mm Total Angular Change = 0.59520 rad
- 7 % = 83.33 mm
+ 7 % = 95.87 mm

3. BP – 23 AND BP – 33

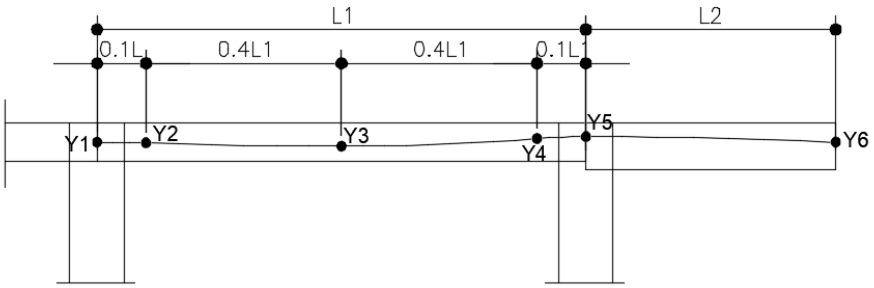


PLAN VIEW BP-23 (700x850/700)



CABLE PROFILE BP-23 (700x850/700)

Cable Profile Type :



Cable Coordinate :

Cable No.	Strand	Cable Coordinate from Top of Beam(mm)					
		Y1	Y2	Y3	Y4	Y5	Y6
C1	17SD05	350	350	350	190	150	250
C2	17SD05	350	350	350	190	150	250
C3	16SD05	350	390	550	350	300	550
Average Coordinate		350	362.80	414.00	241.20	198.00	346.00

3.1. Beam Section Properties :

- Slab Thickness = 150 mm
- Back Span
  - Beam Dimension
    - Width = 700 mm
    - Height = 700 mm
  - Beam Length

    Non – Prismatic Section (Total Length = 9.00 m)
    - Section 1 (T-Beam)

      Length = 2.90 m

      Effective Width (Beff) = 2250 mm

Section	b (mm)	h (mm)	ytop (mm)	A (mm^2)	A.y (mm^3)	I (mm^4)	
1	2250	150	75	337,500	25,312,500	6.33E+08	1.17E+10
2	700	550	425	385,000	163,625,000	9.71E+09	1.03E+10
Total				**722,500**	**188,937,500**	**3.24E+10**	

ytop	261.51	mm
ybottom	438.49	mm
Area	7.23E+05	mm^2
Inertia	3.24E+10	mm^4

    - Section 2 (L-Beam)

      Length = 1.850 m

      Effective Width (Beff) = 1450 mm

Section	b (mm)	h (mm)	ytop (mm)	A (mm^2)	A.y (mm^3)	I (mm^4)	
1	1450	150	75	217,500	16,312,500	4.08E+08	1.09E+10
2	700	550	425	385,000	163,625,000	9.71E+09	6.15E+09
Total				**602,500**	**179,937,500**	**2.71E+10**	

ytop	298.65	mm
ybottom	401.35	mm
Area	6.03E+05	mm^2
Inertia	2.71E+10	mm^4

    - Section 3 (T-Beam)

      Length = 4.25 m

      Effective Width (Beff) = 2250 mm

Section	b (mm)	h (mm)	ytop (mm)	A (mm^2)	A.y (mm^3)	I (mm^4)	
1	2250	150	75	337,500	25,312,500	6.33E+08	1.17E+10
2	700	550	425	385,000	163,625,000	9.71E+09	1.03E+10
Total				**722,500**	**188,937,500**	**3.24E+10**	

ytop	261.51	mm
ybottom	438.49	mm
Area	7.23E+05	mm^2
Inertia	3.24E+10	mm^4

- Cantilever
  - Beam Dimension
    - Width = 700 mm
    - Height = 850 mm
  - Beam Length

    Non-Prismatic Section (Total Length = 4.650 m)
    - Section 1 (T-Beam)

      Length = 3.975 m

      Effective Width (Beff) = 1170 mm

Section	b (mm)	h (mm)	ytop (mm)	A (mm^2)	A.y (mm^3)	I (mm^4)	
1	1170	150	75	175,500	13,162,500	3.29E+08	1.72E+10
2	700	700	500	490,000	245,000,000	2.00E+10	6.16E+09
Total				**665,500**	**258,162,500**	**4.37E+10**	

ytop	387.92	mm
ybottom	462.08	mm
Area	6.66E+05	mm^2
Inertia	4.37E+10	mm^4

    - Section 2 (L-Beam)

      Length = 0.675 m

      Effective Width (Beff) = 1090 mm

Section	b (mm)	h (mm)	ytop (mm)	A (mm^2)	A.y (mm^3)	I (mm^4)	
1	1090	150	75	163,500	12,262,500	3.07E+08	1.60E+10
2	700	700	500	490,000	245,000,000	2.00E+10	6.16E+09
Total				**653,500**	**257,262,500**	**4.25E+10**	

ytop	393.67	mm
ybottom	456.33	mm
Area	6.54E+05	mm^2
Inertia	4.25E+10	mm^4

Resume Beam Section Properties

	Length (m)	ytop (mm)	ybot (mm)	Area (mm^2)	Inertia (mm^4)
Back Span	0.00 ~ 2.90	261.51	438.49	7.23E+05	3.24E+10
	2.90 ~ 9.00	298.65	401.35	6.03E+05	2.71E+10
	4.75 ~ 12.98	261.51	438.49	7.23E+05	3.24E+10
Cantilever	9.00 ~ 12.98	387.92	462.08	6.66E+05	4.37E+10
	12.98 ~ 13.65	393.67	456.33	6.54E+05	4.25E+10

3.2. Force

Strand yang digunakan yaitu Uncoated Stress-Relieved Seven Wire Strand Grade 270-ASTM A416-90a, Low Relaxation Steel

- Diameter Strand = 12.70 mm
- Minimum Breaking Load = 184 kN
- Ultimate Tensile Strength, fpu = 1860 MPa
- Jumlah Strand = 50
- Konfigurasi Strand = 2x17SD05 + 1x16SD05
- Koefisien service
  - Koefisien service back span = 0.53

    Fs $= 0.53 \times 50 \times 184$

    = 4876 kN

  - Koefisien service cantilever = 0.54

    Fs $= 0.54 \times 50 \times 184$

    = 4968 kN

3.3. Cable Eccentricity

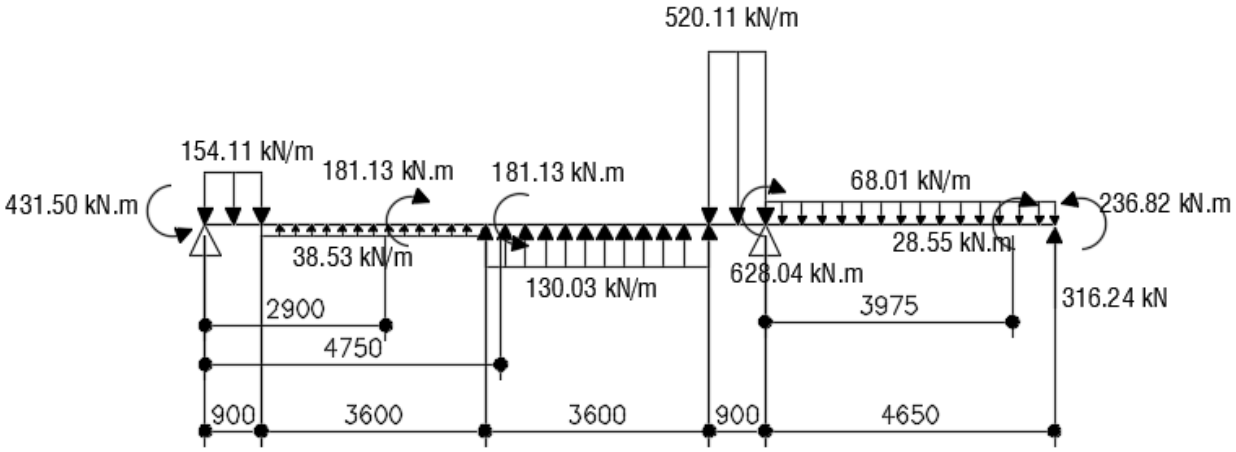
ec = ycable – ytopbeam

	Back Span					Cantilever	
x (m)	0.00	0.90	4.50	8.10	9.00	9.00	13.65
ycable (mm)	350.00	362.80	414.00	241.20	198.00	198.00	346.00
ytopbeam (mm)	261.51	261.51	261.51	261.51	261.51	393.67	393.67
ec (mm)	88.49	101.29	152.49	-20.31	-63.51	-195.67	-47.67

Transformed Section

x (m)	ycable (mm)	ytop from left section (mm)	ytop from right section (mm)	ec from left section (mm)	ec from right section (mm)	Δec (mm)
2.9	412.06	261.51	298.65	150.56	113.41	37.15
4.75	369.66	298.65	261.51	71.01	108.16	-37.15
9	198	298.65	387.92	-100.65	-189.92	89.27
12.975	-0.087	387.92	393.67	-388.01	-393.76	5.75

3.4. Balancing Load



Span	W	F	M	a	b
	kN/m	kN	kN-m	m	m
Back Span	-154.11			0.00	0.90
Back Span	38.53			0.90	4.50
Back Span	130.03			4.50	8.10
Back Span	-520.11			8.10	9.00
Back Span			-431.50	0.00	
Back Span			181.13	2.90	
Back Span			-181.13	4.75	
Back Span			628.04	9.00	
Cantilever	-68.01			0.00	4.65
Cantilever		-316.24		4.65	
Cantilever			28.55	3.98	
Cantilever			236.82	4.65	

Prestress Losses Calculation
Project Title : PC-Beam Erha Ultimate SMG
Girder/Beam/Slab ID : BP-23
Reference : Average Tendon Losses

Number of Turning Points = 6
Stressing Mode = One End Stressing 1

01 Material Properties

UTS	=	1860	N/mm2	% Jacking Force	=	75	% UTS
Friction Coef	=	0.22		Wobble	=	0.0033	
Es	=	194	kN/mm2	Eci	=	25.63547	kN/mm^2
fci	=	29.75	N/mm2	Wedge Draw - in	=	6	mm
Ft	=	5796	kN	Cross Section Area	=	6.73E+05	mm^2
Ft / Area	=	8.61	N/mm2				

02 Tendon Coordinates (All in meters)

X	0.00	0.90	4.50	8.10	9.00	13.65
Y	0.50	0.49	0.44	0.61	0.65	0.50

03 Prestress Losses

Elastic Deformation Loss	=	32.60	MPa
Shrinkage Loss	=	38.80	MPa
Creep Loss	=	117.30	MPa

1st End Stressing
Average Wegde Set Distance = 8.30 m
Average Wedge Set Loss = 284.40 N/mm^2

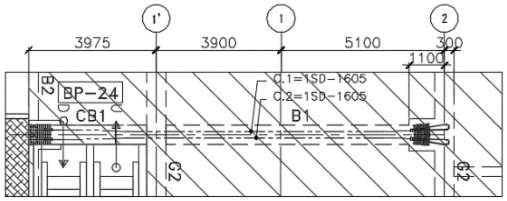
Point No.	x [m]	y [m]	friction [N/mm^2]	Wset [N/mm^2]	Relax [N/mm^2]	Total [N/mm^2]	Effective Prestress [N/mm^2]
1	0.00	0.500	225.10	0.00	20.00	433.80	961.20
2	0.90	0.487	214.30	0.00	21.70	424.60	970.40
3	4.50	0.436	185.10	0.00	26.40	400.20	994.80
4	8.10	0.609	118.00	93.20	22.20	422.00	973.00
5	9.00	0.652	59.10	124.20	26.70	398.60	996.40
6	13.65	0.504	0.00	284.40	15.10	488.10	906.90

Coefficients of effective force & Expected Elongations

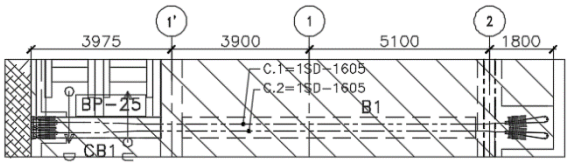
Point No.	x [m]	y [m]	L. Angle (rad)	R. Angle (rad)	L. Extn (mm)	R. Extn (mm)	Transfer Coef	Service Coef
1	0.00	0.500	0.00000	0.00000	0.00	5.50	0.61	0.52
2	0.90	0.487	0.02840	0.02840	0.00	22.20	0.62	0.52
3	4.50	0.436	0.02840	0.09570	0.00	23.10	0.63	0.53
4	8.10	0.609	0.09570	0.09570	0.00	6.10	0.62	0.52
5	9.00	0.652	0.09570	0.06360	0.00	32.70	0.63	0.54
6	13.65	0.504	0.06360	0.00000	0.00	0.00	0.58	0.49

Total Elongation = 89.60 mm Total Angular Change = 0.59520 rad
- 7 % = 83.33 mm
+ 7 % = 95.87 mm

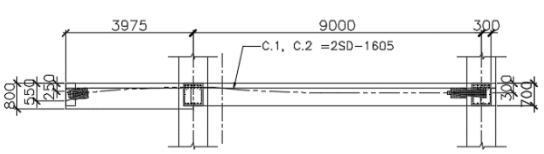
4. BP – 24, BP – 25, BP – 34 AND BP – 35



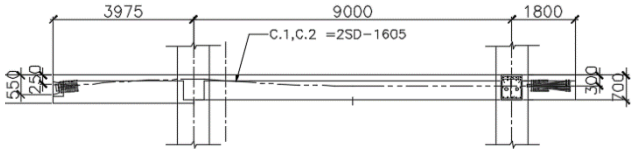
PLAN VIEW BP-24 (600x800/700)



PLAN VIEW BP-25 (600x800/700)

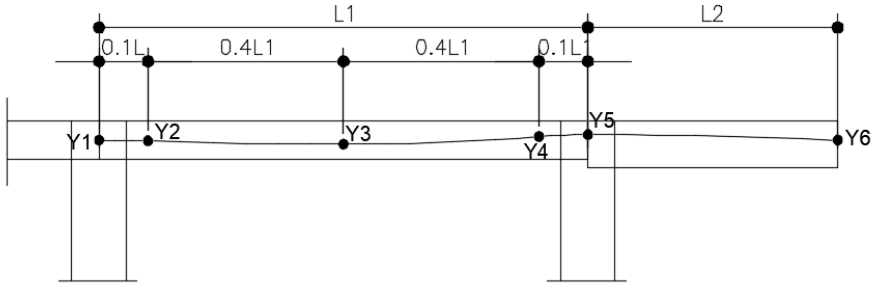


CABLE PROFILE BP-24 (600x800/700)



CABLE PROFILE BP-25 (600x800/700)

Cable Profile Type :



Cable Coordinate :

Cable No.	Strand	Cable Coordinate from Top of Beam(mm)					
		Y1	Y2	Y3	Y4	Y5	Y6
C1	16SD05	300	300	300	156	120	350
C2	16SD05	300	300	300	156	120	350
Average Coordinate		300	300	300	156	120	350

4.1. Beam Section Properties :

- Slab Thickness = 150 mm
- Back Span
  - Beam Dimension
    - Width = 600 mm
    - Height = 700 mm
  - Beam Length

    Prismatic Section (Total Length = 9.00 m)
    - Section 1 (T-Beam)

      Effective Width (Beff) = 2250 mm

Section	b (mm)	h (mm)	ytop (mm)	A (mm^2)	A.y (mm^3)	I (mm^4)	
1	2250	150	75	337,500	25,312,500	6.33E+08	1.01E+10
2	600	550	425	330,000	140,250,000	8.32E+09	1.03E+10
Total				**667,500**	**165,562,500**	**2.94E+10**	

ytop	248.03	mm
ybottom	451.97	mm
Area	6.68E+05	mm^2
Inertia	2.94E+10	mm^4

- Cantilever
  - Beam Dimension
    - Width = 600 mm
    - Height = 800 mm
  - Beam Length

    Prismatic Section (Length = 3.975 m)

    Effective Width = 990 mm

Section	b (mm)	h (mm)	ytop (mm)	A (mm^2)	A.y (mm^3)	I (mm^4)	
1	990	150	75	148,500	11,137,500	2.78E+08	1.25E+10
2	600	650	475	390,000	185,250,000	1.37E+10	4.75E+09
Total				**538,500**	**196,387,500**	**3.12E+10**	

ytop	364.69	mm
ybottom	435.31	mm
Area	5.39E+05	mm^2
Inertia	3.12E+10	mm^4

Resume Beam Section Properties

	Length (m)	ytop (mm)	ybot (mm)	Area (mm^2)	Inertia (mm^4)
Back Span	0.00 ~ 9.00	248.03	451.97	6.68E+05	2.94E+10
Cantilever	9.00 ~ 12.98	364.69	435.31	5.39E+05	3.12E+10

4.2. Force

Strand yang digunakan yaitu Uncoated Stress-Relieved Seven Wire Strand Grade 270-ASTM A416-90a, Low Relaxation Steel

- Diameter Strand = 12.70 mm
- Minimum Breaking Load = 184 kN
- Ultimate Tensile Strength, fpu = 1860 MPa
- Jumlah Strand = 32
- Konfigurasi Strand = 2x16SD05
- Koefisien service
  - Koefisien service back span = 0.57

    Fs $= 0.57 \times 32 \times 184$

    = 3356.16 kN

  - Koefisien service cantilever = 0.55

    Fs $= 0.55 \times 32 \times 184$

    = 3238.4 kN

4.3. Cable Eccentricity

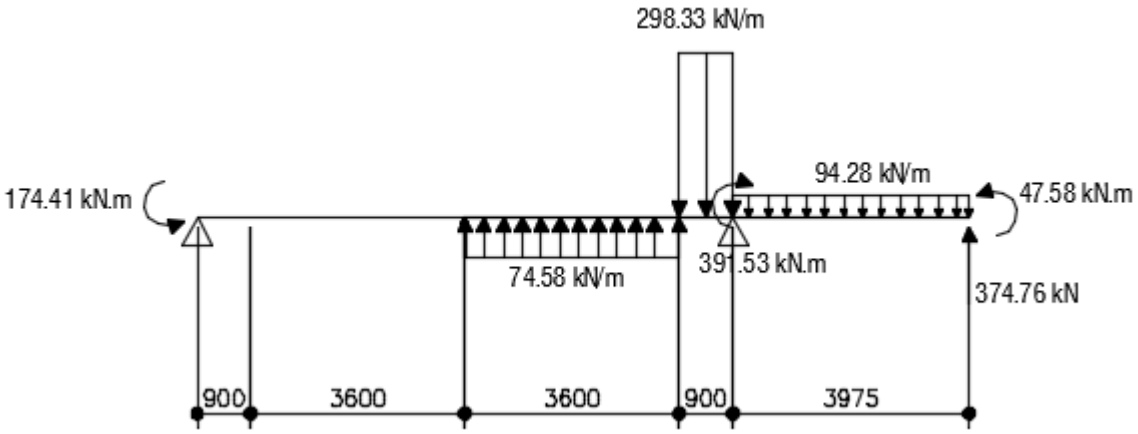
ec = ycable – ytopbeam

	Back Span					Cantilever	
x (m)	0.00	0.90	4.50	8.10	9.00	9.00	12.98
ycable (mm)	300	300	300	156	120	120	350
ytopbeam (mm)	248.03	248.03	248.03	248.03	248.03	364.69	364.69
Ec (mm)	51.97	51.97	51.97	-92.03	-128.03	-244.69	-14.69

Transformed Section

x (m)	ycable (mm)	ytop from left section (mm)	ytop from right section (mm)	ec from left section (mm)	ec from right section (mm)	Δec (mm)
9	120	285.96	364.69	-165.96	-244.69	78.73

4.4. Balancing Load



Span	W	F	M	a	b
	kN/m	kN	kN-m	m	m
Back Span	74.58			4.50	8.10
Back Span	-298.33			8.10	9.00
Back Span			-174.41	0.00	
Back Span			391.53	9.00	
Cantilever	-94.28			0.00	3.98
Cantilever		-374.76		3.98	
Cantilever			47.58	3.98	

Prestress Losses Calculation
Project Title : PC-Beam Erha Ultimate SMG
Girder/Beam/Slab ID : BP-24
Reference : Average Tendon Losses

Number of Turning Points = 6
Stressing Mode = One End Stressing 1

01 Material Properties

UTS	=	1860	N/mm2	% Jacking Force	=	77	% UTS
Friction Coef	=	0.22		Wobble	=	0.0033	
Es	=	194	kN/mm2	Eci	=	25.63547	kN/mm^2
fci	=	29.75	N/mm2	Wedge Draw - in	=	6	mm
Ft	=	3827.2	kN	Cross Section Area	=	6.03E+05	mm^2
Ft / Area	=	6.35	N/mm2				

02 Tendon Coordinates (All in meters)

X	0.00	0.90	4.50	8.10	9.00	12.98
Y	0.50	0.50	0.50	0.64	0.68	0.45

03 Prestress Losses

Elastic Deformation Loss	=	24.00	MPa
Shrinkage Loss	=	38.80	MPa
Creep Loss	=	86.50	MPa

1st End Stressing
Average Wegde Set Distance = 7.40 m
Average Wedge Set Loss = 316.20 N/mm^2

Point No.	x [m]	y [m]	friction [N/mm^2]	Wset [N/mm^2]	Relax [N/mm^2]	Total [N/mm^2]	Effective Prestress [N/mm^2]
1	0.00	0.500	216.30	0.00	28.80	394.40	1037.80
2	0.90	0.500	212.70	0.00	29.40	391.40	1040.80
3	4.50	0.500	198.20	0.00	31.90	379.30	1052.90
4	8.10	0.644	138.80	108.80	23.70	420.50	1011.70
5	9.00	0.680	88.50	147.10	25.60	410.50	1021.70
6	12.98	0.450	0.00	316.20	15.70	481.20	951.00

Coefficients of effective force & Expected Elongations

Point No.	x [m]	y [m]	L. Angle (rad)	R. Angle (rad)	L. Extn (mm)	R. Extn (mm)	Transfer Coef	Service Coef
1	0.00	0.500	0.00000	0.00000	0.00	5.60	0.64	0.56
2	0.90	0.500	0.00000	0.00000	0.00	22.80	0.64	0.56
3	4.50	0.500	0.00000	0.07980	0.00	23.50	0.65	0.57
4	8.10	0.644	0.07980	0.07980	0.00	6.10	0.62	0.54
5	9.00	0.680	0.07980	0.11520	0.00	28.50	0.63	0.55
6	12.98	0.450	0.11520	0.00000	0.00	0.00	0.59	0.51

Total Elongation = 86.50 mm Total Angular Change = 0.54960 rad
- 7 % = 80.45 mm
+ 7 % = 92.56 mm

Prestress Losses Calculation
Project Title : PC-Beam Erha Ultimate SMG
Girder/Beam/Slab ID : BP-25
Reference : Average Tendon Losses

Number of Turning Points = 6
Stressing Mode = One End Stressing 1

01 Material Properties

UTS	=	1860	N/mm2	% Jacking Force	=	77	% UTS
Friction Coef	=	0.22		Wobble	=	0.0033	
Es	=	194	kN/mm2	Eci	=	25.63547	kN/mm^2
fci	=	29.75	N/mm2	Wedge Draw - in	=	6	mm
Ft	=	3827.2	kN	Cross Section Area	=	6.03E+05	mm^2
Ft / Area	=	6.35	N/mm2				

02 Tendon Coordinates (All in meters)

X	0.00	0.90	4.50	8.10	9.00	12.98
Y	0.50	0.50	0.50	0.64	0.68	0.45

03 Prestress Losses

Elastic Deformation Loss	=	24.00	MPa
Shrinkage Loss	=	38.80	MPa
Creep Loss	=	86.50	MPa

1st End Stressing
Average Wegde Set Distance = 7.40 m
Average Wedge Set Loss = 316.20 N/mm^2

Point No.	x [m]	y [m]	friction [N/mm^2]	Wset [N/mm^2]	Relax [N/mm^2]	Total [N/mm^2]	Effective Prestress [N/mm^2]
1	0.00	0.500	216.30	0.00	28.80	394.40	1037.80
2	0.90	0.500	212.70	0.00	29.40	391.40	1040.80
3	4.50	0.500	198.20	0.00	31.90	379.30	1052.90
4	8.10	0.644	138.80	108.80	23.70	420.50	1011.70
5	9.00	0.680	88.50	147.10	25.60	410.50	1021.70
6	12.98	0.450	0.00	316.20	15.70	481.20	951.00

Coefficients of effective force & Expected Elongations

Point No.	x [m]	y [m]	L. Angle (rad)	R. Angle (rad)	L. Extn (mm)	R. Extn (mm)	Transfer Coef	Service Coef
1	0.00	0.500	0.00000	0.00000	0.00	5.60	0.64	0.56
2	0.90	0.500	0.00000	0.00000	0.00	22.80	0.64	0.56
3	4.50	0.500	0.00000	0.07980	0.00	23.50	0.65	0.57
4	8.10	0.644	0.07980	0.07980	0.00	6.10	0.62	0.54
5	9.00	0.680	0.07980	0.11520	0.00	28.50	0.63	0.55
6	12.98	0.450	0.11520	0.00000	0.00	0.00	0.59	0.51

Total Elongation = 86.50 mm Total Angular Change = 0.54960 rad
- 7 % = 80.45 mm
+ 7 % = 92.56 mm

BP-21
B83 - B132 (LT 2 -3)

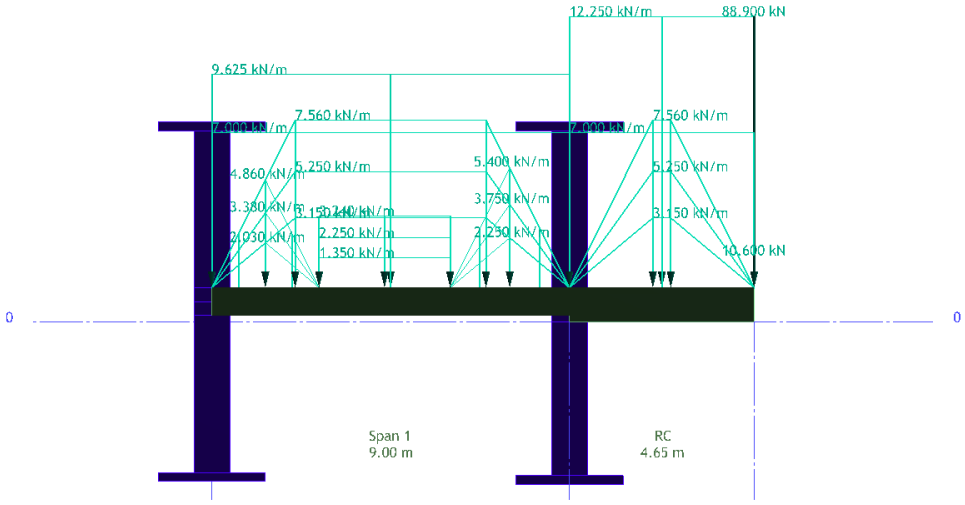


TABLE OF CONTENT:

1 - USER SPECIFIED GENERAL ANALYSIS AND DESIGN PARAMETERS

Parameter	Value	Parameter	Value
Concrete		Minimum Cover at TOP	40.00 mm
F'c for BEAMS/SLABS	35.00 N/mm 2	Minimum Cover at BOTTOM	40.00 mm
F'ci for BEAMS/SLABS	29.75 N/mm 2	Post-tensioning	
For COLUMNS/WALLS	35.00 N/mm 2	SYSTEM	BONDED
Ec for BEAMS/SLABS	27806.00 N/mm 2	Fpu	1860.00 N/mm 2
For COLUMNS/WALLS	27806.00 N/mm 2	Fse	1200.00 N/mm 2
CREEP factor	2.00	Strand area	99.000 mm 2
CONCRETE WEIGHT	NORMAL	Min CGS from TOP	120.00 mm
Tension stress limits / (f'c)1/2		Min CGS from BOT for interior spans	120.00 mm
At Top	0.500	Min CGS from BOT for exterior spans	400.00 mm
At Bottom	0.500	Min average precompression	0.85 N/mm 2
Compression stress limits / f'c		Max spacing / slab depth	8.00
At all locations	0.450	Analysis and design options	
Tension stress limits (initial) / (f'c)1/2		Structural system	BEAM
At Top	0.250	Moment of Inertia over support is	NOT INCREASED
At Bottom	0.250	Moments reduced to face of support	NO
Compression stress limits (initial) / f'c		Moment Redistribution	NO
At all locations	0.600	Effective flange width consideration	YES
Reinforcement		Effective flange width implementation method	ACI-318
Fy (Main bars)	400.00 N/mm 2	DESIGN CODE SELECTED	American-ACI318 (2014)/IBC 2015
Fy (Shear reinforcement)	240.00 N/mm 2		

2 - INPUT GEOMETRY

2.1 Principal Span Data of Uniform Spans

Span	Form	Length	Width	Depth	TF Width	TF Thick.	BF/MF Width	BF/MF Thick.	Rh	Right Mult.	Left Mult.
		m	mm	mm	mm	mm	mm	mm	mm		
1	2	9.00	700	700	2250	150			850	0.50	0.50
C	2	4.65	700	850	1170	150			850	0.34	0.66

2.3 Effective Width Data of Uniform Spans

Span	Effective Width
	mm
1	2250
CR	1170

2.7 Support Width and Column Data

Joint	Support Width	Length LC	B(DIA.) LC	D LC	% LC	CBC LC	Length UC	B(DIA.) UC	D UC	% UC	CBC UC
	mm	m	mm	mm			m	mm	mm		
1	0.0	4.3	700.0	900.0	100	(1)	4.3	700.0	900.0	100	(1)
2	0.0	4.3	700.0	900.0	100	(1)	4.3	700.0	900.0	100	(1)

3 - INPUT APPLIED LOADING

3.1 Loading As Appears in User's Input Screen

Span	Class	Type	W	P1	P2	A	B	C	F	M
			kN/m2	kN/m	kN/m	m	m	m	kN	kN-m
1	LL	L		2.250		2.700	6.000			

1	LL	R		3.380		0.000	2.700			
1	LL	R		3.750		6.000	9.000			
1	LL	Z		5.250		0.000	9.000	2.100		
1	D	L		9.625		0.000	9.000			
1	D	L		3.240		2.700	6.000			
1	D	R		4.860		0.000	2.700			
1	D	R		5.400		6.000	9.000			
1	D	Z		7.560		0.000	9.000	2.100		
1	SDL	L		1.350		2.700	6.000			
1	SDL	L		7.000		0.000	9.000			
1	SDL	R		2.030		0.000	2.700			
1	SDL	R		2.250		6.000	9.000			
1	SDL	Z		3.150		0.000	9.000	2.100		
CANT	LL	C				4.650			10.600	
CANT	LL	Z		5.250		0.000	4.650	2.100		
CANT	D	L		12.250		0.000	4.650			
CANT	D	Z		7.560		0.000	4.650	2.100		
CANT	SDL	C				4.650			88.900	
CANT	SDL	L		7.000		0.000	4.650			
CANT	SDL	Z		3.150		0.000	4.650	2.100		

NOTE: LIVE LOADING is SKIPPED with a skip factor of 1.00

3.2 Compiled loads

Span	Class	Type	P1	P2	F	M	A	B	C	Reduction Factor
			kN/m	kN/m	kN	kN-m	m	m	m	%
1	LL	P	2.250				2.700	6.000		0.000
1	LL	R	3.380				0.000	2.700		0.000
1	LL	R	3.750				6.000	9.000		0.000
1	LL	T								0.000
1	SW	P	9.625				0.000	9.000		
1	SW	P	3.240				2.700	6.000		
1	SW	R	4.860				0.000	2.700		
1	SW	R	5.400				6.000	9.000		
1	SW	T								
1	SDL	P	1.350				2.700	6.000		
1	SDL	P	7.000				0.000	9.000		
1	SDL	R	2.030				0.000	2.700		
1	SDL	R	2.250				6.000	9.000		
1	SDL	T								
CR	LL	C			10.600		4.650			0.000
CR	LL	T								0.000
CR	SW	P	12.250				0.000	4.650		
CR	SW	T								
CR	SDL	C			88.900		4.650			
CR	SDL	P	7.000				0.000	4.650		
CR	SDL	T								

4 - CALCULATED SECTION PROPERTIES

4.1 Section Properties of Uniform Spans and Cantilevers

Span	Area	Yb	Yt	b eff	I	Yb	Yt
	mm2	mm	mm	mm	mm4	mm	mm
1	722500.00	438.49	261.51	2250.00	0.3237E+11	438.49	261.51
CANT	665500.00	462.08	387.92	1170.00	0.4368E+11	462.08	387.92

5 - MOMENTS, SHEARS AND REACTIONS

5.1 Span Moments and Shears (Excluding Live Load)

Span	Load Case	Moment Left	Moment Midspan	Moment Right	Shear Left	Shear Right
		kN-m	kN-m	kN-m	kN	kN
1	SW	-108.28	71.05	-146.73	-77.57	86.57
CANT	SW	-177.26	-----	-----	-76.24	-----
1	SDL	-35.20	23.31	-144.20	-35.45	59.86
CANT	SDL	-507.74	-----	-----	-129.48	-----
1	XL	0.00	0.00	0.00	0.00	0.00
CANT	XL	0.00	-----	-----	0.00	-----

5.2 Reactions and Column Moments (Excluding Live Load)

Joint	Load Case	Reaction	Moment Lower Column	Moment Upper Column
		kN	kN-m	kN-m
1	SW	77.57	-54.14	-54.14
2	SW	162.81	-15.27	-15.27
1	SDL	35.45	-17.60	-17.60
2	SDL	189.34	-181.77	-181.77
1	XL	0.00	0.00	0.00
2	XL	0.00	0.00	0.00

5.3 Span Moments and Shears (Live Load)

Span	Moment Left Max	Moment Left Min	Moment Midspan Max	Moment Midspan Min	Moment Right Max	Moment Right Min	Shear Left	Shear Right
	kN-m	kN-m	kN-m	kN-m	kN-m	kN-m	kN	kN
1	-41.93	5.27	28.13	-3.35	-54.21	-11.97	-26.73	29.02
CR	-80.42	-----	-----	-----	-----	-----	-23.99	-----

5.4 Reactions and Column Moments (Live Load)

Joint	Reaction Max	Reaction Min	Moment Lower Column Max	Moment Lower Column Min	Moment Upper Column Max	Moment Upper Column Min
	kN	kN	kN-m	kN-m	kN-m	kN-m
1	26.73	-1.91	2.63	-20.97	2.63	-20.97
2	53.01	25.90	21.12	-34.22	21.12	-34.22

6 - MOMENTS REDUCED TO FACE OF SUPPORT

6.1 Reduced Moments at Face of Support (Excluding Live Load)

Span	Load Case	Moment Left	Moment Midspan	Moment Right
		kN-m	kN-m	kN-m
1	SW	-108.30	71.05	-146.70
CANT	SW	-177.30	-----	-----
1	SDL	-35.20	23.31	-144.20
CANT	SDL	-507.70	-----	-----
1	XL	0.00	0.00	0.00
CANT	XL	0.00	-----	-----

6.2 Reduced Moments at Face of Support (Live Load)

Span	Moment Left Max	Moment Left Min	Moment Midspan Max	Moment Midspan Min	Moment Right Max	Moment Right Min
	kN-m	kN-m	kN-m	kN-m	kN-m	kN-m

1	-41.93	5.27	28.13	-3.35	-54.21	-11.97
CR	-78.23	-----	-----	-----	-----	-----

7 - SELECTED POST-TENSIONING FORCES AND TENDON PROFILES

7.1 Tendon Profile

Tendon A

Span	Type	X1/L	X2/L	X3/L	A/L
1	1	0.100	0.500	0.100	---
CR	1	0.000	---	---	---

7.2 Selected Post-Tensioning Forces and Tendon Drape

Tendon A

Span	Force	CGS Left	CGS C1	CGS C2	CGS Right	P/A	Wbal	WBal (%DL)
	kN	mm	mm	mm	mm	MPa	kN/-	
1	3091.200	500.00	---	425.00	650.00	4.28	45.796	136
CR	3146.400	650.00	---	---	500.00	4.73	43.655	89

All Tendons

Span	Force	Total P/A	Total WBal (%DL)
	kN	MPa	
1	3091.2	4.28	136
CR	3146.4	4.73	89

Approximate weight of strand: 281.1 Kg

7.4 Required Minimum Post-Tensioning Forces

	Based on Stress Conditions			Based on Minimum P/A		
Type	Left	Center	Right	Left	Center	Right
	kN	kN	kN	kN	kN	kN
1	0.00	0.00	0.00	614.12	614.12	614.12
CR	1191.94	-----	-----	565.67	-----	-----

7.5 Service Stresses (tension shown positive)

Envelope of Service 1

Span	Left Top Max-T	Left Top Max-C	Left Bot Max-T	Left Bot Max-C	Center Top Max-T	Center Top Max-C	Center Bot Max-T	Center Bot Max-C	Right Top Max-T	Right Top Max-C	Right Bot Max-T	Right Bot Max-C
	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa
1	-----	-4.60	-----	-3.92	-----	-3.39	-----	-5.89	-----	-4.62	-----	-4.13
CR	-----	-3.94	-----	-5.92	-----	-----	-----	-----	-----	-----	-----	-----

Envelope of Service 2

Span	Left Top Max-T	Left Top Max-C	Left Bot Max-T	Left Bot Max-C	Center Top Max-T	Center Top Max-C	Center Bot Max-T	Center Bot Max-C	Right Top Max-T	Right Top Max-C	Right Bot Max-T	Right Bot Max-C
	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa
1	-----	-4.63	-----	-4.32	-----	-3.55	-----	-5.92	-----	-4.62	-----	-4.65
CR	-----	-3.94	-----	-6.50	-----	-----	-----	-----	-----	-----	-----	-----

7.6 Post-Tensioning Balance Moments, Shears and Reactions

Span Moments and Shears

Span	Moment Left	Moment Center	Moment Right	Shear Left	Shear Right
	kN-m	kN-m	kN-m	kN	kN
1	182.20	-212.50	323.50	36.20	36.20
CR	591.30	-----	-----	0.00	-----

Reactions and Column Moments

Joint	Reaction	Moment Lower Column	Moment Upper Column
	kN	kN-m	kN-m
1	-36.200	227.900	227.900
2	36.200	-64.980	-64.980

Note: Moments are reported at centerline

8 - FACTORED MOMENTS AND REACTIONS ENVELOPE

8.1 Factored Design Moments (Not Redistributed)

Span	Left Max	Left Min	Middle Max	Middle Min	Right Max	Right Min
	kN-m	kN-m	kN-m	kN-m	kN-m	kN-m
1	216.51	292.03	451.14	400.77	-305.82	-238.23
CR	-959.00	-----	-----	-----	-----	-----

8.2 Reactions and Column Moments

Joint	Reaction Max	Reaction Min	Moment Lower Column Max	Moment Lower Column Min	Moment Upper Column Max	Moment Upper Column Min
	kN	kN	kN-m	kN-m	kN-m	kN-m
1	142.19	96.36	146.02	108.26	146.02	108.26
2	543.54	500.16	-267.67	-356.22	-267.67	-356.22

8.3 Secondary Moments

Span	Left	Midspan	Right
	kN-m	kN-m	kN-m
1	455.80	292.90	130.00

Note: Moments are reported at centerline

10 - MILD STEEL - NO REDISTRIBUTION

10.1 Required Rebar

10.2 Provided Rebar

12 - SHEAR REINFORCEMENT

12.1 Shear Calculation Envelope

SPAN 1

X/L	X	d	Vu,max	Mu,max	Ratio	Req.	Spacing	Base
	m	mm	kN	kNm		mm2/m	mm	
0.00	0.00	560.00	-142.20	294.90	0.49	0.000	0.00	---
0.05	0.45	560.00	-131.20	336.50	0.45	0.000	0.00	---
0.10	0.90	560.00	-116.00	372.90	0.40	0.000	0.00	---
0.15	1.35	560.00	-96.81	402.90	0.34	0.000	0.00	---
0.20	1.80	560.00	-75.53	427.90	0.26	0.000	0.00	---
0.25	2.25	560.00	-54.37	456.00	0.19	0.000	0.00	---
0.30	2.70	560.00	-34.79	474.80	0.12	0.000	0.00	---
0.35	3.15	560.00	-12.17	485.40	0.04	0.000	0.00	---
0.40	3.60	560.00	24.34	485.80	0.08	0.000	0.00	---
0.45	4.05	560.00	41.57	475.90	0.14	0.000	0.00	---
0.50	4.50	560.00	59.02	429.30	0.20	0.000	0.00	---
0.55	4.95	560.00	81.46	425.10	0.28	0.000	0.00	---

0.60	5.40	560.00	104.10	384.40	0.36	0.000	0.00	---
0.65	5.85	560.00	126.70	333.30	0.42	0.000	0.00	---
0.70	6.30	560.00	147.10	272.30	0.40	0.000	0.00	---
0.75	6.75	560.00	168.00	202.10	0.35	0.000	0.00	---
0.80	7.20	560.00	190.60	122.10	0.27	0.000	0.00	---
0.85	7.65	560.00	213.00	31.70	0.29	0.000	0.00	---
0.90	8.10	560.00	232.20	-54.97	0.32	0.000	0.00	---
0.95	8.55	560.00	247.30	-145.30	0.34	0.000	0.00	---
1.00	9.00	560.00	258.30	-240.60	0.38	0.000	0.00	---

CR

X/L	X	d	Vu,max	Mu,max	Ratio	Req.	Spacing	Base
	m	mm	kN	kNm		mm2/m	mm	
0.00	0.00	680.00	-288.00	-962.20	0.65	368.200	600.00	---
0.05	0.23	680.00	-281.50	-901.70	0.63	368.200	600.00	---
0.10	0.47	680.00	-274.70	-836.40	0.60	368.200	600.00	---
0.15	0.70	680.00	-267.50	-772.80	0.57	368.200	600.00	---
0.20	0.93	680.00	-259.90	-710.70	0.54	368.200	600.00	---
0.25	1.16	680.00	-251.90	-650.70	0.50	368.200	600.00	---
0.30	1.40	680.00	-243.50	-592.50	0.47	0.000	0.00	---
0.35	1.63	680.00	-234.70	-536.50	0.44	0.000	0.00	---
0.40	1.86	680.00	-225.50	-482.30	0.41	0.000	0.00	---
0.45	2.09	680.00	-216.00	-430.50	0.37	0.000	0.00	---
0.50	2.33	680.00	-206.20	-381.00	0.34	0.000	0.00	---
0.55	2.56	680.00	-196.50	-333.60	0.30	0.000	0.00	---
0.60	2.79	680.00	-186.90	-288.70	0.27	0.000	0.00	---
0.65	3.02	680.00	-177.80	-245.80	0.23	0.000	0.00	---
0.70	3.25	680.00	-169.00	-205.10	0.20	0.000	0.00	---
0.75	3.49	680.00	-160.60	-166.50	0.18	0.000	0.00	---
0.80	3.72	680.00	-152.60	-129.60	0.17	0.000	0.00	---
0.85	3.95	680.00	-145.00	-94.70	0.17	0.000	0.00	---
0.90	4.18	680.00	-137.80	-61.52	0.16	0.000	0.00	---
0.95	4.42	680.00	-130.90	-29.97	0.15	0.000	0.00	---
1.00	4.65	680.00	-124.50	-0.00	0.14	0.000	0.00	---

Note: "Ratio" is calculated using paired shear (V) and moment (M) design values resulting in the lowest concrete capacity. For ACI and CSA codes, the lowest value of V*d/M is used.
Note: Sections with **** have exceeded the maximum allowable shear stress.
Note: Sections marked with xxxx have insufficient depth for shear design.
Note: Base stirrups flagged as OK satisfy the requirements - additional reinforcement is not needed. Base stirrups flagged as NS are not sufficient - additional stirrups are reported in the table.

14 - DEFLECTIONS

14.1 Maximum Span Deflections - Service Combination 1

Span	SW	SW+PT	SW+PT+ SDL	SW+PT+SDL +Creep	LL	X	Sustained	Total
	mm	mm	mm	mm	mm	mm	mm	mm
1	0.4	-0.9	-0.9	-2.6(3466)	0.0(*****)	0.0(*****)	-2.6(3417)	-2.7(3381)
CR	0.8	-2.0	1.6	4.8(971)	0.6(8236)	0.0(*****)	5.3(878)	5.7(817)

14.3 Maximum Span Deflections - Service Combination 3

Span	SW	SW+PT	SW+PT+ SDL	SW+PT+SDL +Creep	LL	X	Sustained	Total
	mm	mm	mm	mm	mm	mm	mm	mm
1	0.4	-0.9	-0.9	-2.6(3466)	0.0(*****)	0.0(*****)	-2.6(3466)	-2.6(3412)
CR	0.8	-2.0	1.6	4.8(971)	0.6(8236)	0.0(*****)	4.8(971)	5.3(869)

Note: Deflections are calculated using effective moment of inertia of cracked sections.

BP - 22
B115 - B106 (LT 2 -3)

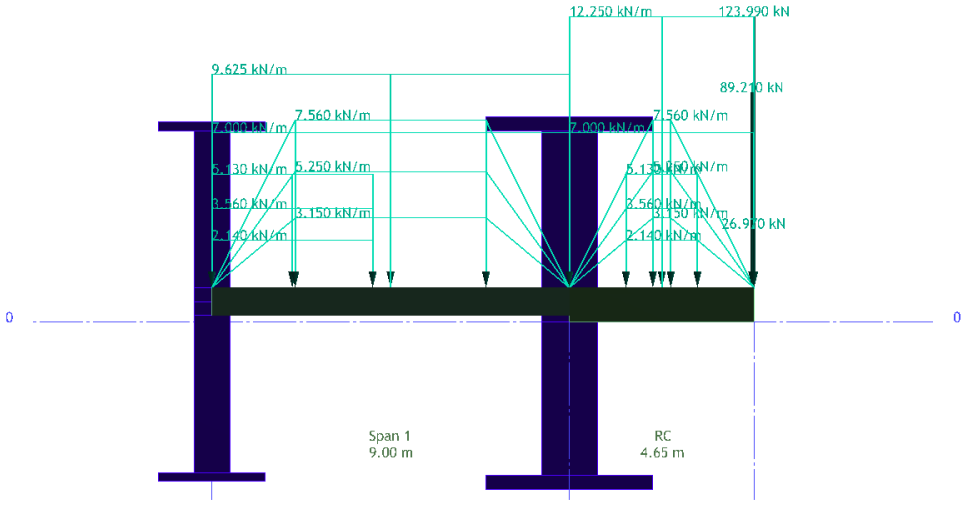


TABLE OF CONTENT:

Tabular Reports - Compact

1 - USER SPECIFIED GENERAL ANALYSIS AND DESIGN PARAMETERS

Parameter	Value	Parameter	Value
Concrete		Minimum Cover at TOP	40.00 mm
F'c for BEAMS/SLABS	35.00 N/mm 2	Minimum Cover at BOTTOM	40.00 mm
F'ci for BEAMS/SLABS	29.75 N/mm 2	Post-tensioning	
For COLUMNS/WALLS	35.00 N/mm 2	SYSTEM	BONDED
Ec for BEAMS/SLABS	27806.00 N/mm 2	Fpu	1860.00 N/mm 2
For COLUMNS/WALLS	27806.00 N/mm 2	Fse	1200.00 N/mm 2
CREEP factor	2.00	Strand area	99.000 mm 2
CONCRETE WEIGHT	NORMAL	Min CGS from TOP	120.00 mm
Tension stress limits / (f'c)1/2		Min CGS from BOT for interior spans	120.00 mm
At Top	0.500	Min CGS from BOT for exterior spans	400.00 mm
At Bottom	0.500	Min average precompression	0.85 N/mm 2
Compression stress limits / f'c		Max spacing / slab depth	8.00
At all locations	0.450	Analysis and design options	
Tension stress limits (initial) / (f'c)1/2		Structural system	BEAM
At Top	0.250	Moment of Inertia over support is	NOT INCREASED
At Bottom	0.250	Moments reduced to face of support	NO
Compression stress limits (initial) / f'c		Moment Redistribution	NO
At all locations	0.600	Effective flange width consideration	YES
Reinforcement		Effective flange width implementation method	ACI-318
Fy (Main bars)	400.00 N/mm 2	DESIGN CODE SELECTED	American-ACI318 (2014)/IBC 2015
Fy (Shear reinforcement)	240.00 N/mm 2		

2 - INPUT GEOMETRY

2.1 Principal Span Data of Uniform Spans

Span	Form	Length	Width	Depth	TF Width	TF Thick.	BF/MF Width	BF/MF Thick.	Rh	Right Mult.	Left Mult.
		m	mm	mm	mm	mm	mm	mm	mm		
C	2	4.65	700	850	1150	150			850	0.50	0.50

2.2 Detailed Data for Nonuniform Spans

Span	Seg.	Form	Left Dist.	Width	Depth	TF Width	TF Thick.	BF/MF Width	BF/MF Thick.	Rh	Right Mult.	Left Mult.
			m	mm	mm	mm	mm	mm	mm	mm		
1	1	2	0.00	700	700	2250	150			850	0.50	0.50
1	2	2	4.05	700	700	1450	150			850	0.74	0.26

2.3 Effective Width Data of Uniform Spans

Span	Effective Width
	mm
CR	1150

2.4 Effective Width Data for Non-Uniform Spans

Span	Seg.	Effective Width
		mm
1	1	2250
1	2	1450

2.7 Support Width and Column Data

Joint	Support Width	Length LC	B(DIA.) LC	D LC	% LC	CBC LC	Length UC	B(DIA.) UC	D UC	% UC	CBC UC
	mm	m	mm	mm			m	mm	mm		
1	0.0	4.3	700.0	900.0	100	(1)	4.3	700.0	900.0	100	(1)
2	0.0	4.3	700.0	1400.0	100	(1)	4.3	700.0	1400.0	100	(1)

3 - INPUT APPLIED LOADING

3.1 Loading As Appears in User's Input Screen

Span	Class	Type	W	P1	P2	A	B	C	F	M
			kN/m2	kN/m	kN/m	m	m	m	kN	kN-m
1	LL	L		3.560		0.000	4.050			
1	LL	Z		5.250		0.000	9.000	2.100		
1	D	L		9.625		0.000	9.000			
1	D	L		5.130		0.000	4.050			
1	D	Z		7.560		0.000	9.000	2.100		
1	SDL	L		2.140		0.000	4.050			
1	SDL	L		7.000		0.000	9.000			
1	SDL	Z		3.150		0.000	9.000	2.100		
CANT	LL	C				4.650			26.970	
CANT	LL	Z		5.250		0.000	4.650	2.100		
CANT	LL	Z		3.560		0.000	4.650	1.425		
CANT	D	C				4.650			123.990	
CANT	D	L		12.250		0.000	4.650			
CANT	D	Z		7.560		0.000	4.650	2.100		
CANT	D	Z		5.130		0.000	4.650	1.425		
CANT	SDL	C				4.600			89.210	
CANT	SDL	L		7.000		0.000	4.650			
CANT	SDL	Z		3.150		0.000	4.650	2.100		
CANT	SDL	Z		2.140		0.000	4.650	1.425		

NOTE: LIVE LOADING is SKIPPED with a skip factor of 1.00

3.2 Compiled loads

Span	Class	Type	P1	P2	F	M	A	B	C	Reduction Factor
			kN/m	kN/m	kN	kN-m	m	m	m	%
1	LL	P	3.560				0.000	4.050		0.000
1	LL	T								0.000
1	LL	T								0.000
1	SW	P	9.625				0.000	9.000		
1	SW	P	5.130				0.000	4.050		
1	SW	T								
1	SW	T								
1	SDL	P	2.140				0.000	4.050		
1	SDL	P	7.000				0.000	9.000		
1	SDL	T								
1	SDL	T								
CR	LL	C			26.970		4.650			0.000
CR	LL	T								0.000
CR	LL	T								0.000
CR	SW	C			123.990		4.650			
CR	SW	P	12.250				0.000	4.650		
CR	SW	T								
CR	SW	T								
CR	SDL	C			89.210		4.600			
CR	SDL	P	7.000				0.000	4.650		
CR	SDL	T								

CR	SDL	T								

4 - CALCULATED SECTION PROPERTIES

4.1 Section Properties of Uniform Spans and Cantilevers

Span	Area	Yb	Yt	b_eff	I	Yb	Yt
	mm2	mm	mm	mm	mm4	mm	mm
1	---	---	---	---	---	---	---
CANT	662500.00	460.66	389.34	1150.00	0.4338E+11	460.66	389.34

4.2 Section Properties for Non-Uniform Spans

Span	Seg.	Area	Yb	Yt	b_eff	i	Yb	Yt
		mm2	mm	mm	mm	mm4	mm	mm
1	1	722500.00	438.49	261.51	2250.00	0.3237E+11	438.49	261.51
1	2	602500.00	401.35	298.65	1450.00	0.2714E+11	401.35	298.65

5 - MOMENTS, SHEARS AND REACTIONS

5.1 Span Moments and Shears (Excluding Live Load)

Span	Load Case	Moment Left	Moment Midspan	Moment Right	Shear Left	Shear Right
		kN-m	kN-m	kN-m	kN	kN
1	SW	-87.56	48.58	-135.33	-71.46	72.23
CANT	SW	-792.28	-----	-----	-216.77	-----
1	SDL	-51.23	29.36	-83.96	-41.81	44.98
CANT	SDL	-520.77	-----	-----	-136.69	-----
1	XL	0.00	0.00	0.00	0.00	0.00
CANT	XL	0.00	-----	-----	0.00	-----

5.2 Reactions and Column Moments (Excluding Live Load)

Joint	Load Case	Reaction	Moment Lower Column	Moment Upper Column
		kN	kN-m	kN-m
1	SW	71.46	-43.78	-43.78
2	SW	289.01	-328.48	-328.48
1	SDL	41.81	-25.61	-25.61
2	SDL	181.67	-218.40	-218.40
1	XL	0.00	0.00	0.00
2	XL	0.00	0.00	0.00

5.3 Span Moments and Shears (Live Load)

Span	Moment Left Max	Moment Left Min	Moment Midspan Max	Moment Midspan Min	Moment Right Max	Moment Right Min	Shear Left	Shear Right
	kN-m	kN-m	kN-m	kN-m	kN-m	kN-m	kN	kN
1	-30.10	3.33	14.59	-1.84	-34.61	-7.01	-23.50	17.27
CR	-183.23	-----	-----	-----	-----	-----	-51.84	-----

5.4 Reactions and Column Moments (Live Load)

Joint	Reaction Max	Reaction Min	Moment Lower Column Max	Moment Lower Column Min	Moment Upper Column Max	Moment Upper Column Min
	kN	kN	kN-m	kN-m	kN-m	kN-m
1	23.50	-1.15	1.67	-15.05	1.67	-15.05
2	69.11	16.12	13.80	-88.11	13.80	-88.11

6 - MOMENTS REDUCED TO FACE OF SUPPORT

6.1 Reduced Moments at Face of Support (Excluding Live Load)

Span	Load Case	Moment Left	Moment Midspan	Moment Right
		kN-m	kN-m	kN-m
1	SW	-87.56	48.58	-135.30
CANT	SW	-792.30	-----	-----
1	SDL	-51.23	29.36	-83.96
CANT	SDL	-520.80	-----	-----
1	XL	0.00	0.00	0.00
CANT	XL	0.00	-----	-----

6.2 Reduced Moments at Face of Support (Live Load)

Span	Moment Left Max	Moment Left Min	Moment Midspan Max	Moment Midspan Min	Moment Right Max	Moment Right Min
	kN-m	kN-m	kN-m	kN-m	kN-m	kN-m
1	-30.10	3.33	14.59	-1.84	-34.61	-7.01
CR	-172.20	-----	-----	-----	-----	-----

7 - SELECTED POST-TENSIONING FORCES AND TENDON PROFILES

7.1 Tendon Profile

Tendon A

Span	Type	X1/L	X2/L	X3/L	A/L
1	1	0.100	0.500	0.100	---
CR	1	0.000	---	---	---

7.2 Selected Post-Tensioning Forces and Tendon Drape

Tendon A

Span	Force	CGS Left	CGS C1	CGS C2	CGS Right	P/A	Wbal	WBal (%DL)
	kN	mm	mm	mm	mm	MPa	kN/-	
1	4876.000	500.00	---	436.00	652.00	8.09	67.421	220
CR	4876.000	652.00	---	---	504.00	7.36	66.750	80

All Tendons

Span	Force	Total P/A	Total WBal (%DL)
	kN	MPa	
1	4876	8.09	220
CR	4876	7.36	80

Approximate weight of strand: 435.5 Kg

7.4 Required Minimum Post-Tensioning Forces

	Based on Stress Conditions			Based on Minimum P/A		
Type	Left	Center	Right	Left	Center	Right
	kN	kN	kN	kN	kN	kN
1	0.00	0.00	0.00	614.12	614.12	512.12
CR	3152.24	-----	-----	563.12	-----	-----

7.5 Service Stresses (tension shown positive)

Envelope of Service 1

Span	Left Top Max-T	Left Top Max-C	Left Bot Max-T	Left Bot Max-C	Center Top Max-T	Center Top Max-C	Center Bot Max-T	Center Bot Max-C	Right Top Max-T	Right Top Max-C	Right Bot Max-T	Right Bot Max-C
	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa
1	-----	-7.98	-----	-4.81	-----	-6.53	-----	-10.27	-----	-10.57	-----	-4.92

CR	-----	-4.15	-----	-11.71	-----	-----	-----	-----	-----	-----	-----	-----

Envelope of Service 2

Span	Left Top Max-T	Left Top Max-C	Left Bot Max-T	Left Bot Max-C	Center Top Max-T	Center Top Max-C	Center Bot Max-T	Center Bot Max-C	Right Top Max-T	Right Top Max-C	Right Bot Max-T	Right Bot Max-C
	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa
1	-----	-8.00	-----	-5.10	-----	-6.64	-----	-10.29	-----	-10.57	-----	-5.27
CR	-----	-4.15	-----	-12.99	-----	-----	-----	-----	-----	-----	-----	-----

7.6 Post-Tensioning Balance Moments, Shears and Reactions

Span Moments and Shears

Span	Moment Left	Moment Center	Moment Right	Shear Left	Shear Right
	kN-m	kN-m	kN-m	kN	kN
1	290.60	-224.60	444.50	85.37	85.37
CR	933.00	-----	-----	0.00	-----

Reactions and Column Moments

Joint	Reaction	Moment Lower Column	Moment Upper Column
	kN	kN-m	kN-m
1	-85.370	361.000	361.000
2	85.370	23.150	23.150

Note: Moments are reported at centerline

8 - FACTORED MOMENTS AND REACTIONS ENVELOPE

8.1 Factored Design Moments (Not Redistributed)

Span	Left Max	Left Min	Middle Max	Middle Min	Right Max	Right Min
	kN-m	kN-m	kN-m	kN-m	kN-m	kN-m
1	507.29	560.78	454.67	428.39	-364.79	-320.62
CR	-1851.24	-----	-----	-----	-----	-----

8.2 Reactions and Column Moments

Joint	Reaction Max	Reaction Min	Moment Lower Column Max	Moment Lower Column Min	Moment Upper Column Max	Moment Upper Column Min
	kN	kN	kN-m	kN-m	kN-m	kN-m
1	88.15	48.72	280.40	253.65	280.40	253.65
2	760.79	676.00	-611.05	-774.11	-611.05	-774.11

8.3 Secondary Moments

Span	Left	Midspan	Right
	kN-m	kN-m	kN-m
1	722.00	337.80	-46.30

Note: Moments are reported at centerline

10 - MILD STEEL - NO REDISTRIBUTION

10.1 Required Rebar

10.1.1 Total Strip Required Rebar

Span	Location	From	To	As Required	Ultimate	Minimum	Initial	UBC
		m	m	mm2	mm2	mm2	mm2	mm2
1	BOT	7.65	9.00	1553.00	1553.00	0.00	0.00	0.00

CR	BOT	0.00	0.00	98.27	98.27	0.00	0.00	0.00

10.2 Provided Rebar

10.2.1 Total Strip Provided Rebar

Span	ID	Location	From	Quantity	Size	Length	Area
			m			m	mm2
1	1	BOT	0.00	4	25	13.66	1962.52

10.2.2 Total Strip Steel Disposition

Span	ID	Location	From	Quantity	Size	Length
			m			m
1	1	BOT	0.00	4	25	9.00
CR	1	BOT	0.00	4	25	4.66

12 - SHEAR REINFORCEMENT

12.1 Shear Calculation Envelope

SPAN 1

X/L	X	d	Vu,max	Mu,max	Ratio	Req.	Spacing	Base
	m	mm	kN	kNm		mm2/m	mm	
0.00	0.00	560.00	-88.15	566.40	0.31	0.000	0.00	---
0.05	0.45	560.00	-71.66	585.50	0.25	0.000	0.00	---
0.10	0.90	560.00	-53.12	598.20	0.18	0.000	0.00	---
0.15	1.35	560.00	-32.53	603.90	0.11	0.000	0.00	---
0.20	1.80	560.00	12.82	608.50	0.04	0.000	0.00	---
0.25	2.25	560.00	30.95	606.70	0.11	0.000	0.00	---
0.30	2.70	560.00	48.19	594.10	0.17	0.000	0.00	---
0.35	3.15	560.00	64.21	572.30	0.22	0.000	0.00	---
0.40	3.60	560.00	78.97	541.90	0.27	0.000	0.00	---
0.45	4.05	560.00	94.32	503.50	0.33	0.000	0.00	---
0.50	4.50	560.00	104.30	459.30	0.36	0.000	0.00	---
0.55	4.95	560.00	116.40	410.00	0.40	0.000	0.00	---
0.60	5.40	560.00	130.50	354.80	0.44	0.000	0.00	---
0.65	5.85	560.00	146.60	292.80	0.40	0.000	0.00	---
0.70	6.30	560.00	164.70	222.90	0.35	0.000	0.00	---
0.75	6.75	560.00	183.30	144.70	0.27	0.000	0.00	---
0.80	7.20	560.00	201.40	58.09	0.28	0.000	0.00	---
0.85	7.65	560.00	217.50	-34.10	0.30	0.000	0.00	---
0.90	8.10	560.00	231.60	-125.70	0.32	0.000	0.00	---
0.95	8.55	560.00	243.60	-222.50	0.34	0.000	0.00	---
1.00	9.00	560.00	253.70	-323.80	0.44	0.000	0.00	---

CR

X/L	X	d	Vu,max	Mu,max	Ratio	Req.	Spacing	Base
	m	mm	kN	kNm		mm2/m	mm	
0.00	0.00	680.00	-507.10	-1564.00	1.23	770.300	328.90	---
0.05	0.23	680.00	-501.20	-1492.00	1.20	693.900	365.10	---
0.10	0.47	680.00	-494.20	-1395.00	1.16	570.500	444.00	---
0.15	0.70	680.00	-486.10	-1299.00	1.11	570.500	444.00	---
0.20	0.93	680.00	-476.90	-1205.00	1.06	570.500	444.00	---
0.25	1.16	680.00	-466.60	-1112.00	1.01	570.500	444.00	---
0.30	1.40	680.00	-455.20	-1022.00	0.95	570.500	444.00	---
0.35	1.63	680.00	-442.90	-934.00	0.89	570.500	444.00	---
0.40	1.86	680.00	-430.10	-848.00	0.83	570.500	444.00	---
0.45	2.09	680.00	-416.70	-764.70	0.77	570.500	444.00	---
0.50	2.33	680.00	-403.00	-683.60	0.70	570.500	444.00	---
0.55	2.56	680.00	-389.40	-605.00	0.64	570.500	444.00	---

0.60	2.79	680.00	-376.00	-528.80	0.57	570.500	444.00	---
0.65	3.02	680.00	-363.20	-454.90	0.50	570.500	444.00	---
0.70	3.25	680.00	-350.90	-383.40	0.43	0.000	0.00	---
0.75	3.49	680.00	-339.50	-314.00	0.39	0.000	0.00	---
0.80	3.72	680.00	-329.70	-287.80	0.38	0.000	0.00	---
0.85	3.95	680.00	-320.80	-211.40	0.37	0.000	0.00	---
0.90	4.18	680.00	-312.60	-137.10	0.36	0.000	0.00	---
0.95	4.42	680.00	-305.10	-64.55	0.35	0.000	0.00	---
1.00	4.65	680.00	-191.90	-0.00	0.22	0.000	0.00	---

Note: "Ratio" is calculated using paired shear (V) and moment (M) design values resulting in the lowest concrete capacity. For ACI and CSA codes, the lowest value of V*d/M is used.
Note: Sections with **** have exceeded the maximum allowable shear stress.
Note: Sections marked with xxxx have insufficient depth for shear design.
Note: Base stirrups flagged as OK satisfy the requirements - additional reinforcement is not needed. Base stirrups flagged as NS are not sufficient - additional stirrups are reported in the table.

14 - DEFLECTIONS

14.1 Maximum Span Deflections - Service Combination 1

Span	SW	SW+PT	SW+PT+ SDL	SW+PT+SDL +Creep	LL	X	Sustained	Total
	mm	mm	mm	mm	mm	mm	mm	mm
1	0.3	-1.6	-1.4	-4.2(2139)	0.0(*****)	0.0(*****)	-4.2(2128)	-4.2(2119)
CR	4.8	-0.4	2.7	8.2(564)	1.1(4273)	0.0(*****)	9.2(504)	10.0(465)

14.3 Maximum Span Deflections - Service Combination 3

Span	SW	SW+PT	SW+PT+ SDL	SW+PT+SDL +Creep	LL	X	Sustained	Total
	mm	mm	mm	mm	mm	mm	mm	mm
1	0.3	-1.6	-1.4	-4.2(2139)	0.0(*****)	0.0(*****)	-4.2(2139)	-4.2(2127)
CR	4.8	-0.4	2.7	8.2(564)	1.1(4273)	0.0(*****)	8.2(564)	9.3(498)

Note: Deflections are calculated using effective moment of inertia of cracked sections.

BP - 23
B188 - B108 (LT 2 -3)

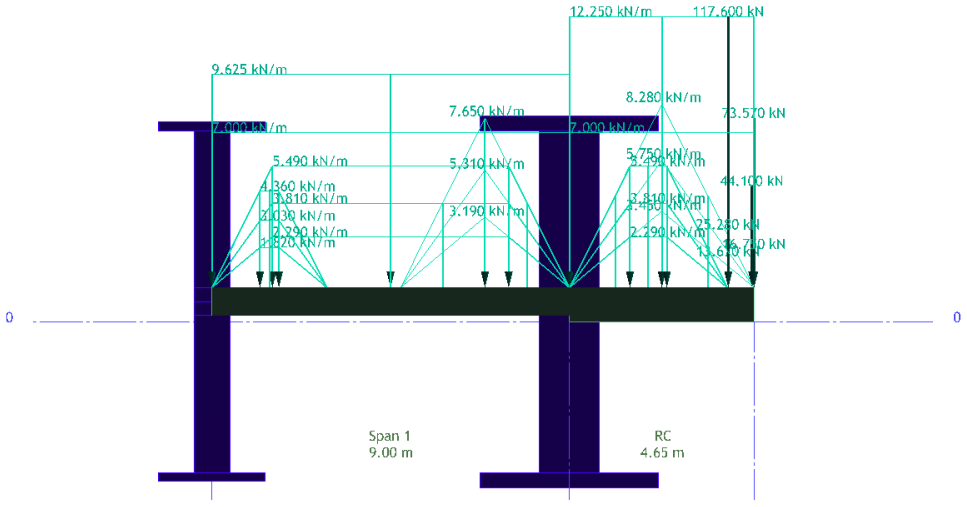


TABLE OF CONTENT:

1 - USER SPECIFIED GENERAL ANALYSIS AND DESIGN PARAMETERS

Parameter	Value	Parameter	Value
Concrete		Minimum Cover at TOP	40.00 mm
F'c for BEAMS/SLABS	35.00 N/mm 2	Minimum Cover at BOTTOM	40.00 mm
F'ci for BEAMS/SLABS	29.75 N/mm 2	Post-tensioning	
For COLUMNS/WALLS	35.00 N/mm 2	SYSTEM	UNBONDED
Ec for BEAMS/SLABS	27806.00 N/mm 2	Fpu	1860.00 N/mm 2
For COLUMNS/WALLS	27806.00 N/mm 2	Fse	1200.00 N/mm 2
CREEP factor	2.00	Strand area	99.000 mm 2
CONCRETE WEIGHT	NORMAL	Min CGS from TOP	120.00 mm
Tension stress limits / (f'c)1/2		Min CGS from BOT for interior spans	120.00 mm
At Top	0.620	Min CGS from BOT for exterior spans	400.00 mm
At Bottom	0.620	Min average precompression	0.85 N/mm 2
Compression stress limits / f'c		Max spacing / slab depth	8.00
At all locations	0.450	Analysis and design options	
Tension stress limits (initial) / (f'c)1/2		Structural system	BEAM
At Top	0.250	Moment of Inertia over support is	NOT INCREASED
At Bottom	0.250	Moments reduced to face of support	NO
Compression stress limits (initial) / f'c		Moment Redistribution	NO
At all locations	0.600	Effective flange width consideration	YES
Reinforcement		Effective flange width implementation method	ACI-318
Fy (Main bars)	460.00 N/mm 2	DESIGN CODE SELECTED	American-ACI318 (2014)/IBC 2015
Fy (Shear reinforcement)	460.00 N/mm 2		

2 - INPUT GEOMETRY

2.2 Detailed Data for Nonuniform Spans

Span	Seg.	Form	Left Dist.	Width	Depth	TF Width	TF Thick.	BF/MF Width	BF/MF Thick.	Rh	Right Mult.	Left Mult.
			m	mm	mm	mm	mm	mm	mm	mm		
1	1	2	0.00	700	700	2250	150			850	0.50	0.50
1	2	2	2.90	700	700	1450	150			850	0.26	0.74
1	3	2	4.75	700	700	2250	150			850	0.50	0.50
CR	1	2	0.00	700	850	1170	150			850	0.50	0.50
CR	2	2	3.98	700	850	1090	150			850	0.66	0.34

2.4 Effective Width Data for Non-Uniform Spans

Span	Seg.	Effective Width
		mm
1	1	2250
1	2	1450
1	3	2250
CR	1	1170
CR	2	1090

2.7 Support Width and Column Data

Joint	Support Width	Length LC	B(DIA.) LC	D LC	% LC	CBC LC	Length UC	B(DIA.) UC	D UC	% UC	CBC UC
	mm	m	mm	mm			m	mm	mm		
1	0.0	4.3	700.0	900.0	100	(1)	4.3	700.0	900.0	100	(1)
2	0.0	4.3	800.0	1500.0	100	(1)	4.3	800.0	1500.0	100	(1)

3 - INPUT APPLIED LOADING

3.1 Loading As Appears in User's Input Screen

Span	Class	Type	W	P1	P2	A	B	C	F	M
			kN/m2	kN/m	kN/m	m	m	m	kN	kN-m
1	LL	R		5.310		4.750	9.000			
1	LL	Z		3.810		0.000	9.000	1.525		
1	LL	Z		3.030		0.000	2.900	1.212		
1	D	L		9.625		0.000	9.000			
1	D	R		7.650		4.750	9.000			
1	D	Z		5.490		0.000	9.000	1.525		
1	D	Z		4.360		0.000	2.900	1.212		
1	SDL	L		7.000		0.000	9.000			
1	SDL	R		3.190		4.750	9.000			
1	SDL	Z		2.290		0.000	9.000	1.525		
1	SDL	Z		1.820		0.000	2.900	1.212		
CANT	LL	C				4.650			16.750	
CANT	LL	C				4.000			25.280	
CANT	LL	R		5.750		0.000	4.650			
CANT	LL	Z		3.810		0.000	3.975	1.525		
CANT	D	C				4.650			73.570	
CANT	D	C				4.000			13.670	
CANT	D	L		12.250		0.000	4.650			
CANT	D	R		8.280		0.000	4.650			
CANT	D	Z		5.490		0.000	3.975	1.525		
CANT	SDL	C				4.600			44.100	
CANT	SDL	C				4.000			117.600	
CANT	SDL	L		7.000		0.000	4.650			
CANT	SDL	R		3.450		0.000	4.650			
CANT	SDL	Z		2.290		0.000	3.975	1.525		

NOTE: LIVE LOADING is SKIPPED with a skip factor of 1.00

3.2 Compiled loads

Span	Class	Type	P1	P2	F	M	A	B	C	Reduction Factor
			kN/m	kN/m	kN	kN-m	m	m	m	%
1	LL	R	5.310				4.750	9.000		0.000
1	LL	T								0.000
1	LL	T								0.000
1	LL	T								0.000
1	LL	T								0.000
1	SW	P	9.625				0.000	9.000		
1	SW	R	7.650				4.750	9.000		
1	SW	T								
1	SW	T								
1	SW	T								
1	SW	T								
1	SDL	P	7.000				0.000	9.000		
1	SDL	R	3.190				4.750	9.000		
1	SDL	T								
1	SDL	T								
1	SDL	T								
1	SDL	T								
CR	LL	C			16.750		4.650			0.000
CR	LL	C			25.280		4.000			0.000
CR	LL	R	5.750				0.000	3.980		0.000
CR	LL	R	5.750				3.980	4.650		0.000
CR	LL	T								0.000

CR	SW	C			73.570		4.650			
CR	SW	C			13.670		4.000			
CR	SW	P	12.250				0.000	4.650		
CR	SW	R	8.280				0.000	3.980		
CR	SW	R	8.280				3.980	4.650		
CR	SW	T								
CR	SDL	C			44.100		4.600			
CR	SDL	C			117.600		4.000			
CR	SDL	P	7.000				0.000	4.650		
CR	SDL	R	3.450				0.000	3.980		
CR	SDL	R	3.450				3.980	4.650		
CR	SDL	T								

4 - CALCULATED SECTION PROPERTIES

4.2 Section Properties for Non-Uniform Spans

Span	Seg.	Area	Yb	Yt	b_eff	i	Yb	Yt
		mm2	mm	mm	mm	mm4	mm	mm
1	1	722500.00	438.49	261.51	2250.00	0.3237E+11	438.49	261.51
1	2	602500.00	401.35	298.65	1450.00	0.2714E+11	401.35	298.65
1	3	722500.00	438.49	261.51	2250.00	0.3237E+11	438.49	261.51
CR	1	665500.00	462.08	387.92	1170.00	0.4368E+11	462.08	387.92
CR	2	653500.00	456.33	393.67	1090.00	0.4246E+11	456.33	393.67

5 - MOMENTS, SHEARS AND REACTIONS

5.1 Span Moments and Shears (Excluding Live Load)

Span	Load Case	Moment Left	Moment Midspan	Moment Right	Shear Left	Shear Right
		kN-m	kN-m	kN-m	kN	kN
1	SW	-74.41	43.29	-128.67	-58.19	76.35
CANT	SW	-600.71	-----	-----	-176.90	-----
1	SDL	-41.27	24.15	-91.71	-34.62	48.37
CANT	SDL	-778.74	-----	-----	-207.88	-----
1	XL	0.00	0.00	0.00	0.00	0.00
CANT	XL	0.00	-----	-----	0.00	-----

5.2 Reactions and Column Moments (Excluding Live Load)

Joint	Load Case	Reaction	Moment Lower Column	Moment Upper Column
		kN	kN-m	kN-m
1	SW	58.19	-37.21	-37.21
2	SW	253.25	-236.02	-236.02
1	SDL	34.62	-20.63	-20.63
2	SDL	256.25	-343.51	-343.51
1	XL	0.00	0.00	0.00
2	XL	0.00	0.00	0.00

5.3 Span Moments and Shears (Live Load)

Span	Moment Left Max	Moment Left Min	Moment Midspan Max	Moment Midspan Min	Moment Right Max	Moment Right Min	Shear Left	Shear Right
	kN-m	kN-m	kN-m	kN-m	kN-m	kN-m	kN	kN
1	-17.82	3.27	9.71	-2.00	-35.80	-7.28	-13.32	21.11
CR	-228.64	-----	-----	-----	-----	-----	-64.73	-----

5.4 Reactions and Column Moments (Live Load)

Joint	Reaction Max	Reaction Min	Moment Lower Column Max	Moment Lower Column Min	Moment Upper Column Max	Moment Upper Column Min
	kN	kN	kN-m	kN-m	kN-m	kN-m
1	13.32	-1.17	1.64	-8.91	1.64	-8.91
2	85.84	19.93	14.26	-110.68	14.26	-110.68

6 - MOMENTS REDUCED TO FACE OF SUPPORT

6.1 Reduced Moments at Face of Support (Excluding Live Load)

Span	Load Case	Moment Left	Moment Midspan	Moment Right
		kN-m	kN-m	kN-m
1	SW	-74.41	43.29	-128.70
CANT	SW	-600.70	-----	-----
1	SDL	-41.27	24.15	-91.71
CANT	SDL	-778.70	-----	-----
1	XL	0.00	0.00	0.00
CANT	XL	0.00	-----	-----

6.2 Reduced Moments at Face of Support (Live Load)

Span	Moment Left Max	Moment Left Min	Moment Midspan Max	Moment Midspan Min	Moment Right Max	Moment Right Min
	kN-m	kN-m	kN-m	kN-m	kN-m	kN-m
1	-17.82	3.27	9.71	-2.00	-35.80	-7.28
CR	-225.20	-----	-----	-----	-----	-----

7 - SELECTED POST-TENSIONING FORCES AND TENDON PROFILES

7.1 Tendon Profile

Tendon A

Span	Type	X1/L	X2/L	X3/L	A/L
1	1	0.100	0.500	0.100	---
CR	5	1.000	---	---	---

7.2 Selected Post-Tensioning Forces and Tendon Drape

Tendon A

Span	Force	CGS Left	CGS C1	CGS C2	CGS Right	P/A	Wbal	WBal (%DL)
	kN	mm	mm	mm	mm	MPa	kN/-	
1	4876.000	500.00	---	436.00	652.00	8.09	67.421	214
CR	4968.000	652.00	---	---	504.00	7.47	68.009	75

All Tendons

Span	Force	Total P/A	Total WBal (%DL)
	kN	MPa	
1	4876	8.09	214
CR	4968	7.47	75

Approximate weight of strand: 440.5 Kg

7.4 Required Minimum Post-Tensioning Forces

Type	Based on Stress Conditions			Based on Minimum P/A		
	Left	Center	Right	Left	Center	Right
	kN	kN	kN	kN	kN	kN
1	0.00	0.00	0.00	614.12	614.12	614.12
CR	3298.89	-----	-----	565.67	-----	-----

7.5 Service Stresses (tension shown positive)

Envelope of Service 1

Span	Left Top Max-T	Left Top Max-C	Left Bot Max-T	Left Bot Max-C	Center Top Max-T	Center Top Max-C	Center Bot Max-T	Center Bot Max-C	Right Top Max-T	Right Top Max-C	Right Bot Max-T	Right Bot Max-C
	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa
1	-----	-7.46	-----	-5.64	-----	-7.10	-----	-9.48	-----	-9.02	-----	-3.43
CR	-----	-3.66	-----	-12.72	-----	-----	-----	-----	-----	-----	-----	-----

Envelope of Service 2

Span	Left Top Max-T	Left Top Max-C	Left Bot Max-T	Left Bot Max-C	Center Top Max-T	Center Top Max-C	Center Bot Max-T	Center Bot Max-C	Right Top Max-T	Right Top Max-C	Right Bot Max-T	Right Bot Max-C
	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa
1	-----	-7.48	-----	-5.81	-----	-7.18	-----	-9.50	-----	-9.02	-----	-3.77
CR	-----	-3.66	-----	-14.39	-----	-----	-----	-----	-----	-----	-----	-----

7.6 Post-Tensioning Balance Moments, Shears and Reactions

Span Moments and Shears

Span	Moment Left	Moment Center	Moment Right	Shear Left	Shear Right
	kN-m	kN-m	kN-m	kN	kN
1	202.70	-160.40	485.50	51.59	51.59
CR	943.50	-----	-----	0.00	-----

Reactions and Column Moments

Joint	Reaction	Moment Lower Column	Moment Upper Column
	kN	kN-m	kN-m
1	-51.590	317.100	317.100
2	51.590	-84.970	-84.970

Note: Moments are reported at centerline

8 - FACTORED MOMENTS AND REACTIONS ENVELOPE

8.1 Factored Design Moments (Not Redistributed)

Span	Left Max	Left Min	Middle Max	Middle Min	Right Max	Right Min
	kN-m	kN-m	kN-m	kN-m	kN-m	kN-m
1	466.87	500.62	498.57	479.82	-151.87	-106.23
CR	-2015.60	-----	-----	-----	-----	-----

8.2 Reactions and Column Moments

Joint	Reaction Max	Reaction Min	Moment Lower Column Max	Moment Lower Column Min	Moment Upper Column Max	Moment Upper Column Min
	kN	kN	kN-m	kN-m	kN-m	kN-m
1	81.09	57.91	250.31	233.43	250.31	233.43
2	800.45	695.00	-757.55	-957.49	-757.55	-957.49

8.3 Secondary Moments

Span	Left	Midspan	Right
	kN-m	kN-m	kN-m
1	634.20	402.10	169.90

Note: Moments are reported at centerline

10 - MILD STEEL - NO REDISTRIBUTION

10.1 Required Rebar

10.1.1 Total Strip Required Rebar

Span	Location	From	To	As Required	Ultimate	Minimum	Initial	UBC
		m	m	mm2	mm2	mm2	mm2	mm2
1	TOP	0.00	1.35	1662.00	0.00	1662.00	0.00	0.00
1	TOP	7.65	9.00	1662.00	0.00	1662.00	0.00	0.00
CR	TOP	0.00	0.70	1368.00	0.00	1368.00	0.00	0.00
1	BOT	3.15	5.85	1228.00	0.00	1228.00	0.00	0.00

10.2 Provided Rebar

10.2.1 Total Strip Provided Rebar

Span	ID	Location	From	Quantity	Size	Length	Area
			m			m	mm2
1	1	TOP	0.00	2	16	13.66	401.92
1	2	TOP	0.00	7	16	2.26	1406.72
1	3	TOP	6.67	7	16	4.66	1406.72
1	4	BOT	0.00	3	25	13.66	1471.89

10.2.2 Total Strip Steel Disposition

Span	ID	Location	From	Quantity	Size	Length
			m			m
1	1	TOP	0.00	2	16	9.00
1	2	TOP	0.00	7	16	2.26
1	3	TOP	6.67	7	16	2.33
CR	1	TOP	0.00	2	16	4.66
CR	3	TOP	0.00	7	16	2.34
1	4	BOT	0.00	3	25	9.00
CR	4	BOT	0.00	3	25	4.66

12 - SHEAR REINFORCEMENT

12.1 Shear Calculation Envelope

SPAN 1

X/L	X	d	Vu,max	Mu,max	Ratio	Req.	Spacing	Base
	m	mm	kN	kNm		mm2/m	mm	
0.00	0.00	560.00	-81.10	505.60	0.28	0.000	0.00	---
0.05	0.45	560.00	-70.08	529.70	0.24	0.000	0.00	---
0.10	0.90	560.00	-54.95	548.60	0.19	0.000	0.00	---
0.15	1.35	560.00	-35.82	561.20	0.12	0.000	0.00	---
0.20	1.80	560.00	-15.51	567.60	0.05	0.000	0.00	---
0.25	2.25	560.00	9.75	571.00	0.03	0.000	0.00	---
0.30	2.70	560.00	21.08	566.40	0.07	0.000	0.00	---
0.35	3.15	560.00	30.47	557.60	0.11	0.000	0.00	---
0.40	3.60	560.00	43.84	543.20	0.15	0.000	0.00	---
0.45	4.05	560.00	59.48	521.00	0.21	0.000	0.00	---
0.50	4.50	560.00	60.06	503.60	0.21	0.000	0.00	---
0.55	4.95	560.00	70.27	472.10	0.24	0.000	0.00	---
0.60	5.40	560.00	83.47	437.10	0.29	0.000	0.00	---
0.65	5.85	560.00	99.59	395.70	0.34	0.000	0.00	---
0.70	6.30	560.00	118.60	346.20	0.41	0.000	0.00	---
0.75	6.75	560.00	141.70	299.10	0.46	0.000	0.00	---
0.80	7.20	560.00	166.70	229.80	0.43	0.000	0.00	---
0.85	7.65	560.00	189.60	149.60	0.37	0.000	0.00	---
0.90	8.10	560.00	208.90	67.79	0.29	0.000	0.00	---

0.95	8.55	560.00	224.00	-17.19	0.31	0.000	0.00	---
1.00	9.00	560.00	235.00	-107.30	0.33	0.000	0.00	---

CR

X/L	X	d	Vu,max	Mu,max	Ratio	Req.	Spacing	Base
	m	mm	kN	kNm		mm2/m	mm	
0.00	0.00	680.00	-565.30	-1663.00	1.35	619.000	600.00	---
0.05	0.23	680.00	-559.40	-1564.00	1.30	557.200	600.00	---
0.10	0.47	680.00	-552.20	-1458.00	1.25	478.400	600.00	---
0.15	0.70	680.00	-543.90	-1353.00	1.20	388.200	600.00	---
0.20	0.93	680.00	-534.40	-1250.00	1.14	303.300	600.00	---
0.25	1.16	680.00	-523.70	-1149.00	1.08	303.300	600.00	---
0.30	1.40	680.00	-511.90	-1050.00	1.02	303.300	600.00	---
0.35	1.63	680.00	-498.90	-953.40	0.95	303.300	600.00	---
0.40	1.86	680.00	-485.20	-859.10	0.88	303.300	600.00	---
0.45	2.09	680.00	-471.00	-767.30	0.81	303.300	600.00	---
0.50	2.33	680.00	-457.20	-678.00	0.73	303.300	600.00	---
0.55	2.56	680.00	-444.10	-591.10	0.65	303.300	600.00	---
0.60	2.79	680.00	-432.10	-506.50	0.58	303.300	600.00	---
0.65	3.02	680.00	-421.30	-424.00	0.50	0.000	0.00	---
0.70	3.25	680.00	-411.70	-343.50	0.47	0.000	0.00	---
0.75	3.49	680.00	-403.20	-264.70	0.46	0.000	0.00	---
0.80	3.72	680.00	-396.00	-187.50	0.45	0.000	0.00	---
0.85	3.95	680.00	-389.90	-111.80	0.44	0.000	0.00	---
0.90	4.18	680.00	-185.10	-66.84	0.21	0.000	0.00	---
0.95	4.42	680.00	-175.30	-31.21	0.20	0.000	0.00	---
1.00	4.65	680.00	-115.10	-0.00	0.13	0.000	0.00	---

Note: "Ratio" is calculated using paired shear (V) and moment (M) design values resulting in the lowest concrete capacity. For ACI and CSA codes, the lowest value of V*d/M is used.
Note: Sections with **** have exceeded the maximum allowable shear stress.
Note: Sections marked with xxxx have insufficient depth for shear design.
Note: Base stirrups flagged as OK satisfy the requirements - additional reinforcement is not needed. Base stirrups flagged as NS are not sufficient - additional stirrups are reported in the table.

14 - DEFLECTIONS

14.1 Maximum Span Deflections - Service Combination 1

Span	SW	SW+PT	SW+PT+ SDL	SW+PT+SDL +Creep	LL	X	Sustained	Total
	mm	mm	mm	mm	mm	mm	mm	mm
1	0.3	-1.4	-1.3	-3.9(2323)	0.0(*****)	0.0(*****)	-3.9(2309)	-3.9(2299)
CR	3.4	-1.5	3.0	8.9(524)	1.3(3574)	0.0(*****)	10.0(463)	10.9(424)

14.3 Maximum Span Deflections - Service Combination 3

Span	SW	SW+PT	SW+PT+ SDL	SW+PT+SDL +Creep	LL	X	Sustained	Total
	mm	mm	mm	mm	mm	mm	mm	mm
1	0.3	-1.4	-1.3	-3.9(2323)	0.0(*****)	0.0(*****)	-3.9(2323)	-3.9(2308)
CR	3.4	-1.5	3.0	8.9(524)	1.3(3574)	0.0(*****)	8.9(524)	10.2(457)

Note: Deflections are calculated using effective moment of inertia of cracked sections.

BP - 24
B163 - B 177 (LT 2 -3)

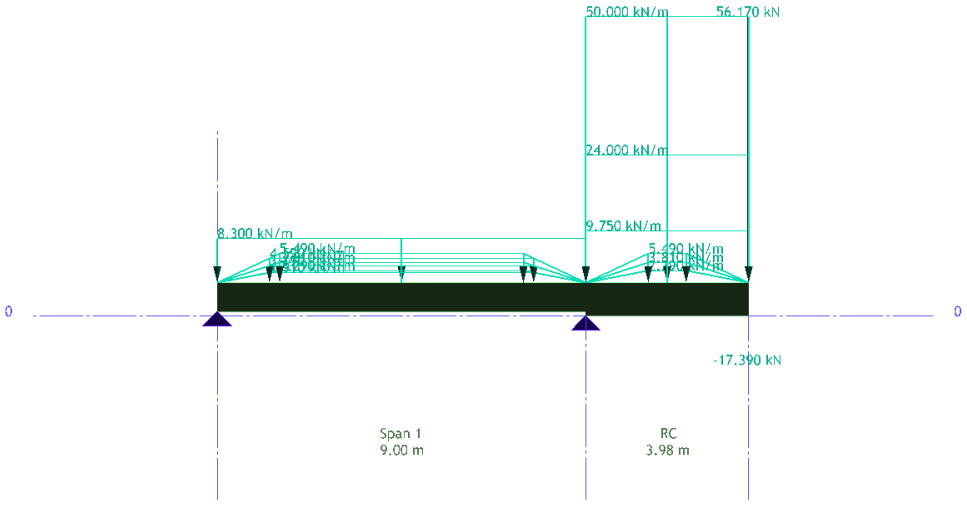


TABLE OF CONTENT:

1 - USER SPECIFIED GENERAL ANALYSIS AND DESIGN PARAMETERS

Parameter	Value	Parameter	Value
Concrete		Minimum Cover at BOTTOM	40.00 mm
F'c for BEAMS/SLABS	35.00 N/mm 2	Post-tensioning	
F'ci for BEAMS/SLABS	29.75 N/mm 2	SYSTEM	BONDED
Ec for BEAMS/SLABS	27806.00 N/mm 2	Fpu	1860.00 N/mm 2
CREEP factor	2.00	Fse	1200.00 N/mm 2
CONCRETE WEIGHT	NORMAL	Strand area	99.000 mm 2
Tension stress limits / (f'c)1/2		Min CGS from TOP	120.00 mm
At Top	0.500	Min CGS from BOT for interior spans	120.00 mm
At Bottom	0.500	Min CGS from BOT for exterior spans	400.00 mm
Compression stress limits / f'c		Min average precompression	0.85 N/mm 2
At all locations	0.450	Max spacing / slab depth	8.00
Tension stress limits (initial) / (f'c)1/2		Analysis and design options	
At Top	0.250	Structural system	BEAM
At Bottom	0.250	Moment of Inertia over support is	NOT INCREASED
Compression stress limits (initial) / f'c		Moments reduced to face of support	NO
At all locations	0.600	Moment Redistribution	NO
Reinforcement		Effective flange width consideration	YES
Fy (Main bars)	400.00 N/mm 2	Effective flange width implementation method	ACI-318
Fy (Shear reinforcement)	240.00 N/mm 2	DESIGN CODE SELECTED	American-ACI318 (2014)/IBC 2015
Minimum Cover at TOP	40.00 mm		

2 - INPUT GEOMETRY

2.1 Principal Span Data of Uniform Spans

Span	Form	Length	Width	Depth	TF Width	TF Thick.	BF/MF Width	BF/MF Thick.	Rh	Right Mult.	Left Mult.
		m	mm	mm	mm	mm	mm	mm	mm		
1	2	9.00	600	700	2250	150			800	0.50	0.50
C	2	3.97	600	800	990	150			800	1.00	0.00

2.3 Effective Width Data of Uniform Spans

Span	Effective Width
	mm
1	2250
CR	931

2.7 Support Width and Column Data

Joint	Support Width	Length LC	B(DIA.) LC	D LC	% LC	CBC LC	Length UC	B(DIA.) UC	D UC	% UC	CBC UC
	mm	m	mm	mm			m	mm	mm		
1	0.0	0.0	0.0	0.0	100	(1)					
2	0.0	0.0	0.0	0.0	100	(1)					

3 - INPUT APPLIED LOADING

3.1 Loading As Appears in User's Input Screen

Span	Class	Type	W	P1	P2	A	B	C	F	M
			kN/m2	kN/m	kN/m	m	m	m	kN	kN-m
1	LL	Z		3.190		0.000	9.000	1.275		
1	LL	Z		3.810		0.000	9.000	1.525		

1	D	L		8.300		0.000	9.000			
1	D	Z		4.590		0.000	9.000	1.275		
1	D	Z		5.490		0.000	9.000	1.525		
1	SDL	Z		1.910		0.000	9.000	1.275		
1	SDL	Z		2.290		0.000	9.000	1.525		
CANT	LL	C				3.975			-17.390	
CANT	LL	L		24.000		0.000	3.975			
CANT	LL	Z		3.810		0.000	3.975	1.525		
CANT	D	L		9.750		0.000	3.975			
CANT	D	Z		5.490		0.000	3.975	1.525		
CANT	SDL	C				3.975			56.170	
CANT	SDL	L		50.000		0.000	3.975			
CANT	SDL	Z		2.290		0.000	3.975	1.525		

NOTE: LIVE LOADING is SKIPPED with a skip factor of 1.00

3.2 Compiled loads

Span	Class	Type	P1	P2	F	M	A	B	C	Reduction Factor
			kN/m	kN/m	kN	kN-m	m	m	m	%
1	LL	T								0.000
1	LL	T								0.000
1	SW	P	8.300				0.000	9.000		
1	SW	T								
1	SW	T								
1	SDL	T								
1	SDL	T								
CR	LL	C			-17.390		3.975			0.000
CR	LL	P	24.000				0.000	3.975		0.000
CR	LL	T								0.000
CR	SW	P	9.750				0.000	3.975		
CR	SW	T								
CR	SDL	C			56.170		3.975			
CR	SDL	P	50.000				0.000	3.975		
CR	SDL	T								

4 - CALCULATED SECTION PROPERTIES

4.1 Section Properties of Uniform Spans and Cantilevers

Span	Area	Yb	Yt	b_eff	I	Yb	Yt
	mm2	mm	mm	mm	mm4	mm	mm
1	667500.00	451.97	248.03	2250.00	0.2939E+11	451.97	248.03
CANT	538500.00	435.31	364.69	931.25	0.3045E+11	430.49	369.51

5 - MOMENTS, SHEARS AND REACTIONS

5.1 Span Moments and Shears (Excluding Live Load)

Span	Load Case	Moment Left	Moment Midspan	Moment Right	Shear Left	Shear Right
		kN-m	kN-m	kN-m	kN	kN
1	SW	0.00	130.85	-103.76	-64.07	87.13
CANT	SW	-103.76	-----	-----	-52.21	-----
1	SDL	0.00	-273.61	-629.46	54.00	85.88
CANT	SDL	-629.44	-----	-----	-260.53	-----
1	XL	0.00	0.00	0.00	0.00	0.00
CANT	XL	0.00	-----	-----	0.00	-----

5.2 Reactions and Column Moments (Excluding Live Load)

Joint	Load Case	Reaction	Moment Lower Column	Moment Upper Column
		kN	kN-m	kN-m
1	SW	64.07	0.00	0.00
2	SW	139.33	0.00	0.00
1	SDL	-54.00	0.00	0.00
2	SDL	346.41	0.00	0.00
1	XL	0.00	0.00	0.00
2	XL	0.00	0.00	0.00

5.3 Span Moments and Shears (Live Load)

Span	Moment Left Max	Moment Left Min	Moment Midspan Max	Moment Midspan Min	Moment Right Max	Moment Right Min	Shear Left	Shear Right
	kN-m	kN-m	kN-m	kN-m	kN-m	kN-m	kN	kN
1	0.00	0.00	68.54	-69.52	-139.04	0.00	-26.56	42.01
CR	-139.03	-----	-----	-----	-----	-----	-87.34	-----

5.4 Reactions and Column Moments (Live Load)

Joint	Reaction Max	Reaction Min	Moment Lower Column Max	Moment Lower Column Min	Moment Upper Column Max	Moment Upper Column Min
	kN	kN	kN-m	kN-m	kN-m	kN-m
1	26.56	-15.45	0.00	0.00	0.00	0.00
2	129.35	26.56	0.00	0.00	0.00	0.00

6 - MOMENTS REDUCED TO FACE OF SUPPORT

6.1 Reduced Moments at Face of Support (Excluding Live Load)

Span	Load Case	Moment Left	Moment Midspan	Moment Right
		kN-m	kN-m	kN-m
1	SW	0.00	130.80	-103.80
CANT	SW	-103.80	-----	-----
1	SDL	0.00	-273.60	-629.50
CANT	SDL	-629.40	-----	-----
1	XL	0.00	0.00	0.00
CANT	XL	0.00	-----	-----

6.2 Reduced Moments at Face of Support (Live Load)

Span	Moment Left Max	Moment Left Min	Moment Midspan Max	Moment Midspan Min	Moment Right Max	Moment Right Min
	kN-m	kN-m	kN-m	kN-m	kN-m	kN-m
1	0.00	0.00	68.54	-69.52	-139.00	0.00
CR	-135.60	-----	-----	-----	-----	-----

7 - SELECTED POST-TENSIONING FORCES AND TENDON PROFILES

7.1 Tendon Profile
Tendon A

Span	Type	X1/L	X2/L	X3/L	A/L
1	1	0.100	0.500	0.100	---
CR	1	0.000	---	---	---

7.2 Selected Post-Tensioning Forces and Tendon Drape

Tendon A

Span	Force	CGS Left	CGS C1	CGS C2	CGS Right	P/A	Wbal	WBal (%DL)
	kN	mm	mm	mm	mm	MPa	kN/-	
1	3356.160	500.00	---	500.00	680.00	5.03	29.833	132
CR	3238.400	680.00	---	---	450.00	6.01	94.279	115

All Tendons

Span	Force	Total P/A	Total WBal (%DL)
	kN	MPa	
1	3356.16	5.03	132
CR	3238.4	6.01	115

Approximate weight of strand: 282.5 Kg

7.4 Required Minimum Post-Tensioning Forces

	Based on Stress Conditions			Based on Minimum P/A		
Type	Left	Center	Right	Left	Center	Right
	kN	kN	kN	kN	kN	kN
1	0.00	0.00	1806.07	567.38	567.37	567.38
CR	1587.46	-----	-----	457.72	-----	-----

7.5 Service Stresses (tension shown positive)

Envelope of Service 1

Span	Left Top Max-T	Left Top Max-C	Left Bot Max-T	Left Bot Max-C	Center Top Max-T	Center Top Max-C	Center Bot Max-T	Center Bot Max-C	Right Top Max-T	Right Top Max-C	Right Bot Max-T	Right Bot Max-C
	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa
1	-----	-3.56	-----	-7.71	-----	-2.29	-----	-10.66	-----	-1.99	-----	-11.20
CR	-----	-6.49	-----	-6.04	-----	-----	-----	-----	-----	-----	-----	-----

Envelope of Service 2

Span	Left Top Max-T	Left Top Max-C	Left Bot Max-T	Left Bot Max-C	Center Top Max-T	Center Top Max-C	Center Bot Max-T	Center Bot Max-C	Right Top Max-T	Right Top Max-C	Right Bot Max-T	Right Bot Max-C
	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa	MPa
1	-----	-3.56	-----	-7.71	-----	-2.69	-----	-11.40	-----	-1.99	-----	-12.69
CR	-----	-6.49	-----	-7.38	-----	-----	-----	-----	-----	-----	-----	-----

7.6 Post-Tensioning Balance Moments, Shears and Reactions

Span Moments and Shears

Span	Moment Left	Moment Center	Moment Right	Shear Left	Shear Right
	kN-m	kN-m	kN-m	kN	kN
1	-174.40	-202.40	373.80	6.21	6.21
CR	765.30	-----	-----	0.00	-----

Reactions and Column Moments

Joint	Reaction	Moment Lower Column	Moment Upper Column
	kN	kN-m	kN-m
1	-6.210	0.000	0.000
2	6.210	0.000	0.000

Note: Moments are reported at centerline

8 - FACTORED MOMENTS AND REACTIONS ENVELOPE

8.1 Factored Design Moments (Not Redistributed)

Span	Left	Left	Middle	Middle	Right	Right

	Max	Min	Max	Min	Max	Min
	kN-m	kN-m	kN-m	kN-m	kN-m	kN-m
1	0.00	0.00	-61.70	-282.59	-1102.36	-879.96
CR	-1096.80	-----	-----	-----	-----	-----

8.2 Reactions and Column Moments

Joint	Reaction Max	Reaction Min	Moment Lower Column Max	Moment Lower Column Min	Moment Upper Column Max	Moment Upper Column Min
	kN	kN	kN-m	kN-m	kN-m	kN-m
1	48.37	-18.85	0.00	0.00	0.00	0.00
2	796.09	631.55	0.00	0.00	0.00	0.00

8.3 Secondary Moments

Span	Left	Midspan	Right
	kN-m	kN-m	kN-m
1	0.00	0.00	0.00

Note: Moments are reported at centerline

10 - MILD STEEL - NO REDISTRIBUTION

10.1 Required Rebar

10.1.1 Total Strip Required Rebar

Span	Location	From	To	As Required	Ultimate	Minimum	Initial	UBC
		m	m	mm2	mm2	mm2	mm2	mm2
1	BOT	6.75	9.00	952.00	952.00	0.00	0.00	0.00
CR	BOT	0.00	0.60	983.60	0.00	0.00	983.60	0.00

10.2 Provided Rebar

10.2.1 Total Strip Provided Rebar

Span	ID	Location	From	Quantity	Size	Length	Area
			m			m	mm2
1	1	BOT	0.00	3	25	12.98	1471.89

10.2.2 Total Strip Steel Disposition

Span	ID	Location	From	Quantity	Size	Length
			m			m
1	1	BOT	0.00	3	25	9.00
CR	1	BOT	0.00	3	25	3.98

12 - SHEAR REINFORCEMENT

12.1 Shear Calculation Envelope
SPAN 1

X/L	X	d	Vu,max	Mu,max	Ratio	Req.	Spacing	Base
	m	mm	kN	kNm		mm2/m	mm	
0.00	0.00	560.00	-54.58	0.00	0.09	0.000	0.00	---
0.05	0.45	560.00	-48.04	23.49	0.08	0.000	0.00	---
0.10	0.90	560.00	-37.42	43.06	0.15	0.000	0.00	---
0.15	1.35	560.00	37.22	56.87	0.15	0.000	0.00	---
0.20	1.80	560.00	49.32	63.31	0.20	0.000	0.00	---
0.25	2.25	560.00	61.51	62.01	0.21	0.000	0.00	---
0.30	2.70	560.00	73.70	52.80	0.18	0.000	0.00	---
0.35	3.15	560.00	85.91	35.85	0.14	0.000	0.00	---

0.40	3.60	560.00	63.30	-185.10	0.19	0.000	0.00	---
0.45	4.05	560.00	110.30	-21.77	0.36	0.000	0.00	---
0.50	4.50	560.00	122.50	-62.19	0.43	0.000	0.00	---
0.55	4.95	560.00	139.70	-110.60	0.52	467.400	525.00	---
0.60	5.40	560.00	156.90	-166.90	0.62	467.400	525.00	---
0.65	5.85	560.00	174.20	-230.90	0.70	467.400	525.00	---
0.70	6.30	560.00	191.40	-302.70	0.77	467.400	525.00	---
0.75	6.75	560.00	208.60	-382.30	0.84	467.400	525.00	---
0.80	7.20	560.00	225.90	-469.90	0.91	467.400	525.00	---
0.85	7.65	560.00	243.00	-565.20	0.98	467.400	525.00	---
0.90	8.10	560.00	257.70	-667.80	1.04	467.400	525.00	---
0.95	8.55	571.00	268.30	-776.40	1.06	462.900	525.00	---
1.00	9.00	580.00	274.80	-888.80	1.07	459.300	525.00	---

CR

X/L	X	d	Vu,max	Mu,max	Ratio	Req.	Spacing	Base
	m	mm	kN	kNm		mm2/m	mm	
0.00	0.00	680.00	-515.00	-880.20	0.99	409.300	600.00	---
0.05	0.20	657.60	-493.00	-814.80	0.97	416.200	600.00	---
0.10	0.40	640.00	-470.50	-743.70	0.94	421.900	600.00	---
0.15	0.60	640.00	-447.60	-675.70	0.88	421.900	600.00	---
0.20	0.80	640.00	-424.30	-610.70	0.82	421.900	600.00	---
0.25	0.99	640.00	-400.60	-548.80	0.75	421.900	600.00	---
0.30	1.19	640.00	-376.60	-489.80	0.69	421.900	600.00	---
0.35	1.39	640.00	-352.10	-434.10	0.63	421.900	600.00	---
0.40	1.59	640.00	-327.20	-381.60	0.56	421.900	600.00	---
0.45	1.79	640.00	-302.20	-332.30	0.50	0.000	0.00	---
0.50	1.99	640.00	-277.30	-286.30	0.44	0.000	0.00	---
0.55	2.19	640.00	-252.40	-243.50	0.38	0.000	0.00	---
0.60	2.38	640.00	-227.40	-203.90	0.32	0.000	0.00	---
0.65	2.58	640.00	-202.60	-167.60	0.29	0.000	0.00	---
0.70	2.78	640.00	-183.50	-156.90	0.26	0.000	0.00	---
0.75	2.98	640.00	-165.30	-121.80	0.23	0.000	0.00	---
0.80	3.18	640.00	-147.40	-90.44	0.21	0.000	0.00	---
0.85	3.38	640.00	-129.80	-62.63	0.18	0.000	0.00	---
0.90	3.58	640.00	-112.40	-38.32	0.16	0.000	0.00	---
0.95	3.78	640.00	-95.41	-17.46	0.13	0.000	0.00	---
1.00	3.98	640.00	-78.64	-0.00	0.11	0.000	0.00	---

Note: "Ratio" is calculated using paired shear (V) and moment (M) design values resulting in the lowest concrete capacity. For ACI and CSA codes, the lowest value of V*d/M is used.
Note: Sections with **** have exceeded the maximum allowable shear stress.
Note: Sections marked with xxxx have insufficient depth for shear design.
Note: Base stirrups flagged as OK satisfy the requirements - additional reinforcement is not needed. Base stirrups flagged as NS are not sufficient - additional stirrups are reported in the table.

14 - DEFLECTIONS

14.1 Maximum Span Deflections - Service Combination 1

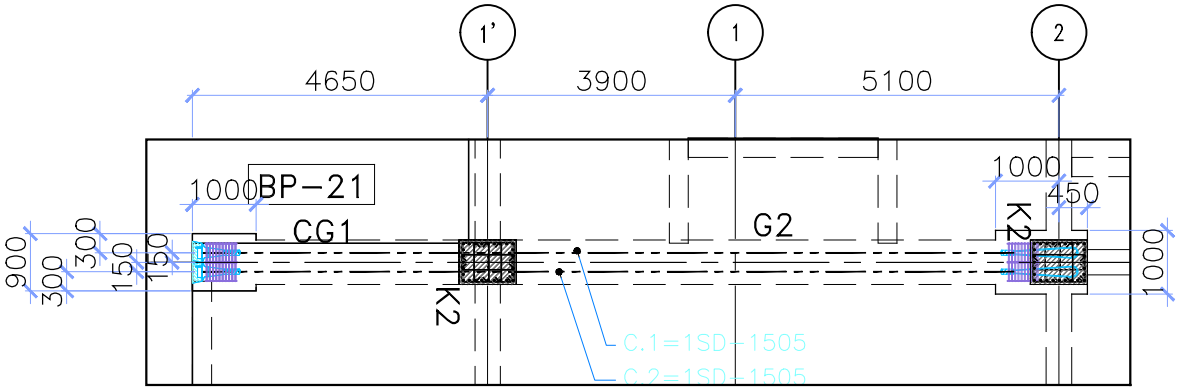
Span	SW	SW+PT	SW+PT+SDL	SW+PT+SDL+Creep	LL	X	Sustained	Total
	mm	mm	mm	mm	mm	mm	mm	mm
1	1.2	-0.6	-4.0	-12.0(747)	-0.9(10205)	0.0(*****)	-12.8(701)	-13.4(669)
CR	-0.7	-4.5	7.4	22.1(179)	2.6(1550)	0.0(*****)	24.4(162)	26.2(151)

14.3 Maximum Span Deflections - Service Combination 3

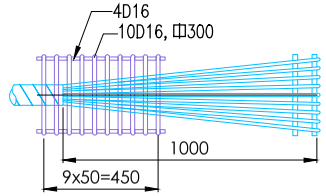
Span	SW	SW+PT	SW+PT+SDL	SW+PT+SDL+Creep	LL	X	Sustained	Total
	mm	mm	mm	mm	mm	mm	mm	mm

1	1.2	-0.6	-4.0	-12.0(747)	-0.9(10205)	0.0(*****)	-12.0(747)	-12.9(696)
CR	-0.7	-4.5	7.4	22.1(179)	2.6(1550)	0.0(*****)	22.1(179)	24.7(161)

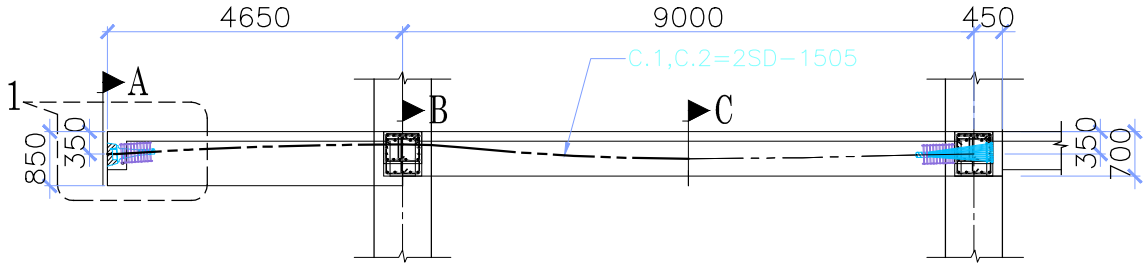
Note: Deflections are calculated using effective moment of inertia of cracked sections.



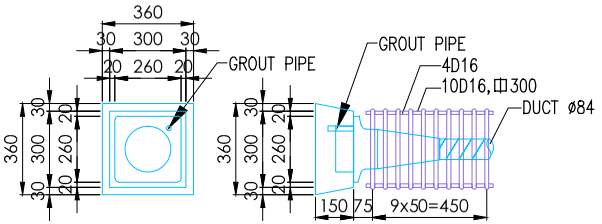
PLAN VIEW BP-21 (700x850/700)



BURSTING STEEL FOR LOOP DEAD ANCHORAGE

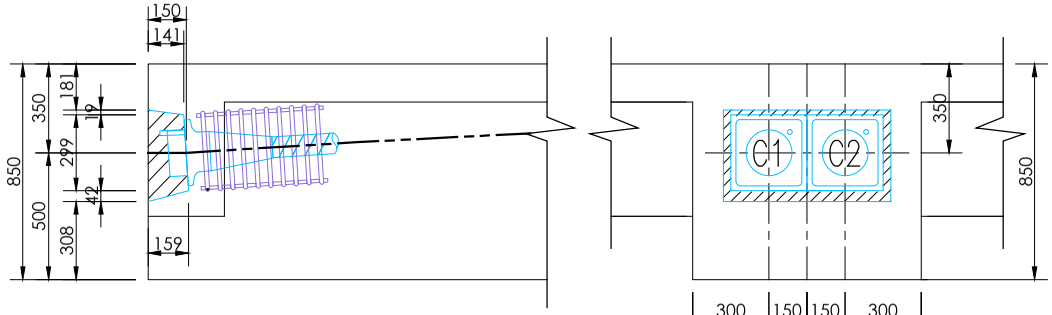


CABLE PROFILE BP-21 (700x850/700)



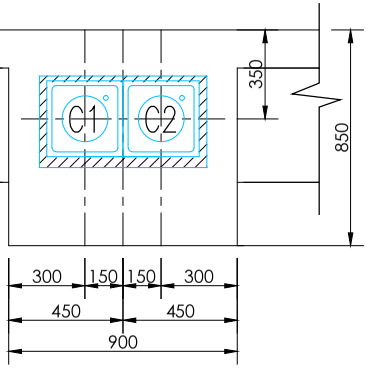
BOX-OUT & BURSTING STEEL DETAILS for (13s-19s)

SCALE 1 : 25



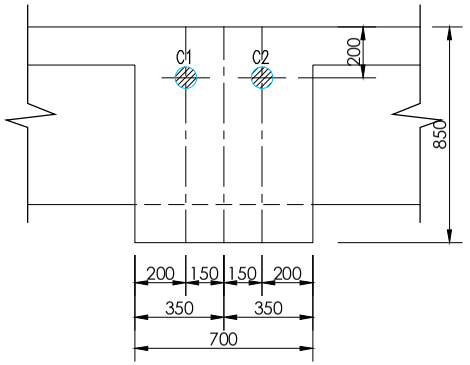
DETAIL - 1

SCALE 1:25



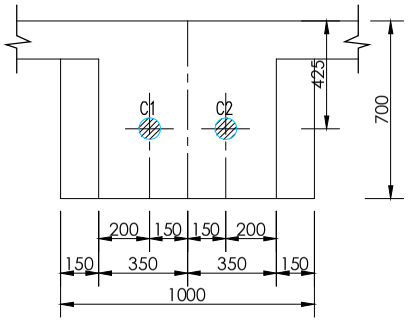
SECTION - A

SCALE 1:25



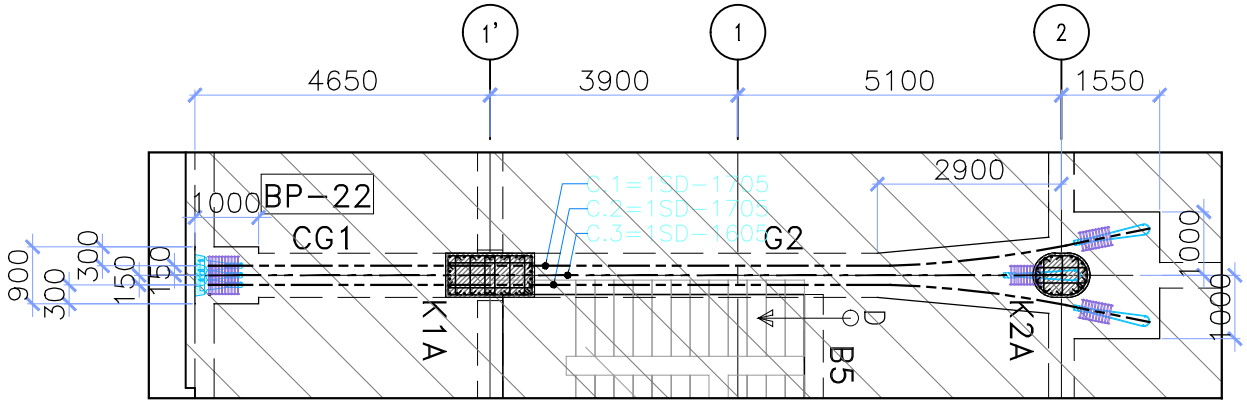
SECTION - B

SCALE 1:25

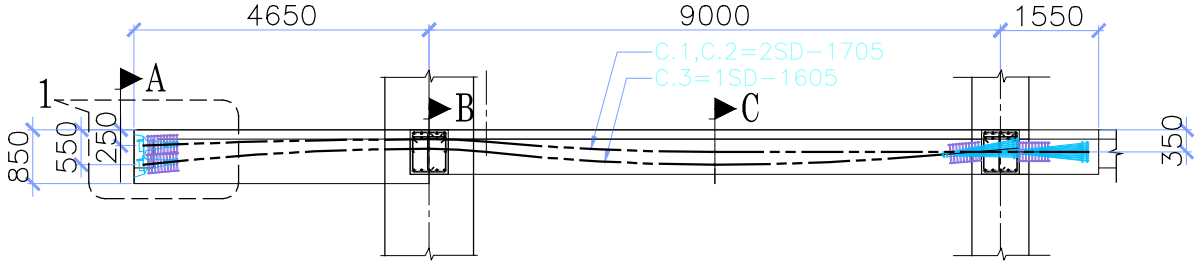


SECTION - C

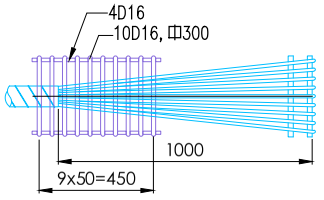
SCALE 1:25



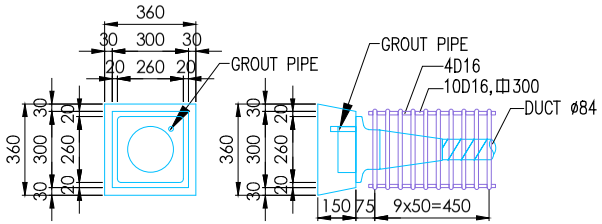
PLAN VIEW BP-22 (700x850/700)



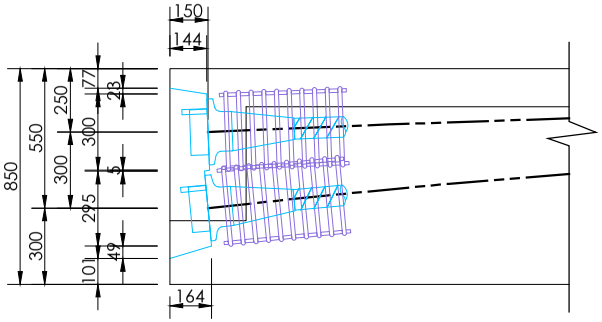
CABLE PROFILE BP-22 (700x850/700)



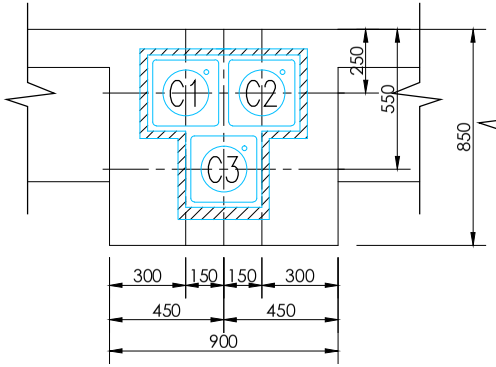
BURSTING STEEL FOR LOOP DEAD ANCHORAGE



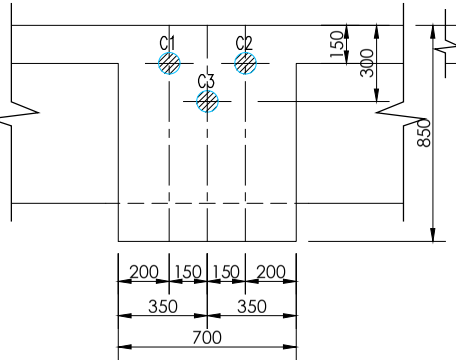
BOX-OUT & BURSTING STEEL DETAILS for (13s-19s)
SCALE 1 : 25



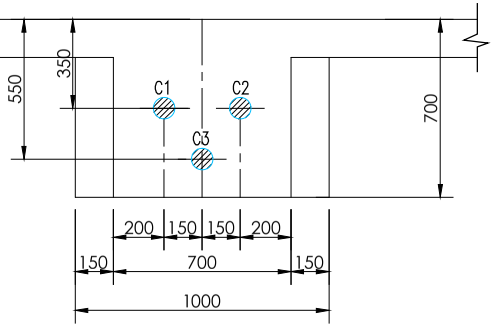
DETAIL - 1
SCALE 1:25



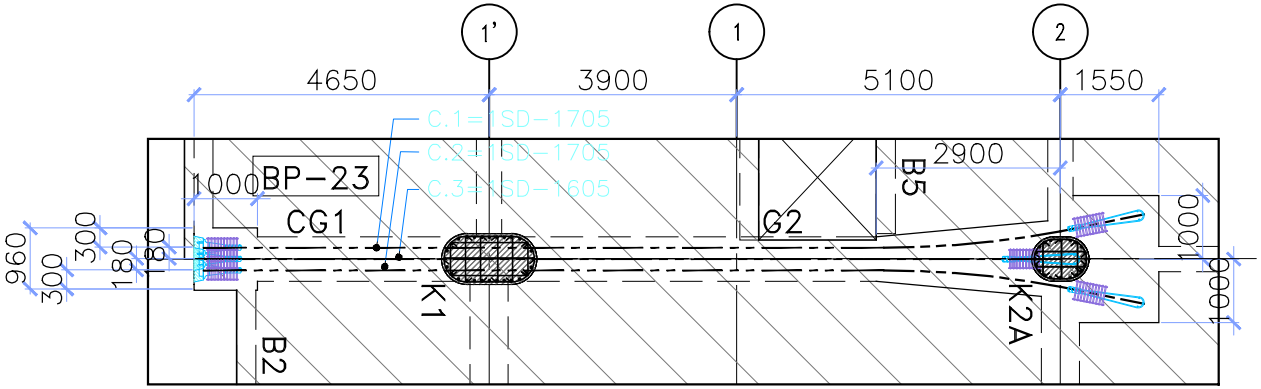
SECTION - A
SCALE 1:25



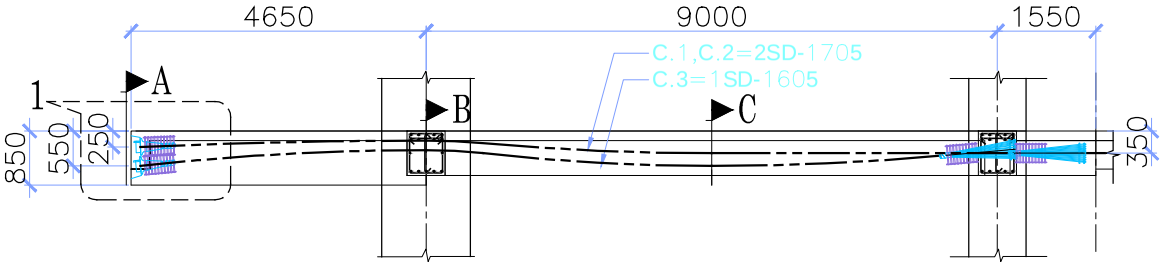
SECTION - B
SCALE 1:25



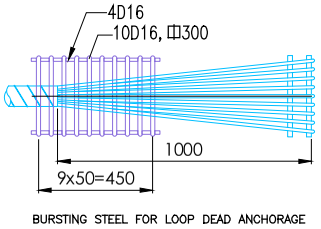
SECTION - C
SCALE 1:25



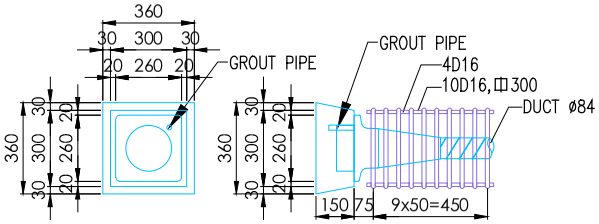
PLAN VIEW BP-23 (700x850/700)



CABLE PROFILE BP-23 (700x850/700)

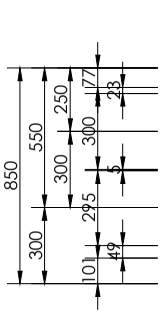


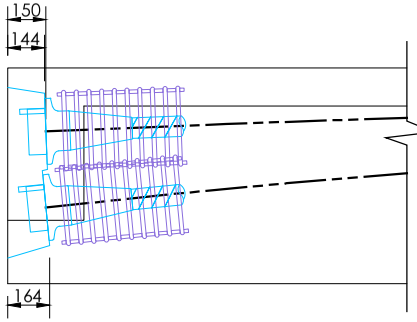
BURSTING STEEL FOR LOOP DEAD ANCHORAGE



BOX-OUT & BURSTING STEEL DETAILS for (13s-19s)

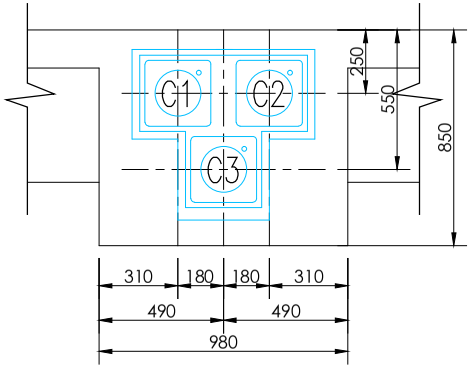
SCALE 1 : 25





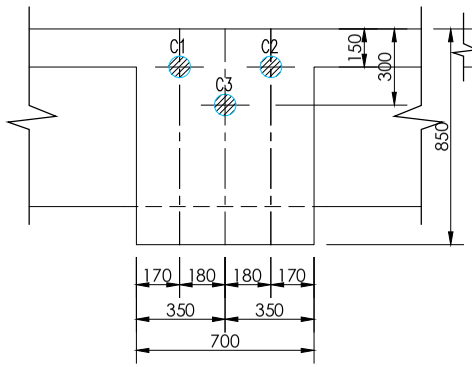
DETAIL - 1

SCALE 1:25



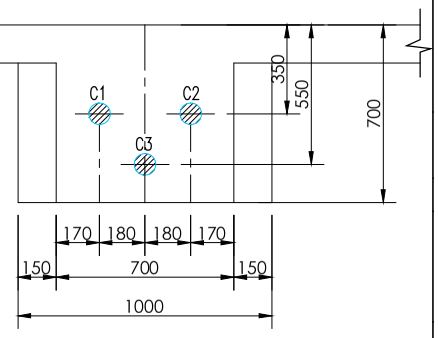
SECTION - A

SCALE 1:25



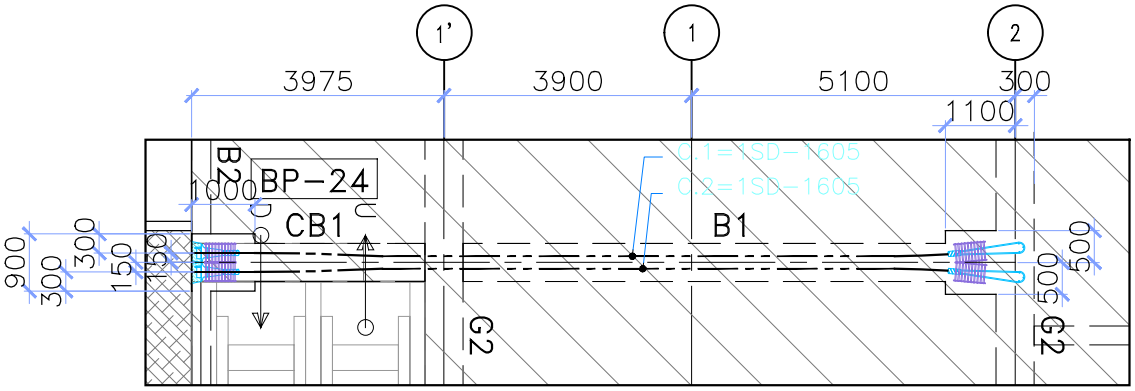
SECTION - B

SCALE 1:25

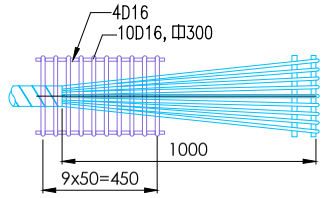


SECTION - C

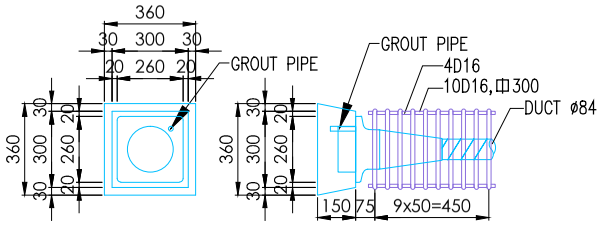
SCALE 1:25



PLAN VIEW BP-24 (600x800/700)

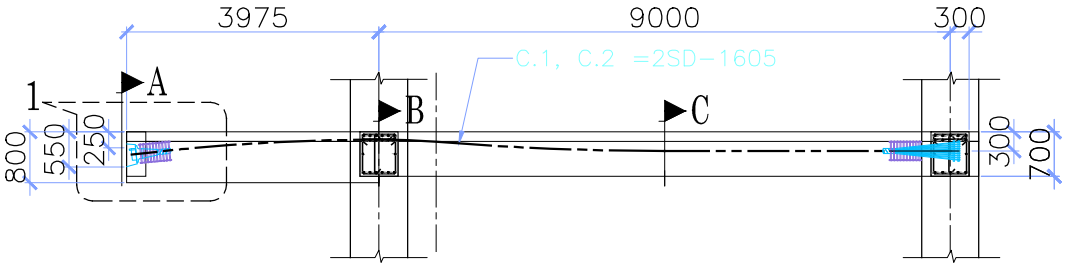


BURSTING STEEL FOR LOOP DEAD ANCHORAGE

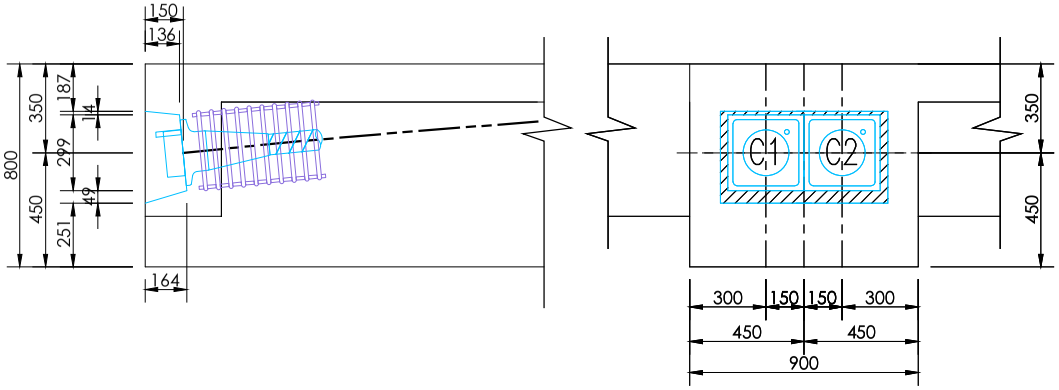


BOX-OUT & BURSTING STEEL DETAILS for (13s-19s)

SCALE 1 : 25



CABLE PROFILE BP-24 (600x800/700)

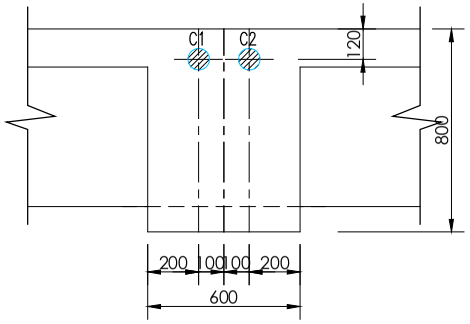


DETAIL - 1

SCALE 1:25

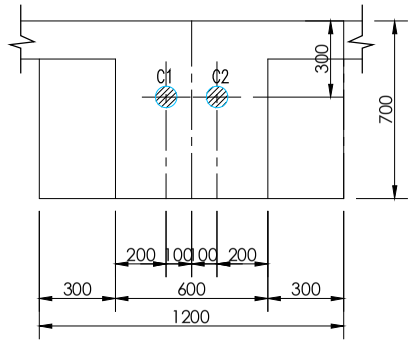
SECTION - A

SCALE 1:25



SECTION - B

SCALE 1:25



SECTION - C

SCALE 1:25