付録 A　　　講義及びセミナー資料

A-9　　　鋼箱桁橋の設計演習

Practice Design of Steel Box Girder

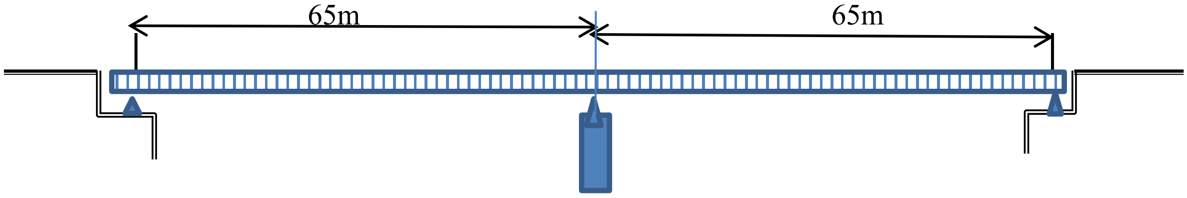
Contents of File

1 Condition of Girder Design

2-span continuos Girder

Span length	0.5+65+65+0.5 =131m	
Width	0.6+2@3.5+2@3.5+0.6=15.2m	
	（2-carriageways （4lanes＊3.5m＝14m width） ）	
Deck Type	RC slab Deck	
Alignment	Vertical Curve	500m R
	Horizontal	straight
	Superelevation	±2%

Navigation Height



2 Design Items

a Evaluation of Dead Load

i Pavement: Thickness 60mm(Carriageway) (Unit Weight 22.5kn/m^3)

ii Concrete Slab : Assumed weight due to 220mm thickness that depeds on spacing of girder. (Unit Weught: 24.5Kn/m^3

iii Concrete Curb : Definite weight due to 600m width and 200mm height (Same as Slab)

iv Assumed Steel Weight : Provisionally assumed steel weight?

v Additional Weight GurrdRail : 0.5kn/m)

b Trial Design of Girder Arrangement

i Calculation as Beam Analysis according that calculation of Bending Moment by using MIDAS. Comparison with several cases so that number of girders is from 2- Girders to 3- Girders

ii Creation of Input Data for Frame Analysis

iii Trial calculation of Bending Moment of inertia and Torsional Moment of Inertia of the main Girder

iv Comparison of Moment differences in case that Stiffeness ratio between main girder and cross gider will be changed.

v Whole section compositions of selected case as the most suitable one

c Making Section Composition of Selected case as the most suitable one

i Calculation of section properties and stress at each position

ii Decision of Segment Length

iii Calculation of Sttifeners in accordance with the Panel Aspect

d Design of Cross Girder
- i Calculation of section properties and stress at each position
- ii Calculation of Sttifeners in accordance with the Panel Aspect
- iii Calculation of Splice Plates

e Detail Calcvulation of Stress Check
- i Picking up of Stress Combination
- ii Bi-AxialStress Check

f Design of Splice Joint at every joint
- i Calculation of Required bolts
- ii Bolt Arrangement
- iii Calculation of Splice Plates

g Design of Weld Joint
- i Required welding condition
- ii Calculation of Stress

h Desing of Diaphramn
- i Diaphramn at Bearing Point
- ii Diaphramn at Cross Girder
- iii Intermediate Diaphramn

i Desing of Concrete Slab
- i Decision of Slab Thickness
- ii Decision of Need of Longitudinal Beam

j Estimation of Steel Quantity
- i Steel weight of each grade and thickness
- ii Painting Area
- iii Concrete Bolume and Quantity of Re-bars

Dead Load

Item		Unit weigl	Width	Thickness:m	Unit weigl	Unit weight	
unit		Kn/m^3	m	mm	Kn/m^2	Kn/m	
Pavement	Cariagewau	22.5	14	60	1.35	**18.9**	
	Pedestrianwa	22.5	3	20	0.45	1.35	
Slab	Cariagewau	24.5	18.6	220	5.39	**100.25**	
Pede.Slab	Pedestrianwa	24.5	3	100	2.45		
Curb	Left	24.5	0.6	200	4.9	**2.94**	
	Median]	24.5	0.6	200	4.9	**2.94**	
	Right	24.5	0.4	200	4.9	**1.96**	
Guard Rail	Both Sides					**1.00**	
						129.34	
Steel weight (assumed)					6.954	129.34	43.11467
						258.688	

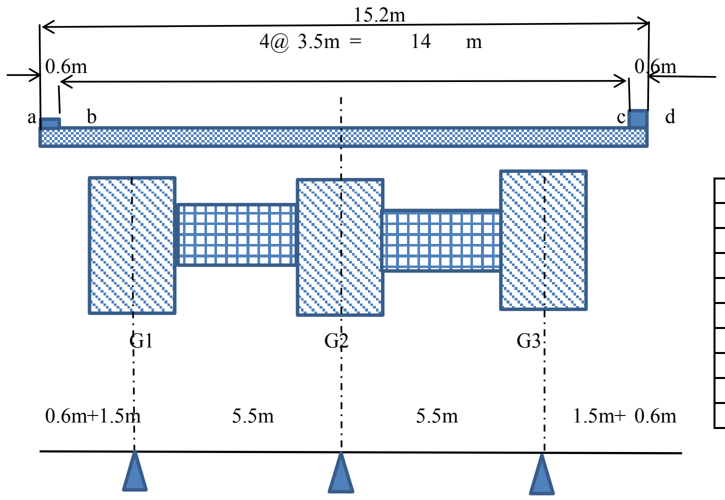
Live Load

Item		Load/1-La	Lane	Deduction	Concentrat	Total	
					Kn	Kn/m	
Vihecle	Uniform	9.3	4	0.65		24.18	
	Concentrat	325	4	0.85	718.25		51.30357
Pedestrain	y	10.8	1			10.8	
Total					718.25	34.98	

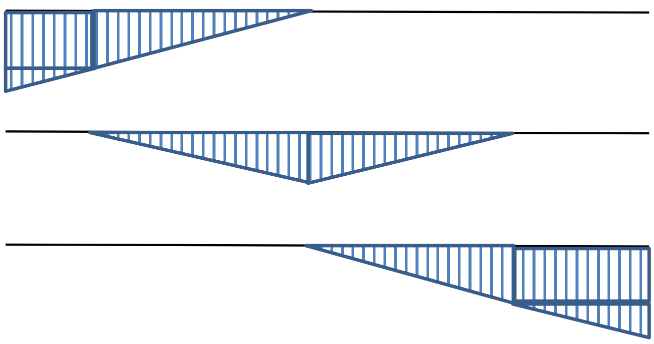
Bending Moment in accordance with Infulence Line M Kn-m

				Mid Pier		Center of Span	
Dead Load	Uniform	258.688	Kn/m	*-0.0625*	*-0.0625*	*0.0938*	*-0.0313*
				-80840		40420	
Live Load	Uniform	24.18	Kn/m	*-0.0625*	*-0.0625*	*0.0938*	*-0.0313*
				-7556		5670	
Live Load	Concentrat	718.25	Kn	*-0.096*		*0.2064*	
				-3447.6		7412	
Pedestrian	Uniform	10.8	Kn/m	*-0.0625*	*-0.0625*	*0.0938*	*-0.0313*
				-3375		2533	
				-95219		**56035**	

	Steel Wei	Guard Rai	Curb	Curb	Pavement		Slab	Pede.Slab	Uni.Live	Truck	
	G1,G2,G	a-b, f-g	a-b,c-d	f-g	b-c,d-e		a-g	e-f	b-c,d-e	b-c,d-e	
Kn/m											
Kn/m^2											



	mm
a	0
b	600
G1	1500
G2	7000
G3	12500
c	14600
d	15200



Position	mm	Height
a	0	1.273
b	600	1.164
G1	1500	1.000
G2	7000	0.000

Position	mm	Height
G1	1500	0.000
G2	7000	1.000
G3	12500	0.000

Position	mm	Height
G2	7000	0.000
G3	12500	1.000
e	14600	1.164
f	15200	1.273

Wheel Load: Kn/m(Translation to uniform load)

	325/3.48=		93.391		
G1,G3	1.00	2-lanes	93.391	0.85	79.382
G2	0.85	3-lanes	79.382	0.85	67.475
	0.65	more ove	60.704	0.85	51.598

0.85 is taken account of the inluence value.
relating wheel spacing

	Steel Wei	Guard Rai	Curb	Curb	Pavement		Slab		Uni.Live	Truck		
	G1,G2,G	a-b, e--f	a-b	e-f	b-e		a-f		b-c	2-Lanes	3-lanes	
Kn/m										79.382	67.475	51.598
Kn/m	19.000	0.5	2.94	2.94								
Kn/m^2					1.35		5.39		2.672	:2-Lanes		
									2.272	:3-lanesn		
									1.737	:more than 3-lanes		
	6840	130	382.2	382.2	2457		9,810		4,650			
Total Load		Σdead Load		20,001					4,650			

!st step:
4-Lanes Loading is calculated

2nd Step
2-Lanes loading is applied
3-Lanes Loadin is applied

G1	Steel Wei	Guard Rai	Curb		Pavement		Slab		Uni.Live	Truck		
	G1	a-b	a-b		b-G2		a-G2		b-G2	b-G2		
Kn/m										51.598		
Kn/m	19.000	0.5	2.94									

Kn/m^2					1.35		5.39		1.7371			
	1.000	1.218	1.218									
					3.724		4.455		3.724	3.724		
	19.000	0.609	3.581									23.191
					5.027		24.010					29.037
												52.227
									6.468			6.468
										192.134		58.696

G2	Steel Weight			Curb	Pavement		Slab		Uni.Live	Truck		
	G2				G1-G3		G1-G3		G1-G3	G1-c		
Kn/m										51.598		
Kn/m	19.000											
Kn/m^2					1.35		5.39		1.7371			
	1.000											
					5.500		5.500		5.500	5.500		
	19.000	0.000	0.000									19.000
					7.425		29.645					37.070
												56.070
									9.554			9.554
										283.791		65.624

G1	Bending Moment in accordance with Infulence Li					Kn-m			Reacrion			
					Mid Pier		Center of Span		End		Mid Pier	
	Dead Loa	Uniform	52.227	Kn/m	*-0.0625*	*-0.0625*	*0.0938*	*-0.0313*	0.4376	-0.0625	0.625	0.625
			5,223	kn	-16321		8161		980		3,264	
	Live Loa	Uniform	6.468	Kn/m	*-0.0625*	*-0.0625*	*0.0938*	*-0.0313*	0.4376	-0.0625	0.625	0.625
			647	kn	-2021		1517		142		404	
	Impact	0.33	213		-667		501		47		133	
	Live Loa	Concentra	192.134	Kn	*-0.096*		*0.2064*		1.000		1.000	
					-922.24		1983		192		192	
	Impact	0.33			-304		654		63		63	
					-3915		4654					
					-20236		**12815**		1,423		4,057	

G2	Bending Moment in accordance with Infulence Li					Kn-m			Reacrion			
					Mid Pier		Center of Span		End		Mid Pier	
	Dead Loa	Uniform	56.070	Kn/m	*-0.0625*	*-0.0625*	*0.0938*	*-0.0313*	0.4376	-0.0625	0.625	0.625
			5607	kn	-17522		8761		1,052		3,504	
	Live Loa	Uniform	9.554	Kn/m	*-0.0625*	*-0.0625*	*0.0938*	*-0.0313*	0.4376	-0.0625	0.625	0.625
			955.39	kn	-2986		2240		209		597	
	Impact	0.33	315.28		-985		739		69		197	
	Live Loa	Concentra	283.791	Kn	*-0.096*		*0.2064*		1.000		1.000	
					-1362.2		2929		284		284	
	Impact	0.33			-450		966		94		94	
					-5783		6875					
					-23304		**15636**		1,707		4,676	

表-9.2.4 Minimum Thickness of Cocrte Slab (mm)

床版の区分	Span Direction of Slab		
	Span Direction of Slab : Right Angle		Span Direction of Slab : Palallel Angle
Simple Span Type	40L+110		65L+130
Continuous Span Type	30L+110		50L+130
Cantilever Span Type	0<L≦0.25	280L+160	240L+130
	L>0.25	80L+210	

Effwctive Height of Haunch

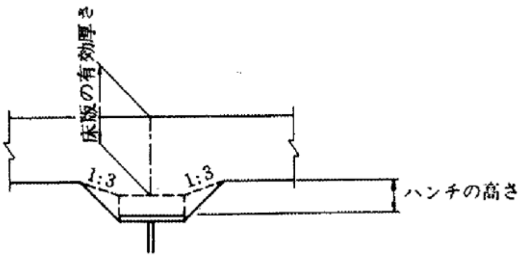
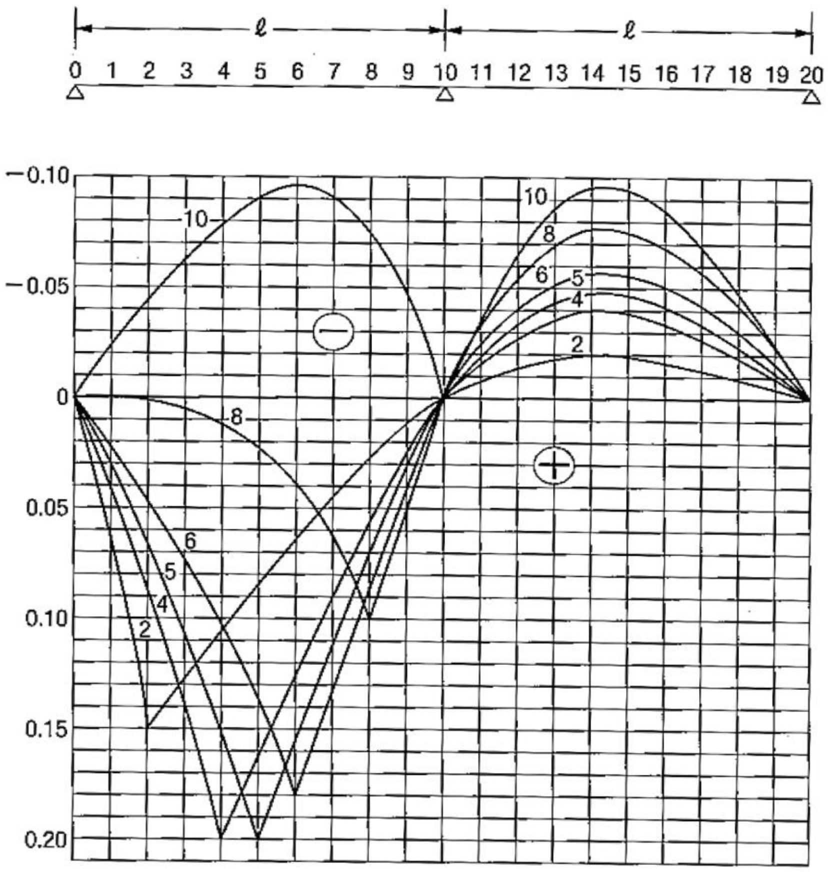


図-9.2.5 ハンチ部の床版の有効厚さ

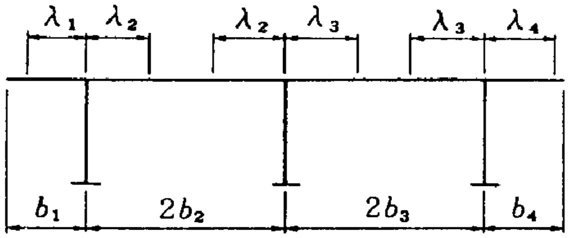
〈曲げモーメント〉



載荷点	着				目						点			
	曲げモーメント (kN・m)										せん断力(kN)		支点反力(kN)	
	1	2	3	4	5	6	7	8	9	10	$\ell_1(Q_0)$	$\ell_2(Q_{10})$	R_A	R_B
0	0	0	0	0	0	0	0	0	0	0	1.0000	0	1.0000	0
1	0.0875	0.0751	0.0626	0.0501	0.0376	0.0252	0.0127	0.0002	−0.0123	−0.0248	0.8753	0.0248	0.8753	0.1495
2	0.0752	0.1504	0.1256	0.1008	0.0760	0.0512	0.0264	0.0016	−0.0232	−0.0480	0.7520	0.0480	0.7520	0.2960
3	0.0632	0.1264	0.1895	0.1527	0.1159	0.0791	0.0422	0.0054	−0.0314	−0.0683	0.6318	0.0683	0.6318	0.4365
4	0.0516	0.1032	0.1548	0.2064	0.1580	0.1096	0.0612	0.0128	−0.0356	−0.0840	0.5160	0.0840	0.5160	0.5680
5	0.0406	0.0812	0.1219	0.1625	0.2031	0.1438	0.0844	0.0250	−0.0344	−0.0938	0.4063	0.0938	0.4063	0.6875
6	0.0304	0.0608	0.0912	0.1216	0.1520	0.1824	0.1128	0.0432	−0.0264	−0.0960	0.3040	0.0960	0.3040	0.7920
7	0.0211	0.0422	0.0632	0.0843	0.1054	0.1265	0.1475	0.0686	−0.0103	−0.0893	0.2108	0.0893	0.2108	0.8785
8	0.0128	0.0256	0.0384	0.0512	0.0640	0.0768	0.0896	0.1024	0.0152	−0.0720	0.1280	0.0720	0.1280	0.9440
9	0.0057	0.0115	0.0172	0.0229	0.0286	0.0344	0.0401	0.0458	0.0515	−0.0428	0.0573	0.0428	0.0573	0.9855
10	0	0	0	0	0	0	0	0	0	0	0	1.0000	0	1.0000
11	−0.0043	−0.0086	−0.0128	−0.0171	−0.0214	−0.0257	−0.0299	−0.0342	−0.0385	−0.0428	−0.0428	0.9428	−0.0428	0.9855
12	−0.0072	−0.0144	−0.0216	−0.0288	−0.0360	−0.0432	−0.0504	−0.0576	−0.0648	−0.0720	−0.0720	0.8720	−0.0720	0.9440
13	−0.0089	−0.0179	−0.0268	−0.0357	−0.0446	−0.0536	−0.0625	−0.0714	−0.0803	−0.0893	−0.0893	0.7893	−0.0893	0.8785
14	−0.0096	−0.0192	−0.0288	−0.0384	−0.0480	−0.0576	−0.0672	−0.0768	−0.0864	−0.0960	−0.0960	0.6960	−0.0960	0.7920
15	−0.0094	−0.0188	−0.0281	−0.0375	−0.0469	−0.0563	−0.0656	−0.0750	−0.0844	−0.0938	−0.0938	0.5938	−0.0938	0.6875
16	−0.0084	−0.0168	−0.0252	−0.0336	−0.0420	−0.0504	−0.0588	−0.0672	−0.0756	−0.0840	−0.0840	0.4840	−0.0840	0.5680
17	−0.0068	−0.0137	−0.0205	−0.0273	−0.0341	−0.0410	−0.0478	−0.0546	−0.0614	−0.0683	−0.0683	0.3683	−0.0683	0.4365
18	−0.0048	−0.0096	−0.0144	−0.0192	−0.0240	−0.0288	−0.0336	−0.0384	−0.0432	−0.0480	−0.0480	0.2480	−0.0480	0.2960
19	−0.0025	−0.0050	−0.0074	−0.0099	−0.0124	−0.0149	−0.0173	−0.0198	−0.0223	−0.0248	−0.0248	0.1248	−0.0248	0.1495
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	× ℓ (m)										×1.0			
A_1	0.0388	0.0675	0.0863	0.0950	0.0938	0.0825	0.0613	0.0300	−0.0113	−0.0625	0.4375	0.0625	0.4375	0.6250
A_2	−0.0063	−0.0125	−0.0188	−0.0250	−0.0313	−0.0375	−0.0438	−0.0500	−0.0563	−0.0625	−0.0625	0.5625	−0.0625	0.6250
ΣA	0.0325	0.0550	0.0675	0.0700	0.0625	0.0450	0.0175	−0.0200	0.0675	−0.1250	0.3750	0.6250	0.3750	1.2500
	$\times \ell^2(m^2)$										× ℓ (m)			

Effective Width of Flange

The **Shear lag** phenomena causes that flange has not equivalent stress at whole width of flange, but the hiegher stress zone appears near at the web.
So, the eqivalent stress is considered at the effective width(decreased width) of flange.



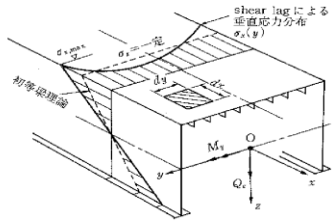
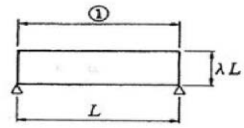
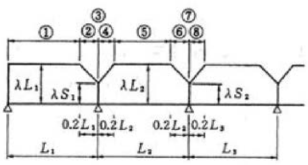
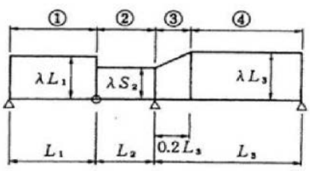


表-11.3.1　フランジの片側有効幅

区間	(箇所)	記号	適用式	Effectve span	摘　要
単純桁	①	λL	(11.3.1)	L	
連続桁	①	λL_1	(11.3.1)	$0.8L_1$	
	⑤	λL_2		$0.6L_2$	
	③	λS_1	(11.3.2)	$0.2(L_1+L_2)$	
	⑦	λS_2		$0.2(L_2+L_3)$	
	②④ ⑥⑧	両端の有効幅を用いて，直線変化させる。			
ゲルバー桁	①	λL_1	(11.3.1)	L_1	
	④	λL_3		$0.8L_3$	
	②	λS_2	(11.3.2)	$2L_2$	
	③	両端の有効幅を用いて，直線変化させる。			

In case of simple span, it is notneccessary to be considered.

In case of continuous span, effective width shoul be cosidered at the mid support.

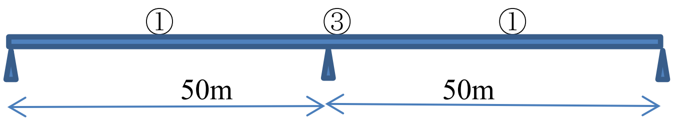
In case of cantilever span, effective width shoul be cosidered at the mid support.

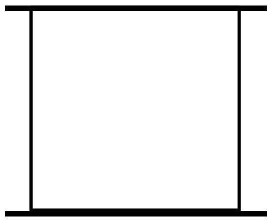
11.3.1
$$\lambda = b \qquad \left(\frac{b}{l} \leqq 0.05\right)$$
$$= \left\{1.1 - 2\left(\frac{b}{l}\right)\right\} b \qquad \left(0.05 < \frac{b}{l} < 0.30\right)$$
$$= 0.15l \qquad \left(0.30 \leqq \frac{b}{l}\right)$$

if b＜0.05Le
λ=b (Whole width effective)

11.3.2
$$\lambda = b \qquad \left(\frac{b}{l} \leqq 0.02\right)$$
$$= \left\{1.06 - 3.2\left(\frac{b}{l}\right) + 4.5\left(\frac{b}{l}\right)^2\right\} b \qquad \left(0.02 < \frac{b}{l} < 0.30\right)$$
$$= 0.15l \qquad \left(0.30 \leqq \frac{b}{l}\right)$$

if b＜0.02Le
λ=b (Whole width effective)





① Le=0.8L=40m
b=1.8m/2=0.9m ＜0.05Le
=2m
λ=b

③ Le=0.2×100=20m
b=1.8m/2=0.9m ＞0.02Le
=0.4m
b/Le= 0.045
λ=1.06-{(3.2(b/Le)+4.5(b/Le)^2}・b
= 0.832601
93%
2b=1.8・0.93
1.665 m
Wf= 1800×0.93+2@100
1874

Flange width shall be revised to 1874mm at the mid pier,

G1 -31792 Kn-M

		Width/H	Thickne	Area	y cm	Ay cm3	Ay^2+I0
1	—Flange	2000	27	540	126	68,229	8,620,734
1	—stiff	140	12	17	118	1,982	234,198
2	—Web	2500	10	500	0	0	2,604,167
3	—stiff	140	12	50	-118	-5,947	702,044
1	—Flange	2000	25	500	-126	-63,125	7,969,531
Σ	Σ			1,607		1,139	20,130,674
				e=	0.7		807
				I=			20,131,481

Iy= 0.20131481 m4

Zu= 0.1602 m^3 σa= 210 n/mm^2= 210,000 Kn/m^2

Zl= -0.1586 m^3 σa= 210 n/mm^2= 210,000 Kn/m^2

w= σu= -198,413

σl= 200,493

		Width/H	Thickne	Area	X cm	AX cm3	AX^2+I0
1	—Web	2000	27	540		0	1,800,000
1	—stiff	140	12	17	0	0	0
1	—Flange	2500	10	250	90	22,500	2,025,000
1	—Flange	2500	10	250	-90	-22,500	2,025,000
3	—stiff	140	12	34	45		68,040
1	—Web	2000	25	500	0	0	1,666,667
Σ	Σ			1,590		0	7,584,707
				e=	0.0		0
				I=			7,584,707

Iz= 0.07584707 m4

b1	1800	t1	27
b2	2500	t2	10
b3	1800	t3	25
bt	2500	t4	10

J= $\fallingdotseq (4 \cdot (b1 \cdot b2)^2)$

0.12683 m^4

G1 18823.3 Kn-M

		Width/H	Thickne	Area	y cm	Ay cm3	Ay^2+I0
1	一Flange	2000	16	320	126	40,256	5,064,205
3	一stiff	140	12	50	118	5,947	702,044
2	一Web	2500	9	450	0	0	2,343,750
1	一stiff	140	12	17	-118	-1,982	234,198
1	一Flange	2000	14	280	-126	-35,196	4,424,137
Σ	Σ			1,117		9,025	12,768,334
				e=	8.1		72903
				I=			12,841,236

Iy= 0.12841236 m4

Zu= 0.1091 m^3 σa= 181.825 n/mm^2 181,825 Kn/m^2

Zl= -0.0960 m^3 σa= 210 n/mm^2= 210,000 Kn/m^2

28.125 σu= 172,562

σl= -196,098

		Width/H	Thickne	Area	y cm	Ay cm3	Ay^2+I0
1	一Web	2000	16	320		0	1,066,667
3	一stiff	140	12	34	45		68,040
1	一Flange	2500	9	225	90	20,250	1,822,500
1	一Flange	2500	9	225	-90	-20,250	1,822,500
1	一stiff	140	12	17	0		0
1	一Web	2000	14	280		0	933,333
Σ	Σ			1,100		0	5,713,040
				e=	0.0		0
				I=			5,713,040

Iz= 0.0571304 m4

b1	1800	t1	16
b2	2500	t2	9
b3	1800	t3	14
bt	2500	t4	9

J= $\fallingdotseq (4\cdot(b1\cdot b2)^2)$

0.10168 m^4

G2 -33794 Kn-M

		Width/H	Thickne	Area	y cm	Ay cm3	Ay^2+I0
1	—Flange	2000	28	560	126	70,784	8,947,098
1	—stiff	140	12	17	118	1,982	234,198
2	—Web	2500	10	500	0	0	2,604,167
3	—stiff	140	12	50	-118	-5,947	702,044
1	—Flange	2000	28	560	-126	-70,784	8,947,098
Σ	Σ			1,687		-3,965	21,434,603
				e=	-2.3		9317
				I=			21,443,920

Iy= 0.2144392 m4

Zu= 0.1666 m^3 σa＝ 210 n/mm^2 210,000 Kn/m^2

Zl= -0.1729 m^3 σa＝ 210 n/mm^2 210,000 Kn/m^2

σu＝ −202,901

σl＝ 195,494

		Width/H	Thickne	Area	X cm	AX cm3	AX^2+I0
1	—Web	2000	28	560		0	1,866,667
1	—stiff	140	12	17	*0*	0	0
1	—Flange	2500	10	250	90	22,500	2,025,000
1	—Flange	2500	10	250	-90	-22,500	2,025,000
3	—stiff	140	12	34	45		68,040
1	—Web	2000	28	560	0	0	1,866,667
Σ	Σ			1,670		0	7,851,373
				e=	0.0		0
				I=			7,851,373

Iz= 0.07851373 m4

b1	1800	t1	28
b2	2500	t2	10
b3	1800	t3	28
bt	2500	t4	10

J= $\fallingdotseq (4 \cdot (b1 \cdot b2)^2)$

0.12886 m^4

G2 20600 Kn-M

		Width/H	Thickne	Area	y cm	Ay cm3	Ay^2+I0
1	─Flange	2000	17	340	126	42,789	5,384,996
3	─stiff	140	12	50	118	5,947	702,044
2	─Web	2500	9	450	0	0	2,343,750
1	─stiff	140	12	17	-118	-1,982	234,198
1	─Flange	2000	15	300	-126	-37,725	4,743,919
Σ	Σ			1,157		9,029	13,408,906
				e=	7.8		70445
				I=			13,479,351

Iy= 0.13479351 m4

Zu= 0.1142 m^3 σa＝ 189.4353 n/mm^2 189,435 Kn/m^2

Zl= -0.1009 m^3 σa＝ 210 n/mm^2 210,000 Kn/m^2

26.471 σu＝ 180,408

σl＝ -204,103

		Width/H	Thickne	Area	y cm	Ay cm3	Ay^2+I0
1	─Web	2000	17	340		0	1,133,333
3	─stiff	140	12	34	45		68,040
1	─Flange	2500	9	225	90	20,250	1,822,500
1	─stiff	140	12	17	0		0
1	─Web	2000	15	300		0	1,000,000
Σ	Σ			1,140		0	5,846,373
				e=	0.0		0
				I=			5,846,373

Iz= 0.05846373 m4

b1	1800	t1	17
b2	2500	t2	9
b3	1800	t3	15
bt	2500	t4	9

J= $\fallingdotseq (4 \cdot (b1 \cdot b2)^2)$

0.10366 m^4

G3 -32176 Kn-M

		Width/H	Thickne	Area	y cm	Ay cm3	Ay^2+I0
1	—Flange	2000	27	540	126	68,229	8,620,734
1	—stiff	140	12	17	118	1,982	234,198
2	—Web	2500	10	500	0	0	2,604,167
3	—stiff	140	12	50	-118	-5,947	702,044
1	—Flange	2000	27	540	-126	-68,229	8,620,734
Σ	Σ			1,647		-3,965	20,781,877
				e=	-2.4		9543
				I=			20,791,420

Iy= 0.2079142 m4

Zu= 0.1615 m^3 σa＝ 210 n/mm^2 210,000 Kn/m^2

Zl= -0.1677 m^3 σa＝ 210 n/mm^2 210,000

σu＝ -199,259

σl＝ 191,809

		Width/H	Thickne	Area	X cm	AX cm3	AX^2+I0
1	—Web	2000	27	540		0	1,800,000
1	—stiff	140	12	17		0	0
1	—Flange	2500	10	250	90	22,500	2,025,000
1	—Flange	2500	10	250	-90	-22,500	2,025,000
3	—stiff	140	12	34	45		68,040
1	—Web	2000	27	540	0	0	1,800,000
Σ	Σ			1,630		0	7,718,040
				e=	0.0		0
				I=			7,718,040

Iy= 0.0771804 m4

b1	1800	t1	27
b2	2500	t2	10
b3	1800	t3	27
bt	2500	t4	10

J= $\fallingdotseq (4 \cdot (b1 \cdot b2)^2)$

0.12789 m^4

G3 18067.8 Kn-M

		Width/H	Thickne	Area	y cm	Ay cm3	Ay^2+I0
1	—Flange	2000	16	320	126	40,256	5,064,205
3	—stiff	140	12	50	118	5,947	702,044
2	—Web	2500	9	450	0	0	2,343,750
1	—stiff	140	12	17	-118	-1,982	234,198
1	—Flange	2000	14	280	-126	-35,196	4,424,137
Σ	Σ			1,117		9,025	12,768,334
				e=	8.1		72903
				I=			12,841,236

Iy= 0.12841236 m4

Zu= 0.1091 m^3 σa＝ 181.825 n/mm^2 181,825 Kn/m^2

Zl= -0.0960 m^3 σa＝ 210 n/mm^2 210,000

28.125 σu＝ 165,636

σl＝ -188,228

		Width/H	Thickne	Area	y cm	Ay cm3	Ay^2+I0
1	—Web	2000	16	320		0	1,066,667
3	—stiff	140	12	34	45		68,040
1	—Flange	2500	9	225	90	20,250	1,822,500
1	—Flange	2500	9	225	-90	-20,250	1,822,500
1	—stiff	140	12	17	0		0
1	—Web	2000	14	280		0	933,333
Σ	Σ			1,100		0	5,713,040
				e=	0.0		0
				I=			5,713,040

Iy= 0.0571304 m4

b1	1800	t1	16
b2	2500	t2	9
b3	1800	t3	14
bt	2500	t4	9

J= $\fallingdotseq (4 \cdot (b1 \cdot b2)^2)$

0.10168 m^4

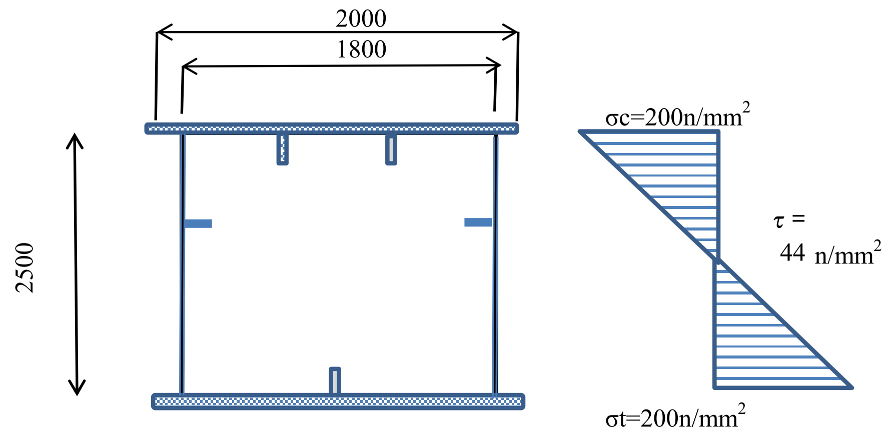
表−4. 2. 5　補剛板の局部座屈に対する許容応力度（N/mm²）

鋼種 / 板厚 (mm)	SS400 SM400 SMA400W	SM490	SM490Y SM520 SMA490W	SM570 SMA570W
40以下	$140 : \frac{b}{28fn} \leqq t$ $140 - 2.6\left(\frac{b}{tfn} - 28\right) : \frac{b}{56fn} \leqq t < \frac{b}{28fn}$ $210,000\left(\frac{tfn}{b}\right)^2 : \frac{b}{80fn} \leqq t < \frac{b}{56fn}$	$185 : \frac{b}{24fn} \leqq t$ $185 - 3.9\left(\frac{b}{tfn} - 24\right) : \frac{b}{48fn} \leqq t < \frac{b}{24fn}$ $210,000\left(\frac{tfn}{b}\right)^2 : \frac{b}{80fn} \leqq t < \frac{b}{48fn}$	$210 : \frac{b}{22fn} \leqq t$ $210 - 4.6\left(\frac{b}{tfn} - 22\right) : \frac{b}{46fn} \leqq t < \frac{b}{22fn}$ $210,000\left(\frac{tfn}{b}\right)^2 : \frac{b}{80fn} \leqq t < \frac{b}{46fn}$	$255 : \frac{b}{22fn} \leqq t$ $255 - 6.9\left(\frac{b}{tfn} - 22\right) : \frac{b}{40fn} \leqq t < \frac{b}{22fn}$ $210,000\left(\frac{tfn}{b}\right)^2 : \frac{b}{80fn} \leqq t < \frac{b}{40fn}$
40を超え75以下	$125 : \frac{b}{28fn} \leqq t$ $125 - 2.1\left(\frac{b}{tfn} - 28\right) : \frac{b}{58fn} \leqq t < \frac{b}{28fn}$ $210,000\left(\frac{tfn}{b}\right)^2 : \frac{b}{80fn} \leqq t < \frac{b}{58fn}$	$175 : \frac{b}{24fn} \leqq t$ $175 - 3.5\left(\frac{b}{tfn} - 24\right) : \frac{b}{50fn} \leqq t < \frac{b}{24fn}$ $210,000\left(\frac{tfn}{b}\right)^2 : \frac{b}{80fn} \leqq t < \frac{b}{50fn}$	$195 : \frac{b}{22fn} \leqq t$ $195 - 4.0\left(\frac{b}{tfn} - 22\right) : \frac{b}{46fn} \leqq t < \frac{b}{22fn}$ $210,000\left(\frac{tfn}{b}\right)^2 : \frac{b}{80fn} \leqq t < \frac{b}{46fn}$	$245 : \frac{b}{22fn} \leqq t$ $245 - 6.2\left(\frac{b}{tfn} - 22\right) : \frac{b}{42fn} \leqq t < \frac{b}{22fn}$ $210,000\left(\frac{tfn}{b}\right)^2 : \frac{b}{80fn} \leqq t < \frac{b}{42fn}$
75を超え100以下			$190 : \frac{b}{22fn} \leqq t$ $190 - 3.7\left(\frac{b}{tfn} - 22\right) : \frac{b}{48fn} \leqq t < \frac{b}{22fn}$ $210,000\left(\frac{tfn}{b}\right)^2 : \frac{b}{80fn} \leqq t < \frac{b}{48fn}$	$240 : \frac{b}{22fn} \leqq t$ $240 - 6.0\left(\frac{b}{tfn} - 22\right) : \frac{b}{42fn} \leqq t < \frac{b}{22fn}$ $210,000\left(\frac{tfn}{b}\right)^2 : \frac{b}{80fn} \leqq t < \frac{b}{42fn}$

b=	1800	1800
n=	5	4
f=	1	1
b/28fn=	12.9	16.1
b/22fn=	16.4	20.5

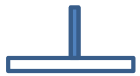
Design Condition

Width of Flange W=	2200 mm		a=	2000 mm						
Distance of both webs w=	2000 mm		b=	1800 mm						
Thickness of Flange tf=	25 mm		n=	4						
Space of Cross beam a=	2000 mm	Tentative	f=	1.0						
Thickness of Web plate tw=	9 mm		t=	25	SM490Y	210	22	46	4.6	
Sheraing Force of girder S=	1980 Kn		Io= $bt^3/11$=	2,556,818						

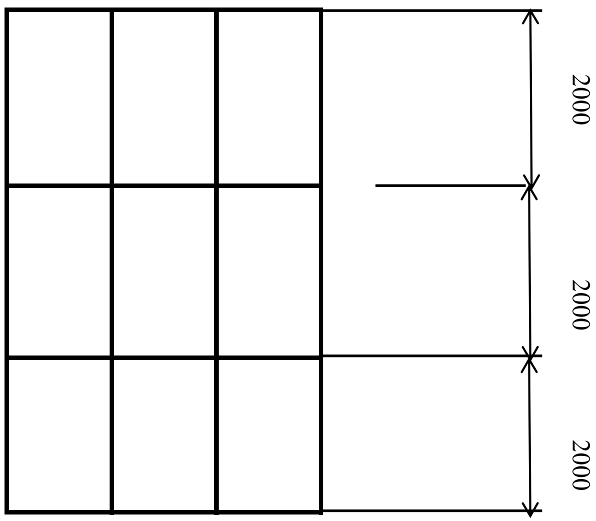


to=b/(22fn)=	20.4545	<t
b/(46fn)=	9.78261	<t
b/(tfn)=	18	
4.6(b/(tfn)-28)=	-18.4	

σcal＝ 210 N/mm^2



hr	210	mm
tr	19	mm



Il= hr^3・tr/3=		58,653,000	mm^4
Al= hr・tr	=	3,990	mm^2
＞	bt/10n	1,125	mm^2
δ_l =Al/ bt=		0.0887	
n・δ_l	=	0.3547	
γl＝ Ii/(bt^3/11)=		22.9	
(1+nγl)=		92.8	
√ (1+nγl)=		9.63	
α0= ⁴√ (1+nγl)=		3.10	
α= a/b=		1.1 ＜	α0

① $\gamma_{l,req.} = 4\alpha^2 n \left(\frac{t_0}{t}\right)^2 (1+n\delta_l) - \frac{(\alpha^2+1)^2}{n}$ (t≧to) (RR＜0.5)

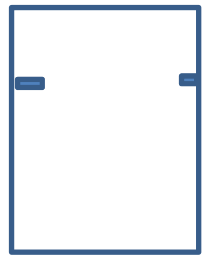
② $= 4\alpha^2 n (1+n\delta_l) - \frac{(\alpha^2+1)}{n}$ (t＜to) (RR＞0.5)

① γlreq＝	16.66462	Io・γlreq＝	42,608,414	1.377
② γlreq＝	26.20021	Io・γlreq＝	66,989,162	N.A

鋼種 / 板厚 (mm)	SS400 SM400 SMA400W	SM490	SM490Y SM520 SMA490W	SM570 SMA570W
40以下	$140 : \frac{b}{28fn} \leq t$	$185 : \frac{b}{24fn} \leq t$	$210 : \frac{b}{22fn} \leq t$	$255 : \frac{b}{22fn} \leq t$
	$140 - 2.6\left(\frac{b}{tfn} - 28\right) : \frac{b}{56fn} \leq t < \frac{b}{28fn}$	$185 - 3.9\left(\frac{b}{tfn} - 24\right) : \frac{b}{48fn} \leq t < \frac{b}{24fn}$	$210 - 4.6\left(\frac{b}{tfn} - 22\right) : \frac{b}{46fn} \leq t < \frac{b}{22fn}$	$255 - 6.9\left(\frac{b}{tfn} - 22\right) : \frac{b}{40fn} \leq t < \frac{b}{22fn}$
	$210,000\left(\frac{tfn}{b}\right)^2 : \frac{b}{80fn} \leq t < \frac{b}{56fn}$	$210,000\left(\frac{tfn}{b}\right)^2 : \frac{b}{80fn} \leq t < \frac{b}{48fn}$	$210,000\left(\frac{tfn}{b}\right)^2 : \frac{b}{80fn} \leq t < \frac{b}{46fn}$	$210,000\left(\frac{tfn}{b}\right)^2 : \frac{b}{80fn} \leq t < \frac{b}{40fn}$

$$\left(\frac{b}{100t}\right)^4 \left[\left(\frac{\sigma}{900}\right)^2 + \left\{\frac{\tau}{120+58(b/a)^2}\right\}^2\right] \le 1 : \left(\frac{a}{b} > 0.80\right)$$

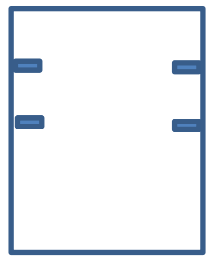
$$\left(\frac{b}{100t}\right)^4 \left[\left(\frac{\sigma}{900}\right)^2 + \left\{\frac{\tau}{90+77(b/a)^2}\right\}^2\right] \le 1 : \left(\frac{a}{b} \le 0.80\right)$$



900	120	58	16.000	0.049	0.079	**2.053**
900	90	77	16.000	0.049	0.090	**2.224**

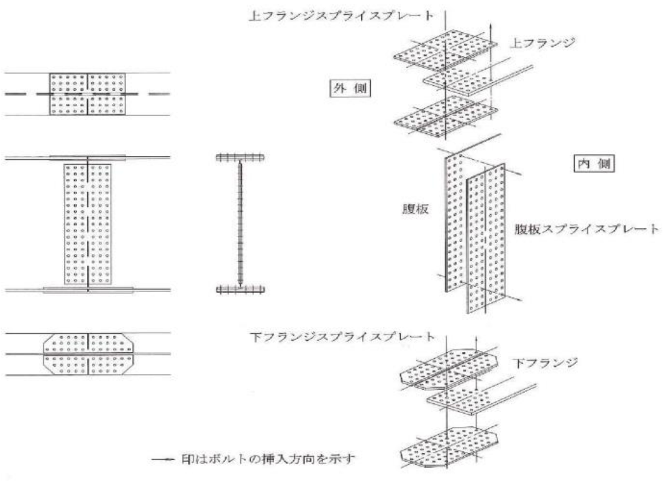
$$\left(\frac{b}{100t}\right)^4 \left[\left(\frac{\sigma}{3,000}\right)^2 + \left\{\frac{\tau}{187+58(b/a)^2}\right\}^2\right] \le 1 : \left(\frac{a}{b} > 0.64\right)$$

$$\left(\frac{b}{100t}\right)^4 \left[\left(\frac{\sigma}{3,000}\right)^2 + \left\{\frac{\tau}{140+77(b/a)^2}\right\}^2\right] \le 1 : \left(\frac{a}{b} \le 0.64\right)$$



3000	187	58	16.000	0.004	0.042	*0.738*
3000	140	77	16.000	0.004	0.053	*0.921*

t	10	mm	bt3/11	181,818	
a	2000	mm	30*a/b	30	
b	2000	mm			
a/b	1.0		Ih.req	5,454,545	mm^4
σ	200				
τ	50		t=	120	
			b=	10	
			b^3t/3=	11,250,000	


上フランジスプライスプレート
上フランジ
外側
内側
腹板
腹板スプライスプレート
下フランジスプライスプレート
下フランジ
→ 印はボルトの挿入方向を示す

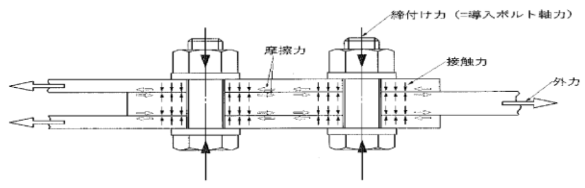

締付け力（=導入ボルト軸力）
摩擦力
接触力
外力

図 1.1 摩擦接合

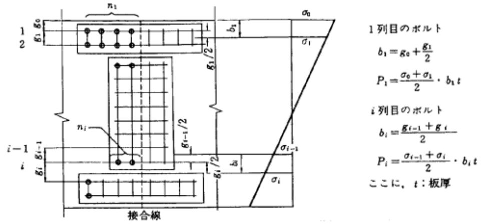
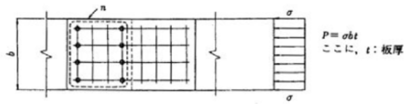


図-7. 3. 1　ボルトに作用する力（垂直応力の分布が均等でない場合）



$$\rho_s = S/n \leq \rho_a$$

$$\rho = \sqrt{\rho_p^2 + \rho_s^2} \leq \rho_a$$

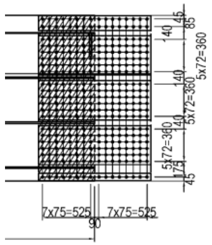
Joint Force:F

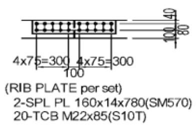
F= σf＊Af

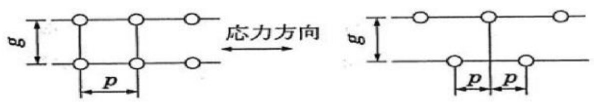
Required numbers of Bolts

n= F/ρ

ρ Is unit resistance friction force relating to single friction or double friction and surface treatment.







Stres directiom

stress direction

Minimum Spacing

表-7. 3. 2　ボルトの最小中心間隔（mm）

ボルトの呼び	最小中心間隔
M24	85
M22	75
M20	65

Maximum Spacing

表-7. 3. 3　ボルトの最大中心間隔　（mm）

ボルトの呼び	最大中心間隔		
	p		g
M24	170	$12t$ 千鳥の場合は，$15t-3/8\cdot g$ ただし，$12t$ 以下	$24t$ ただし，300 以下
M22	150		
M20	130		

表-3.2.7 摩擦接合用高力ボルトの許容力
（1ボルト1摩擦面あたり）

(a) 接触面を塗装しない場合 (kN)

ボルトの等級 / ねじの呼び	F8T	F10T	S10T
M20	31	39	39
M22	39	48	48
M24	45	56	56

(b) 接触面に無機ジンクリッチペイントを塗布する場合

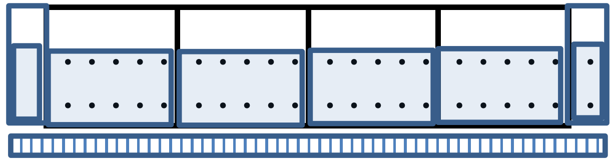
(kN)

ボルトの等級 / ねじの呼び	F8T	F10T	S10T
M20	35	44	44
M22	44	54	54
M24	51	63	63

In case of the below condition
*Surface is not painted
*Single contact surface
*If double contact surface is effective,
the restance force is 2-times.

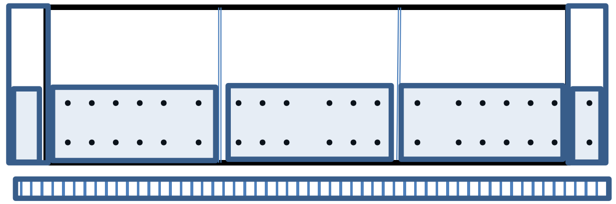
In case of the below condition
*Surface is painted by non-organic Zinc-Rich
*Single contact surface
*If double contact surface is effective,
the restance force is 2-times.

			J1	J2	J3	J4
Position						
U-Flange	Width	mm	2000	2000	2000	2000
	Thickness	mm	16	22	32	22
	Area	cm2	320	440	640	440
			SM400	SM400	SM490	SM490
	0.75σa	N/mm2	105	105	157.5	157.5
	0.75σca	N/mm2	105	105	150	150
	σf	N/mm2	90	110	180	120
Joint Force		KN	3360	4840	11520	6600
Nreq	ρa=96KN		35.0	50.4	120.0	68.8
	Ng		22	22	22	23
	Np		2	3	6	3
			200+4@450	200+4@450	200+4@450	200+2@900
LF-lange	Width		2000	2000	2000	2000
	Thickness		16	22	34	25
	Area		320	440	680	500
			SM400	SM400	SM490	SM490
	0.75σa		105	105	157.5	157.5
	0.75σca		105	105	150	150
	σf		90	110	190	135
Joint Force			3360	4840	12920	7500
Nreq	ρa=96KN		35.0	50.4	134.6	78.1
	Ng		23	23	23	22
	Np		2	3	6	4
			200+2@900	200+2@900	200+2@900	200+4@450



65+4@80+65=

450 450 450 450



60+6@80+60=

600 600 600

Splice plate

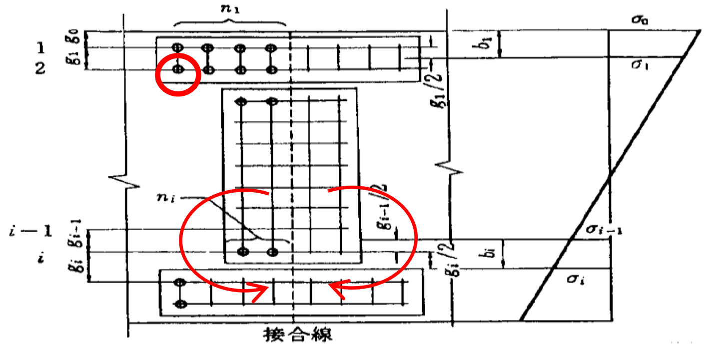
External	1-plate	2000x ts1	(ts1 = α・tf/2)
	2-plates	80 x ts2	(ts2=1.2・α・tf/2)
Internal comp	4-plates	430xts3	(ts3 > α・tf/2・(450/430)
tens	3-plates	560xts3	(ts3 > α・tf/2・(600/560)

α : Net width factor (W/(W-n・w))

(Tenssion side only)

Moreover splicejoint of stiffener is requreied.

			J1	J2	J3	J4
Position						
Web	Height	mm	2500	2500	2500	2500
	Moment Plate	mm	250	250	250	250
	Thickness	mm	9	9	9	10
	Monet PL	cm2	22.5	22.5	22.5	25
	Total Area	cm2	225	225	225	250
			SM400	SM400	SM490	SM490
	σf	N/mm2	90	110	180	120
Joint Axial Force F		KN	182.25	222.75	364.5	270
Joint ShearForce(2-we		KN	3000	2000	1000	3000
ρa=	96	KN				
Mom	Nm		1.86	2.27	3.72	2.76
Shear	Ns		15.31	10.20	5.10	15.31
			2@2=4	**2@2=4**	**2@2=4**	**2@2=4**
			"2@10=20	"2@10=20	"2@10=20	"2@10=20
	ρm=		45.6	55.7	91.1	67.5
	ρs=		62.5	41.7	20.8	62.5
	SQR($\rho m^2+\rho s^2$)		77.3	69.6	93.5	92.0



g0=100
g1=100
150
"9@200=
1800
150
g1=100
g0=100

1st Raw

$b_1 = g_0 + \frac{g_1}{2}$

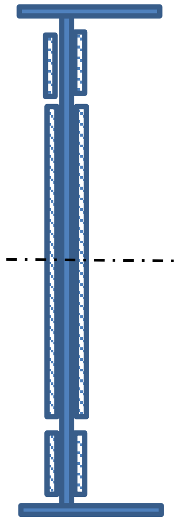
$P_1 = \frac{\sigma_0 + \sigma_1}{2} \cdot b_1 t$

i-Raw

$b_i = \frac{g_{i-1} + g_i}{2}$

$P_i = \frac{\sigma_{i-1} + \sigma_i}{2} \cdot b_i t$

ここに、t：板厚

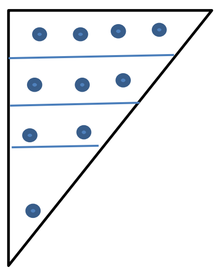


2-plates
180 x t5

2-plates
1880 x t4

(2-plate)
2420 x t4'

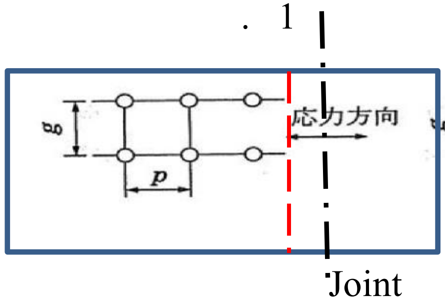
2-plates
180 x t5



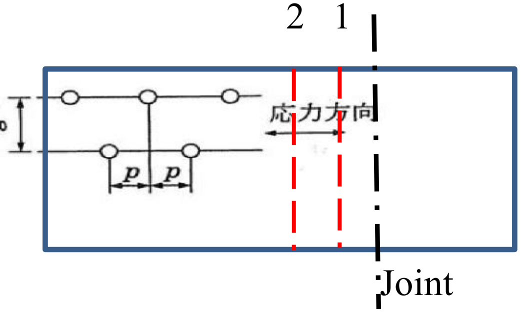
I w= 1/12・hw³・tw < Is

Is= 1/12・hs³・t4' ・2
- A(gap)・ys²

Net Width of Splice Plate



Parallel Arrangemnet



Diagonal Arrangemnet

Reduction width/ 1-bolt doue to 2nd line

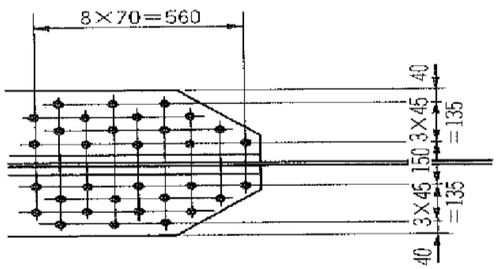
$$w = d - \frac{p^2}{4g} \quad \text{(mm)}$$

d= 24.5mm(in case of M22)

Examle:

p=75/2＝	37.5	45
g=	75	75
$p^2/4g$=	4.69	6.75
w=	19.81	17.75

Net width of tenssion side　　　Wf*=Wf-n1・d-n2・w



1－PL 500×19　95.0－(4×2.5＋0×W)×1.9
＝76.0 cm²

2－PL 215×21　90.3－(4×2.5＋0×W)×2.1
＝69.3 cm²

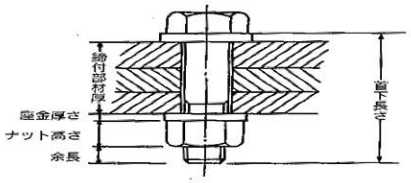
AN 合計　＝145.3 cm²

σ_t＝2 089×144.00/145.3
＝2 070 kgf/cm²＜2 100 kgf/cm²

ボルトの呼び	M16		M20		M22		M24	
ナット質量 kg/個	0.057		0.097		0.137		0.201	
座金質量 kg/2枚	0.040		0.064		0.104		0.124	
首下長さ mm ＼ 質量 kg	ボルト	セット	ボルト	セット	ボルト	セット	ボルト	セット
30								
35								
40	0.105	0.202						
45	0.113	0.210	0.187	0.348	0.240	0.481		
50	0.120	0.217	0.200	0.361	0.255	0.496	0.323	0.648
55	0.128	0.225	0.212	0.373	0.269	0.510	0.341	0.666
60	0.136	0.233	0.224	0.385	0.284	0.525	0.358	0.683
65	0.144	0.241	0.237	0.398	0.299	0.540	0.376	0.701
70	0.152	0.249	0.249	0.410	0.314	0.555	0.394	0.719
75	0.160	0.257	0.261	0.422	0.329	0.570	0.412	0.737
80	0.168	0.265	0.274	0.435	0.344	0.585	0.429	0.754
85	0.176	0.273	0.286	0.447	0.359	0.600	0.447	0.772
90	0.184	0.281	0.298	0.459	0.374	0.615	0.465	0.790
95	0.192	0.289	0.311	0.472	0.389	0.630	0.483	0.808
100	0.199	0.296	0.323	0.484	0.404	0.645	0.500	0.825
105	0.207	0.304	0.335	0.496	0.418	0.659	0.518	0.843
110	0.215	0.312	0.348	0.509	0.433	0.674	0.536	0.861
115	0.223	0.320	0.360	0.521	0.448	0.689	0.554	0.879
120	0.231	0.328	0.372	0.533	0.463	0.704	0.571	0.896
125			0.385	0.546	0.478	0.719	0.589	0.914
130			0.397	0.558	0.493	0.734	0.607	0.932
135			0.409	0.570	0.508	0.749	0.625	0.950
140			0.422	0.583	0.523	0.764	0.642	0.967
145					0.538	0.779	0.660	0.985
150					0.553	0.794	0.678	1.003
155					0.567	0.808	0.696	1.021
160					0.582	0.823	0.713	1.038
165							0.731	1.056
170							0.749	1.074
175							0.767	1.092
180							0.784	1.109
185							0.802	1.127
190								

値

screw part.



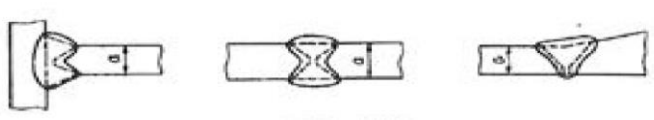
単位：mm

呼び(d)	締付け長さに加える値	最大余長	最小余長
M16	30	9	5
M20	35	10	6
M22	40	10	6
M24	45	13	9
M27	50	15	11
M30	55	13	9
M33	60	15	11
M36	65	17	13

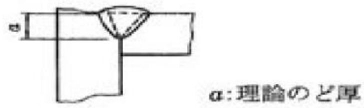
注）最大余長は5 mm 単位に切り上げた場合の値を示す。（施主により異なる場合もある。）

Welding Joint Type

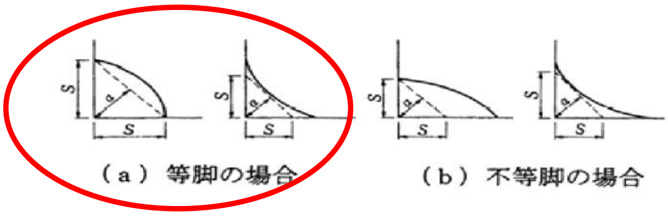
Butt Weld (Full Penetration)



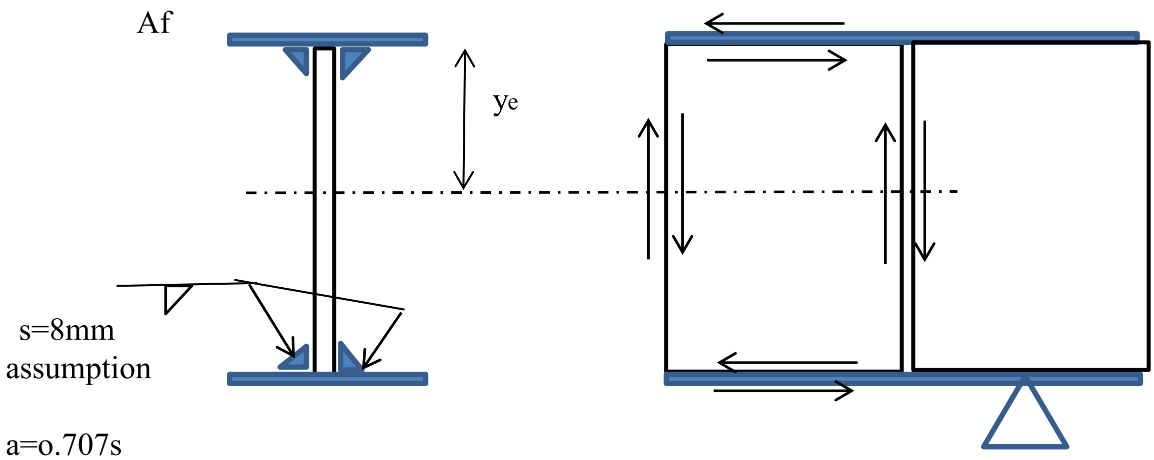
Partial Butt Weld



Fillet Weld



Shear Flow at the position of Bearing Support



a=o.707s

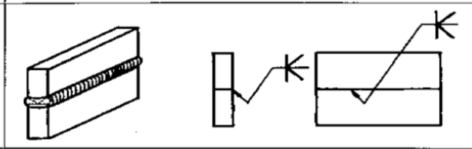
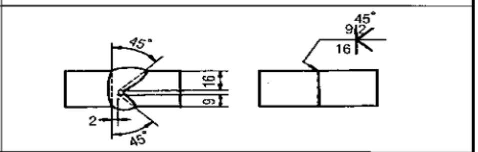
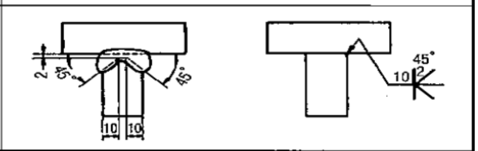
q=S･Q/I

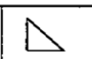
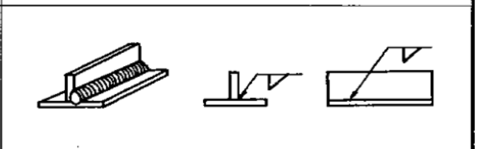
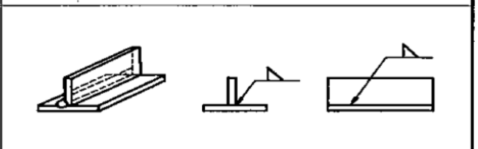
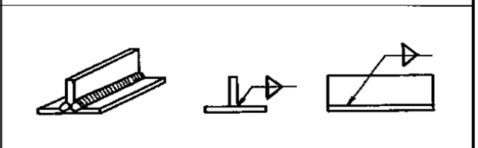
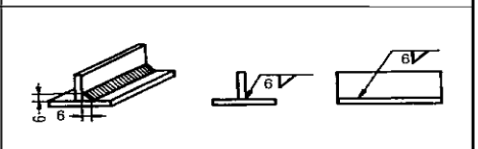
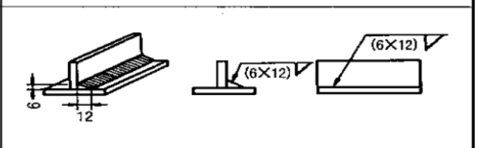
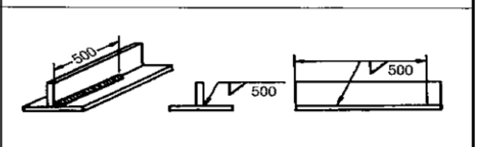
Q=Af･ ye　　　ye ≒H/2

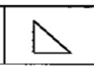
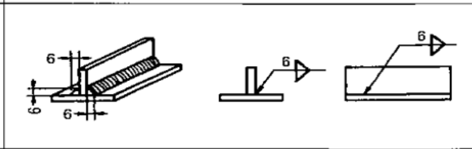
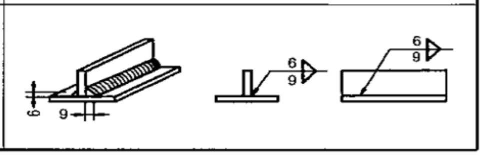
τ=q/4a　　　Weld Lines between flange and we are 4.

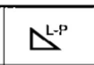
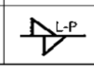
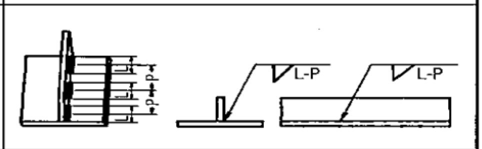
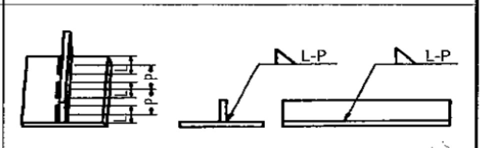
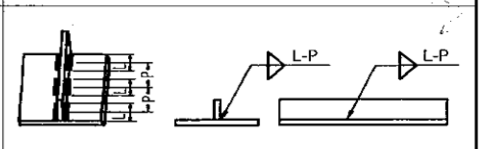
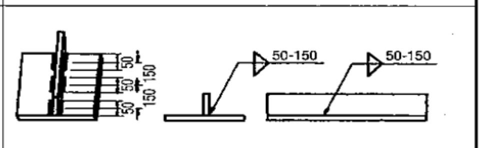
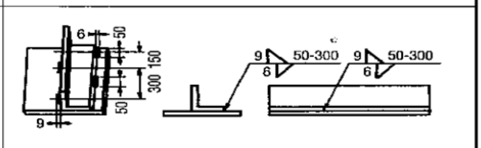
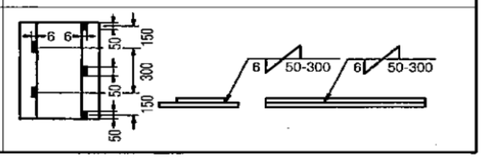
			J1	J2	J3
Af	cm		200	200	200
	cm		3.2	2	1.6
	cm^2		640	400	320
ye	cm		125	125	125
I	cm^4		2.6E+07	1.7E+07	1.4E+07
S	Kn		7000	3000	5000
q=S･Q/I	Kn/cm		21.26	8.65	13.94
s	mm		7.00	6.00	6.00
τ=q/4a	N/mm^2		43.4	20.6	33.2

Indication o

K形グループ溶接	記号	K	レ形グループ溶接記号を基線に対称に書く
溶 接 部	実形	図示	
両 側			
矢 の 側 開先深さ16mm 開先角度45度 矢の反対側 開先深さ 9 mm 開先角度45度 ルート間隔 2 mm の 場 合			
T 継 手 開先深さ10mm 開先力度45度 ルート間隔 2 mm の 場 合			

すみ肉溶接	連 続 (1)	記号		直角二等辺三角形と書く
溶 接 部	実形	図示		
矢 の 側 または 手 前 側				
矢の反対側 または 向 側				
両 側				
脚長 6 mm の 場 合				
不等脚の場合，小さい脚の寸法を先に，大きい脚を後に書き，かっこでくくる。 断面の表示が可能な場合は不等脚の方向がわかるように記入する。				
溶 接 長 さ 500mm の 場 合				

すみ肉溶接	連 続 (2)	記号		直角二等辺三角形と書く
溶 接 部	実形	図示		
両 側 脚 長 6 mm の 場 合				
両側脚長の 異なる場合				

すみ肉溶接	断続	記号	並列		直角二等辺三角形でL（溶接長さ）とP（ピッチ）を記入する
			千鳥		両側のすみ肉が等しい場合は  の記号を用いてもよい
溶 接 部	実形	図示			
矢 の 側 または 手 前 側					
矢の反対側 または 向 側					
両 側					
並列溶接 溶接長さ50mm ピッチ150mm の 場 合					
千鳥溶接 手前側脚長6mm 向側脚長9mm 溶接長さ50mm ピッチ300mm の 場 合					
千鳥溶接 両側脚長 6 mm 溶接長さ50mm ピッチ300mm の 場 合					

G1														
Sec No.		1	2	3	4	5	6	7	8	9	10	11	12	13
	Length	11750	10000	10000	10000	10000	10000	6500	10000	10000	10000	10000	10000	11750
U.Flang	Width	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
U.Flang	Thickness	14	16	22	22	18	22	28	22	18	22	22	16	14
U.Flang	Dgrade	SM400	SM400	SM490	SM490	SM400	SM490	SM490	SM490	SM400	SM490	SM490	SM400	SM400
U.Longi	Height	190	190	190	190	190	190	190	190	190	190	190	190	190
	Thickness	16	16	16	16	16	16	16	16	16	16	16	16	16
	Quantity	4	4	4	4	4	2	2	2	4	4	4	4	4
L.Flang	Width	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
	Thickness	14	16	19	19	18	22	30	22	18	10	19	16	14
	Dgrade	SM400	SM400	SM490	SM490	SM400	SM490	SM490	SM490	SM400	SM490	SM490	SM400	SM400
L.Longi	Height	190	190	190	190	190	190	190	190	190	190	190	190	190
	Thickness	16	16	16	16	16	16	16	16	16	16	16	16	16
	Quantity	2	2	2	2	2	4	4	4	2	2	2	2	2
Web	Height	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500
	Thickness	9	9	9	9	9	9	9	9	9	9	9	9	9
	Quantity	2	2	2	2	2	2	2	2	2	2	2	2	2
	Grade	SM400	SM400	SM490	SM490	SM400	SM490	SM490	SM490	SM400	SM490	SM490	SM400	SM400
H.Stiff	Length	1050	1050	1050	1050	1050	1050	1050	1050	1050	1050	1050	1050	1050
	Height	120	120	120	120	120	120	120	120	120	120	120	120	120
	Thickness	10	10	10	10	10	10	10	10	10	10	10	10	10
	Quantity	38	32	32	32	32	32	20.8	32	32	32	32	32	38
V.Stiff	Height	150	150	150	150	150	150	150	150	150	150	150	150	150
	Thickness	14	14	14	14	14	14	14	14	14	14	14	14	14
	Length	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500
	Quantity	19	16	16	16	16	16	10.4	16	16	16	16	16	18.8
Bearing .Diaphragm	Width	1792						1792						1792
	Thickness	16						22						16
	Height	2500						2500						2500
	Quantity	1						1						1
V.Stiff at bearing	Width	220						220						220
	Thickness	19						22						19
	Height	2500						2500						2500
	Quantity	2						2						2
Stiifenesr for Manh	Height	100						100						100
	Thickness	9						9						9
	Length	900						900						900
	Quantity	4						4						4

Sec No.		1	2	3	4	5	6	7	8	9	10	11	12	13
Mid Diaphragm	Width	1792	1792	1792	1792	1792	1792		1792	1792	1792	1792	1792	1792
	Thickness	9	9	9	9	9	9		9	9	9	9	9	9
	Height	2500	2500	2500	2500	2500	2500		2500	2500	2500	2500	2500	2500
	Quantity	2	2	2	2	2	2	0	2	2	2	2	2	2
Stiifenesr for Manh	Height	100	100	100	100	100	100		100	100	100	100	100	100
	Thickness	9	9	9	9	9	9		9	9	9	9	9	9
	Length	900	900	900	900	900	900		900	900	900	900	900	900
	Quantity	8	8	8	8	8	8		8	8	8	8	8	8
Cross Beam:Web	Height	500	500	500	500	500	500	500	500	500	500	500	500	500
	Thickness	9	9	9	9	9	9	9	9	9	9	9	9	9
	Length	1791	1791	1791	1791	1791	1791	1791	1791	1791	1791	1791	1791	1791
	Quantity	4	4	4	4	4	4	4	4	4	4	4	4	4
Cross Beam:Flg	Height	200	200	200	200	200	200	200	200	200	200	200	200	200
	Thickness	12	12	12	12	12	12	12	12	12	12	12	12	12
	Length	1791	1791	1791	1791	1791	1791	1791	1791	1791	1791	1791	1791	1791
	Quantity	4	4	4	4	4	4	4	4	4	4	4	4	4
Cross Girder:Flg	Width	200	200											
	Thickness	12	12											
	Length	3200	250											
	Quantity	108	216											
Cross Girder:web	Width	1200	1200											
	Thickness	9	9											
	Length	3200	250											
	Quantity	54	108											
		SM400	SM400											

Sec No.		1	2	3	4	5	6	7	8	9	10	11	12	13
Joint	**Decision side**		1−2	2−3	**3**−4	4−**5**	**5**−6	**6**−7	7−**8**	8−**9**	**9**−10	10−**11**	11−**12**	12−**13**
U.Flange														
Required Bolts			40.83	46.67	96.25	52.50	52.50	96.25	96.25	52.50	52.50	96.25	46.67	40.83
Required Columns /each panel			3.41	3.41	3.41	3.41	6.84	6.84	6.84	3.41	3.41	3.41	3.41	3.41
Applied Columns/each Panel			3.00	3.00	3.00	3.00	6.00	6.00	6.00	3.00	3.00	3.00	3.00	3.00
Required Rows			2.72	3.11	6.42	3.50	2.92	5.35	5.35	2.92	3.50	6.42	3.11	2.72
Applied Rows			3.00	4.00	7.00	4.00	3.00	6.00	6.00	3.00	4.00	7.00	4.00	3.00
	External	Width	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
		Thickness	9	9	11	9	11	14	14	11	9	11	11	9
		Length	470	620	1070	620	470	920	920	470	620	1070	620	470
		Quantity	1	1	1	1	1	1	1	1	1	1	1	1
	External	Width	80	80	80	80	80	80	80	80	80	80	80	80
		Thickness	9	12	12	11	14	16	16	14	11	12	12	9
		Length	470	620	1070	620	470	920	920	470	620	1070	620	470
		Quantity	2	2	2	2	2	2	2	2	2	2	2	2
	internal	Width	310	310	310	310	310	550	550	310	310	310	310	310
		Thickness	10	10	13	11	13	16	16	13	11	13	10	10
		Length	470	620	1070	620	470	920	920	470	620	1070	620	470
		Quantity	5	5	5	5	5	3	3	5	5	5	5	5
	Grade		SM400	SM490	SM490	SM400	SM490	SM490	SM490	SM400	SM490	SM490	SM400	SM400
L.Flang														
Required Bolts			40.83	46.67	83.13	52.50	52.50	64.17	64.17	52.50	52.50	83.13	46.67	40.83
Required Columns /each panel			6.84	6.84	6.84	6.84	6.84	3.41	3.41	4.11	6.84	6.84	6.84	6.84
Applied Columns/each Panel			6.00	6.00	6.00	6.00	6.00	3.00	3.00	4.00	6.00	6.00	6.00	6.00
Required Rows			3.40	3.89	6.93	4.38	4.38	5.35	5.35	6.56	4.38	6.93	3.89	3.40
Applied Rows			4.00	4.00	7.00	5.00	5.00	6.00	6.00	7.00	5.00	7.00	4.00	4.00
	External	Width	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
		Thickness	9	9	11	9	11	14	14	11	9	11	11	9
		Length	620	620	1070	770	770	920	920	1070	770	1070	620	620
		Quantity	1	1	1	1	1	1	1	1	1	1	1	1
	External	Width	80	80	80	80	80	80	80	80	80	80	80	80
		Thickness	9	12	12	11	14	16	16	14	11	12	12	9
		Length	620	620	1070	770	770	920	920	1070	770	1070	620	620
		Quantity	2	2	2	2	2	2	2	2	2	2	2	2
	internal	Width	550	550	550	550	550	310	310	550	550	550	550	550
		Thickness	10	10	13	11	13	16	16	13	11	13	10	10
		Length	620	620	1070	770	770	920	920	1070	770	1070	620	620
		Quantity	1	1	1	1	1	1	1	1	1	1	1	1
	Grade		SS400	SM490	SM490	SS400	SM490	SM490	SM490	SS400	SM490	SM490	SS400	SS400

Sec No.		1	2	3	4	5	6	7	8	9	10	11	12	13
Web														
Moment Pl	2-Columns	Width	180	180	180	180	180	180	180	180	180	180	180	180
Upper&Lower		Thickness	8	8	8	8	8	8	8	8	8	8	8	8
	3-Rows	Length	470	470	470	470	470	470	470	470	470	470	470	470
		Quantity	4	4	4	4	4	4	4	4	4	4	4	4
Shear Pl	2-Columns	Width	320	320	320	320	320	320	320	320	320	320	320	320
		Thickness	8	8	8	8	8	8	8	8	8	8	8	8
	10-Rows	Length	1880	1880	1880	1880	1880	1880	1880	1880	1880	1880	1880	1880
		Quantity	2	2	2	2	2	2	2	2	2	2	2	2
	Grade		SS400	SS400	SM490	SS400	SM490	SM490	SM490	SS400	SM490	SM490	SS400	SS400
Longi		Width	160	160	160	160	160	160	160	160	160	160	160	160
		Thickness	10	10	10	10	10	10	10	10	10	10	10	10
	Upper	Length	470	620	1070	620	470	920	920	470	620	1070	620	470
		Width	160	160	160	160	160	160	160	160	160	160	160	160
		Thickness	10	10	10	10	10	10	10	10	10	10	10	10
	Lower	Length	620	620	1070	770	770	920	920	1070	770	1070	620	620
			SS400	SS400	SM490	SS400	SM490	SM490	SM490	SS400	SM490	SM490	SS400	SS400

Cross Girder:Spl	Width	200	80											
	Thickness	8	8											
	Length	470	470											
	Quantity	108	216											
	Width	320												
	Thickness	8												
	Length	940												
	Quantity	216												
	Grade	SS400	SS400											

1-Main Girder Only

	Width	Thickness	Length	quantity	Net	Weight	
U.Flang	2000	14	11750	1		2,583	SM400
U.Flang	2000	16	10000	1		2,512	SM400
U.Flang	2000	22	10000	1		3,454	SM490
U.Flang	2000	22	10000	1		3,454	SM490
U.Flang	2000	18	10000	1		2,826	SM400
U.Flang	2000	22	10000	1		3,454	SM490
U.Flang	2000	28	6500	1		2,857	SM490
U.Flang	2000	22	10000	1		3,454	SM490
U.Flang	2000	18	10000	1		2,826	SM400
U.Flang	2000	22	10000	1		3,454	SM490
U.Flang	2000	22	10000	1		3,454	SM490
U.Flang	2000	16	10000	1		2,512	SM400
U.Flang	2000	14	11750	1		2,583	SM400
U.Longi	190	16	11750	4		1,122	SM400
U.Longi	190	16	10000	4		955	SM400
U.Longi	190	16	10000	4		955	SM490
U.Longi	190	16	10000	4		955	SM490
U.Longi	190	16	10000	4		955	SM400
U.Longi	190	16	10000	2		477	SM490
U.Longi	190	16	6500	2		310	SM490
U.Longi	190	16	10000	2		477	SM490
U.Longi	190	16	10000	2		477	SM400
U.Longi	190	16	10000	4		955	SM490
U.Longi	190	16	10000	4		955	SM490
U.Longi	190	16	10000	4		955	SM400
U.Longi	190	16	11750	4		1,122	SM400
L.Flang	2000	14	11750	1		2,583	SM400
L.Flang	2000	16	10000	1		2,512	SM400
L.Flang	2000	19	10000	1		2,983	SM490
L.Flang	2000	19	10000	1		2,983	SM490
L.Flang	2000	18	10000	1		2,826	SM400
L.Flang	2000	22	10000	1		3,454	SM490
L.Flang	2000	30	6500	1		3,062	SM490
L.Flang	2000	22	10000	1		3,454	SM490
L.Flang	2000	18	10000	1		2,826	SM400
L.Flang	2000	18	10000	1		2,826	SM490
L.Flang	2000	19	10000	1		2,983	SM490
L.Flang	2000	16	10000	1		2,512	SM400
L.Flang	2000	14	11750	1		2,583	SM400
L.Longi	190	16	11750	2		561	SM400
L.Longi	190	16	10000	2		477	SM400
L.Longi	190	16	10000	2		477	SM490
L.Longi	190	16	10000	2		477	SM490
L.Longi	190	16	10000	2		477	SM400
L.Longi	190	16	10000	4		955	SM490
L.Longi	190	16	6500	4		620	SM490
L.Longi	190	16	10000	4		955	SM490
L.Longi	190	16	10000	2		477	SM400
L.Longi	190	16	10000	2		477	SM490
L.Longi	190	16	10000	2		477	SM490
L.Longi	190	16	10000	2		477	SM400
L.Longi	190	16	11750	2		561	SM400
Web	2500	9	11750	2		4,151	SM400
Web	2500	9	10000	2		3,533	SM400
Web	2500	9	10000	2		3,533	SM490
Web	2500	9	10000	2		3,533	SM490

	Width	Thickness	Length	quantity	Net	Weight	
Web	2500	9	10000	2		3,533	SM400
Web	2500	9	10000	2		3,533	SM490
Web	2500	9	6500	2		2,296	SM490
Web	2500	9	10000	2		3,533	SM490
Web	2500	9	10000	2		3,533	SM400
Web	2500	9	10000	2		3,533	SM490
Web	2500	9	10000	2		3,533	SM490
Web	2500	9	10000	2		3,533	SM400
Web	2500	9	11750	2		4,151	SM400
H.Stiff	120	10	1050	38		372	SM400
H.Stiff	120	10	1050	32		317	SM400
H.Stiff	120	10	1050	32		317	SM490
H.Stiff	120	10	1050	32		317	SM490
H.Stiff	120	10	1050	32		317	SM400
H.Stiff	120	10	1050	32		317	SM490
H.Stiff	120	10	1050	21		206	SM490
H.Stiff	120	10	1050	32		317	SM490
H.Stiff	120	10	1050	32		317	SM400
H.Stiff	120	10	1050	32		317	SM490
H.Stiff	120	10	1050	32		317	SM490
H.Stiff	120	10	1050	32		317	SM400
H.Stiff	120	10	1050	38		372	SM400
V.Stiff	150	14	2500	19		775	SM400
V.Stiff	150	14	2500	16		659	SM400
V.Stiff	150	14	2500	16		659	SM400
V.Stiff	150	14	2500	16		659	SM400
V.Stiff	150	14	2500	16		659	SM400
V.Stiff	150	14	2500	16		659	SM400
V.Stiff	150	14	2500	10		429	SM400
V.Stiff	150	14	2500	16		659	SM400
V.Stiff	150	14	2500	16		659	SM400
V.Stiff	150	14	2500	16		659	SM400
V.Stiff	150	14	2500	16		659	SM400
V.Stiff	150	14	2500	16		659	SM400
V.Stiff	150	14	2500	19		775	SM400
Bearing .Diaphragm	1792	16	2500	1	0.75	422	SM490
Bearing .Diaphragm	1792	22	2500	1	0.75	580	SM490
Bearing .Diaphragm	1792	16	2500	1		563	SM490
V.Stiff at bearing	220	19	2500	2		164	SM400
V.Stiff at bearing	220	22	2500	2		190	SM400
V.Stiff at bearing	220	19	2500	2		164	SM400
Stiifenesr for Manhole	1792	9	2500	2		633	SM400
Stiifenesr for Manhole	1792	9	2500	2		633	SM400
Stiifenesr for Manhole	1792	9	2500	2		633	SM400
Stiifenesr for Manhole	1792	9	2500	2		633	SM400
Stiifenesr for Manhole	1792	9	2500	2		633	SM400
Stiifenesr for Manhole	1792	9	2500	2		633	SM400
Mid Diaphragm	1792	9	2500	2	0.75	475	SM400
Mid Diaphragm	1792	9	2500	2	0.75	475	SM400
Mid Diaphragm	1792	9	2500	2	0.75	475	SM400
Mid Diaphragm	1792	9	2500	2	0.75	475	SM400
Mid Diaphragm	1792	9	2500	2	0.75	475	SM400
Mid Diaphragm	1792	9	2500	2	0.75	475	SM400
Stiifenesr for Manhole	100	9	900	8		51	SM400
Stiifenesr for Manhole	100	9	900	8		51	SM400
Stiifenesr for Manhole	100	9	900	8		51	SM400
Stiifenesr for Manhole	100	9	900	8		51	SM400
Stiifenesr for Manhole	100	9	900	8		51	SM400

	Width	Thickness	Length	quantity	Net	Weight	
Stiifenesr for Manhole	100	9	900	8		51	SM400
Stiifenesr for Manhole	100	9	900	8		51	SM400
Stiifenesr for Manhole	100	9	900	8		51	SM400
Stiifenesr for Manhole	100	9	900	8		51	SM400
Stiifenesr for Manhole	100	9	900	8		51	SM400
Stiifenesr for Manhole	100	9	900	8		51	SM400
Stiifenesr for Manhole	100	9	900	8		51	SM400
Cross Beam:Web	500	9	1791	4		253	SM400
	500	9	1791	4		253	SM400
	500	9	1791	4		253	SM400
	500	9	1791	4		253	SM400
	500	9	1791	4		253	SM400
	500	9	1791	4		253	SM400
	500	9	1791	4		253	SM400
	500	9	1791	4		253	SM400
	500	9	1791	4		253	SM400
	500	9	1791	4		253	SM400
	500	9	1791	4		253	SM400
	500	9	1791	4		253	SM400
	500	9	1791	4		253	SM400
Cross Beam:Flg	200	12	1791	4		135	SM400
	200	12	1791	4		135	SM400
	200	12	1791	4		135	SM400
	200	12	1791	4		135	SM400
	200	12	1791	4		135	SM400
	200	12	1791	4		135	SM400
	200	12	1791	4		135	SM400
	200	12	1791	4		135	SM400
	200	12	1791	4		135	SM400
	200	12	1791	4		135	SM400
	200	12	1791	4		135	SM400
	200	12	1791	4		135	SM400
	200	12	1791	4		135	SM400
						165,557	
					3*	496,670	

	Width	Thickness	Length	quantity	Net	Weight	
	200	12	3200	108		6,511	SM400
	200	12	250	216		1,017	SM400
	1200	9	3200	54		14,650	SM400
	1200	9	250	108		2,289	SM400
	2000	9	470	1		66	SM400
	2000	9	620	1		88	SM490
	2000	11	1070	1		185	SM490
	2000	9	620	1		88	SM400
	2000	11	470	1		81	SM490
	2000	14	920	1		202	SM490
	2000	14	920	1		202	SM490
	2000	11	470	1		81	SM400
	2000	9	620	1		88	SM490
	2000	11	1070	1		185	SM490
	2000	11	620	1		107	SM400
	80	9	470	2		5	SM400
	80	12	620	2		9	SM400
	80	12	1070	2		16	SM490
	80	11	620	2		9	SM490
	80	14	470	2		8	SM400
	80	16	920	2		18	SM490
	80	16	920	2		18	SM490
	80	14	470	2		8	SM490
	80	11	620	2		9	SM400
	80	12	1070	2		16	SM490
	310	10	470	5		57	SM490
	310	10	620	5		75	SM400
	310	13	1070	5		169	SM400
	310	11	620	5		83	SM400
	310	13	470	5		74	SM490
	550	16	920	3		191	SM490
	550	16	920	3		191	SM490
	310	13	470	5		74	SM400
	310	11	620	5		83	SM490
	310	13	1070	5		169	SM490
	310	10	620	5		75	SM400
	310	10	470	5		57	SM400
						0	
	2000	9	620	1		88	SS400
	2000	9	620	1		88	SM490
	2000	11	1070	1		185	SM490
	2000	9	770	1		109	SS400
	2000	11	770	1		133	SM490
	2000	14	920	1		202	SM490
	2000	14	920	1		202	SM490
	2000	11	1070	1		185	SS400
	2000	9	770	1		109	SM490
	2000	11	1070	1		185	SM490
	2000	11	620	1		107	SS400
	2000	9	620	1		88	SS400
						0	
	80	9	620	2		7	SS400
	80	12	620	2		9	SM490
	80	12	1070	2		16	SM490
	80	11	770	2		11	SS400
	80	14	770	2		14	SM490
	80	16	920	2		18	SM490
	80	16	920	2		18	SM490

	Width	Thickness	Length	quantity	Net	Weight	
	80	14	1070	2		19	SS400
	80	11	770	2		11	SM490
	80	12	1070	2		16	SM490
	80	12	620	2		9	SS400
	80	9	620	2		7	SS400
						0	
	550	10	620	1		27	SS400
	550	10	620	1		27	SM490
	550	13	1070	1		60	SM490
	550	11	770	1		37	SS400
	550	13	770	1		43	SM490
	310	16	920	1		36	SM490
	310	16	920	1		36	SM490
	550	13	1070	1		60	SS400
	550	11	770	1		37	SM490
	550	13	1070	1		60	SM490
	550	10	620	1		27	SS400
	550	10	620	1		27	SS400
						0	
	180	8	470	4		21	SS400
	180	8	470	4		21	SS400
	180	8	470	4		21	SM490
	180	8	470	4		21	SS400
	180	8	470	4		21	SM490
	180	8	470	4		21	SM490
	180	8	470	4		21	SM490
	180	8	470	4		21	SS400
	180	8	470	4		21	SM490
	180	8	470	4		21	SM490
	180	8	470	4		21	SS400
	180	8	470	4		21	SS400
						0	
	320	8	1880	2		76	SS400
	320	8	1880	2		76	SS400
	320	8	1880	2		76	SM490
	320	8	1880	2		76	SS400
	320	8	1880	2		76	SM490
	320	8	1880	2		76	SM490
	320	8	1880	2		76	SM490
	320	8	1880	2		76	SS400
	320	8	1880	2		76	SM490
	320	8	1880	2		76	SM490
	320	8	1880	2		76	SS400
	320	8	1880	2		76	SS400
						0	
	160	10	470	4		24	SS400
	160	10	620	4		31	SS400
	160	10	1070	4		54	SM490
	160	10	620	4		31	SS400
	160	10	470	4		24	SM490
	160	10	920	2		23	SM490
	160	10	920	2		23	SM490
	160	10	470	4		24	SS400
	160	10	620	4		31	SM490
	160	10	1070	4		54	SM490
	160	10	620	4		31	SS400
	160	10	470	4		24	SS400
						0	

	Width	Thickness	Length	quantity	Net	Weight	
	160	10	620	2		16	SS400
	160	10	620	2		16	SS400
	160	10	1070	2		27	SM490
	160	10	770	2		19	SS400
	160	10	770	2		19	SM490
	160	10	920	4		46	SM490
	160	10	920	4		46	SM490
	160	10	1070	2		27	SS400
	160	10	770	2		19	SM490
	160	10	1070	2		27	SM490
	160	10	620	2		16	SS400
	160	10	620	2		16	SS400
						0	
	200	8	470	108		638	SS400
	320	8	940	216		4,080	SS400
	80	8	470	216		510	SS400
						36,623	

Total Plate	533	ton
	5,226	Kn

	Width	Thickness	Length	quantity	Net	Weight	

	Width	Thickness	Length	quantity	Net	Weight	
V.Stiff at bearing	220	22	2500	2		190	SM400
V.Stiff at bearing	220	19	2500	2		164	SM400
V.Stiff at bearing	220	19	2500	2		164	SM400
U.Flang	2000	18	10000	1		2,826	SM400
U.Flang	2000	18	10000	1		2,826	SM400
L.Flang	2000	18	10000	1		2,826	SM400
L.Flang	2000	18	10000	1		2,826	SM400
U.Flang	2000	16	10000	1		2,512	SM400
U.Flang	2000	16	10000	1		2,512	SM400
U.Longi	190	16	11750	4		1,122	SM400
U.Longi	190	16	10000	4		955	SM400
U.Longi	190	16	10000	4		955	SM400
U.Longi	190	16	10000	2		477	SM400
U.Longi	190	16	10000	4		955	SM400
U.Longi	190	16	11750	4		1,122	SM400
L.Flang	2000	16	10000	1		2,512	SM400
L.Flang	2000	16	10000	1		2,512	SM400
L.Longi	190	16	11750	2		561	SM400
L.Longi	190	16	10000	2		477	SM400
L.Longi	190	16	10000	2		477	SM400
L.Longi	190	16	10000	2		477	SM400
L.Longi	190	16	10000	2		477	SM400
L.Longi	190	16	11750	2		561	SM400
U.Flang	2000	14	11750	1		2,583	SM400
U.Flang	2000	14	11750	1		2,583	SM400
L.Flang	2000	14	11750	1		2,583	SM400
L.Flang	2000	14	11750	1		2,583	SM400
V.Stiff	150	14	2500	18.8		775	SM400
V.Stiff	150	14	2500	16		659	SM400
V.Stiff	150	14	2500	16		659	SM400
V.Stiff	150	14	2500	16		659	SM400
V.Stiff	150	14	2500	16		659	SM400
V.Stiff	150	14	2500	16		659	SM400
V.Stiff	150	14	2500	10.4		429	SM400
V.Stiff	150	14	2500	16		659	SM400
V.Stiff	150	14	2500	16		659	SM400
V.Stiff	150	14	2500	16		659	SM400
V.Stiff	150	14	2500	16		659	SM400
V.Stiff	150	14	2500	16		659	SM400
V.Stiff	150	14	2500	18.8		775	SM400
	80	14	470	2		8	SM400
	310	13	1070	5		169	SM400
	310	13	470	5		74	SM400
Cross Beam:Flg	200	12	1791	4		135	SM400
	200	12	1791	4		135	SM400
	200	12	1791	4		135	SM400
	200	12	1791	4		135	SM400
	200	12	1791	4		135	SM400
	200	12	1791	4		135	SM400
	200	12	1791	4		135	SM400
	200	12	1791	4		135	SM400
	200	12	1791	4		135	SM400
	200	12	1791	4		135	SM400
	200	12	1791	4		135	SM400
	200	12	1791	4		135	SM400
	200	12	1791	4		135	SM400

	Width	Thickness	Length	quantity	Net	Weight	
	200	12	3200	108		6,511	SM400
	200	12	250	216		1,017	SM400
	80	12	620	2		9	SM400
	2000	11	470	1		81	SM400
	2000	11	620	1		107	SM400
	80	11	620	2		9	SM400
	310	11	620	5		83	SM400
H.Stiff	120	10	1050	37.6		372	SM400
H.Stiff	120	10	1050	32		317	SM400
H.Stiff	120	10	1050	32		317	SM400
H.Stiff	120	10	1050	32		317	SM400
H.Stiff	120	10	1050	32		317	SM400
H.Stiff	120	10	1050	37.6		372	SM400
	310	10	620	5		75	SM400
	310	10	620	5		75	SM400
	310	10	470	5		57	SM400
Web	2500	9	11750	2		4,151	SM400
Web	2500	9	10000	2		3,533	SM400
Web	2500	9	10000	2		3,533	SM400
Web	2500	9	10000	2		3,533	SM400
Web	2500	9	10000	2		3,533	SM400
Web	2500	9	11750	2		4,151	SM400
Stiifenesr for Manhole	1792	9	2500	2		633	SM400
Stiifenesr for Manhole	1792	9	2500	2		633	SM400
Stiifenesr for Manhole	1792	9	2500	2		633	SM400
Stiifenesr for Manhole	1792	9	2500	2		633	SM400
Stiifenesr for Manhole	1792	9	2500	2		633	SM400
Stiifenesr for Manhole	1792	9	2500	2		633	SM400
Mid Diaphragm	1792	9	2500	2	0.75	475	SM400
Mid Diaphragm	1792	9	2500	2	0.75	475	SM400
Mid Diaphragm	1792	9	2500	2	0.75	475	SM400
Mid Diaphragm	1792	9	2500	2	0.75	475	SM400
Mid Diaphragm	1792	9	2500	2	0.75	475	SM400
Mid Diaphragm	1792	9	2500	2	0.75	475	SM400
Stiifenesr for Manhole	100	9	900	8		51	SM400
Stiifenesr for Manhole	100	9	900	8		51	SM400
Stiifenesr for Manhole	100	9	900	8		51	SM400
Stiifenesr for Manhole	100	9	900	8		51	SM400
Stiifenesr for Manhole	100	9	900	8		51	SM400
Stiifenesr for Manhole	100	9	900	8		51	SM400
Stiifenesr for Manhole	100	9	900	8		51	SM400
Stiifenesr for Manhole	100	9	900	8		51	SM400
Stiifenesr for Manhole	100	9	900	8		51	SM400
Stiifenesr for Manhole	100	9	900	8		51	SM400
Stiifenesr for Manhole	100	9	900	8		51	SM400
Stiifenesr for Manhole	100	9	900	8		51	SM400
Cross Beam:Web	500	9	1791	4		253	SM400
	500	9	1791	4		253	SM400
	500	9	1791	4		253	SM400
	500	9	1791	4		253	SM400
	500	9	1791	4		253	SM400
	500	9	1791	4		253	SM400
	500	9	1791	4		253	SM400
	500	9	1791	4		253	SM400
	500	9	1791	4		253	SM400
	500	9	1791	4		253	SM400
	500	9	1791	4		253	SM400
	500	9	1791	4		253	SM400

	Width	Thickness	Length	quantity	Net	Weight	
	500	9	1791	4		253	SM400
	1200	9	3200	54		14,650	SM400
	1200	9	250	108		2,289	SM400
	2000	9	470	1		66	SM400
	2000	9	620	1		88	SM400
	80	9	470	2		5	SM400
L.Flang	2000	30	6500	1		3,062	SM490
U.Flang	2000	28	6500	1		2,857	SM490
U.Flang	2000	22	10000	1		3,454	SM490
U.Flang	2000	22	10000	1		3,454	SM490
U.Flang	2000	22	10000	1		3,454	SM490
U.Flang	2000	22	10000	1		3,454	SM490
U.Flang	2000	22	10000	1		3,454	SM490
U.Flang	2000	22	10000	1		3,454	SM490
L.Flang	2000	22	10000	1		3,454	SM490
L.Flang	2000	22	10000	1		3,454	SM490
Bearing .Diaphragm	1792	22	2500	1	0.75	580	SM490
L.Flang	2000	19	10000	1		2,983	SM490
L.Flang	2000	19	10000	1		2,983	SM490
L.Flang	2000	19	10000	1		2,983	SM490
L.Flang	2000	18	10000	1		2,826	SM490
U.Longi	190	16	10000	4		955	SM490
U.Longi	190	16	10000	4		955	SM490
U.Longi	190	16	10000	2		477	SM490
U.Longi	190	16	6500	2		310	SM490
U.Longi	190	16	10000	2		477	SM490
U.Longi	190	16	10000	4		955	SM490
U.Longi	190	16	10000	4		955	SM490
L.Longi	190	16	10000	2		477	SM490
L.Longi	190	16	10000	2		477	SM490
L.Longi	190	16	10000	4		955	SM490
L.Longi	190	16	6500	4		620	SM490
L.Longi	190	16	10000	4		955	SM490
L.Longi	190	16	10000	2		477	SM490
L.Longi	190	16	10000	2		477	SM490
Bearing .Diaphragm	1792	16	2500	1	0.75	422	SM490
Bearing .Diaphragm	1792	16	2500	1		563	SM490
	80	16	920	2		18	SM490
	80	16	920	2		18	SM490
	550	16	920	3		191	SM490
	550	16	920	3		191	SM490
	80	16	920	2		18	SM490
	80	16	920	2		18	SM490
	310	16	920	1		36	SM490
	310	16	920	1		36	SM490
	2000	14	920	1		202	SM490
	2000	14	920	1		202	SM490
	80	14	470	2		8	SM490
	2000	14	920	1		202	SM490
	2000	14	920	1		202	SM490
	80	14	770	2		14	SM490
	310	13	470	5		74	SM490
	310	13	1070	5		169	SM490
	550	13	1070	1		60	SM490
	550	13	770	1		43	SM490
	550	13	1070	1		60	SM490
	80	12	1070	2		16	SM490
	80	12	1070	2		16	SM490

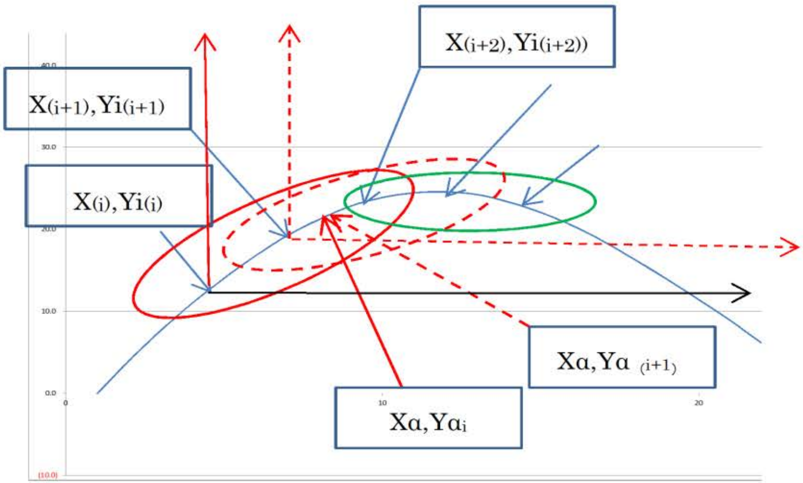
	Width	Thickness	Length	quantity	Net	Weight	
	80	12	620	2		9	SM490
	80	12	1070	2		16	SM490
	80	12	1070	2		16	SM490
	2000	11	1070	1		185	SM490
	2000	11	470	1		81	SM490
	2000	11	1070	1		185	SM490
	80	11	620	2		9	SM490
	310	11	620	5		83	SM490
	2000	11	1070	1		185	SM490
	2000	11	770	1		133	SM490
	2000	11	1070	1		185	SM490
	80	11	770	2		11	SM490
	550	11	770	1		37	SM490
H.Stiff	120	10	1050	32		317	SM490
H.Stiff	120	10	1050	32		317	SM490
H.Stiff	120	10	1050	32		317	SM490
H.Stiff	120	10	1050	20.8		206	SM490
H.Stiff	120	10	1050	32		317	SM490
H.Stiff	120	10	1050	32		317	SM490
H.Stiff	120	10	1050	32		317	SM490
	310	10	470	5		57	SM490
	550	10	620	1		27	SM490
	160	10	1070	4		54	SM490
	160	10	470	4		24	SM490
	160	10	920	2		23	SM490
	160	10	920	2		23	SM490
	160	10	620	4		31	SM490
	160	10	1070	4		54	SM490
	160	10	1070	2		27	SM490
	160	10	770	2		19	SM490
	160	10	920	4		46	SM490
	160	10	920	4		46	SM490
	160	10	770	2		19	SM490
	160	10	1070	2		27	SM490
Web	2500	9	10000	2		3,533	SM490
Web	2500	9	10000	2		3,533	SM490
Web	2500	9	10000	2		3,533	SM490
Web	2500	9	6500	2		2,296	SM490
Web	2500	9	10000	2		3,533	SM490
Web	2500	9	10000	2		3,533	SM490
Web	2500	9	10000	2		3,533	SM490
	2000	9	620	1		88	SM490
	2000	9	620	1		88	SM490
	2000	9	620	1		88	SM490
	2000	9	770	1		109	SM490
	180	8	470	4		21	SM490
	180	8	470	4		21	SM490
	180	8	470	4		21	SM490
	180	8	470	4		21	SM490
	180	8	470	4		21	SM490
	180	8	470	4		21	SM490
	320	8	1880	2		76	SM490
	320	8	1880	2		76	SM490
	320	8	1880	2		76	SM490
	320	8	1880	2		76	SM490
	320	8	1880	2		76	SM490
	320	8	1880	2		76	SM490
	80	14	1070	2		19	SS400

	Width	Thickness	Length	quantity	Net	Weight	
	550	13	1070	1		60	SS400
	80	12	620	2		9	SS400
	2000	11	1070	1		185	SS400
	2000	11	620	1		107	SS400
	80	11	770	2		11	SS400
	550	11	770	1		37	SS400
	550	10	620	1		27	SS400
	550	10	620	1		27	SS400
	550	10	620	1		27	SS400
	160	10	470	4		24	SS400
	160	10	620	4		31	SS400
	160	10	620	4		31	SS400
	160	10	470	4		24	SS400
	160	10	620	4		31	SS400
	160	10	470	4		24	SS400
	160	10	620	2		16	SS400
	160	10	620	2		16	SS400
	160	10	770	2		19	SS400
	160	10	1070	2		27	SS400
	160	10	620	2		16	SS400
	160	10	620	2		16	SS400
	2000	9	620	1		88	SS400
	2000	9	770	1		109	SS400
	2000	9	620	1		88	SS400
	80	9	620	2		7	SS400
	80	9	620	2		7	SS400
	180	8	470	4		21	SS400
	180	8	470	4		21	SS400
	180	8	470	4		21	SS400
	180	8	470	4		21	SS400
	180	8	470	4		21	SS400
	180	8	470	4		21	SS400
	320	8	1880	2		76	SS400
	320	8	1880	2		76	SS400
	320	8	1880	2		76	SS400
	320	8	1880	2		76	SS400
	320	8	1880	2		76	SS400
	320	8	1880	2		76	SS400
	200	8	470	108		638	SS400
	320	8	940	216		4,080	SS400
	80	8	470	216		510	SS400

Calculation of Camber at each position of vertical stiffeners in accordance with the coordinate of the cross beam position.

- ✓ Camber line should be considered like as parabolic curve which is one of spline curve.
- ✓ Parabolic curve that pass through the 3 points could be defined unambiguously (looks like only one curve

$$Y=a+b*X+c*X^2$$



Coefficient a, b, c can be derived from the following equations

$Y_i=a_i+b_i*X_i+c_i*X_i^2$, $Y_{(i+1)}=a_i+b_i*X_{(i+1)}+c_i*X_{(i+1)}^2$, $Y_{(i+2)}=a_i+b_i*X_{(i+2)}+c_i*X_{(i+2)}^2$

$X_{(i+2)}-X_{(i+1)}= X_{(i+1)}-X_i=\Delta x$ (on sample Calculation, Δx is considered 1)

$a_i= Y_i$	$a_{(i+1)}= Y_{(i+1)}$
$b_i= (-3 Y_i+4 Y_{(i+1)}-Y_{(i+2)}) / 2$	$b_{(i+1)}= (-3 Y_{(i+1)}+4 Y_{(i+2)}-Y_{(i+3)}) / 2$
$C_i= (Y_i-2 Y_{(i+1)}+Y_{(i+2)}) / 2$	$C_{(i+1)}= (Y_{(i+1)}-2 Y_{(i+2)}+Y_{(i+3)}) / 2$
$Y_{\alpha i}=a_i+b_iX\alpha+C_iX\alpha^2$	$Y_{\alpha i}=a_{i+1}+b_{i+1}X\alpha+C_{i+1}X\alpha^2$

There might be small deviation between $Y_{\alpha i}$ and $Y_{\alpha i+1}$、then the average value would be adopted.

This procedure should be done at the next 3points sequentially.

assumption

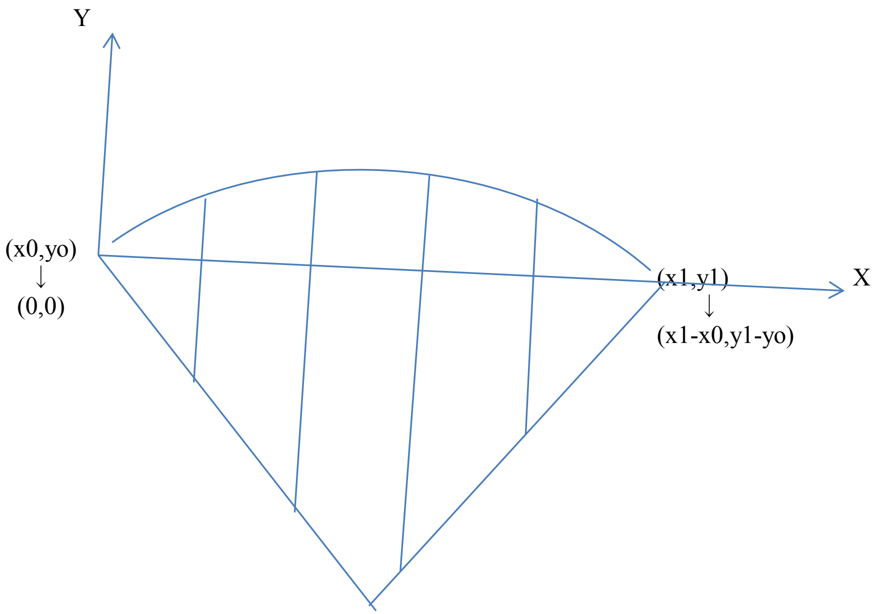
(x0,y0)	5200	21.02
(x1,y1)	5335	20.5

0	0
135	-0.52

$\tan\ \alpha =$ -0.00385
$\alpha =$ -0.00385 rad

R= 500 m
R・sin θ = x
θ = $\sin^{-1}$(x/R)
R・(1-cosθ)= y

x	0	5	10	15	20	25	30	35	40	45	50	55	60	65
x/R	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.1	0.11	0.12	0.13
θ	0	0.01	0.020001	0.030005	0.040011	0.050021	0.060036	0.070057	0.080086	0.090122	0.100167	0.110223	0.12029	0.130369
y	0	0.025001	0.10001	0.225051	0.40016	0.625391	0.900811	1.226504	1.602568	2.029117	2.506281	3.034206	3.613054	4.243003
y'	0	0.005742	0.061492	0.167273	0.323124	0.529096	0.785257	1.09169	1.448495	1.855785	2.31369	2.822356	3.381945	3.992635



	END	P12 S1				C1				C2				C3				C4				C5				C6			
	−0.273	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
	−400	0	1465.8	2931.5	4397.3	5863.0	7332.3	8801.5	10270.8	11740.0	13209.3	14678.5	16147.8	17617.0	19086.3	20555.5	22024.8	23494.0	24963.3	26432.5	27901.8	29371.0	30840.3	32309.5	33778.8	35248.0	36717.3	38186.5	39655.8
G1	(1.15)	0.00	4.00	7.67	11.01	14.03	16.72	19.09	21.13	22.85	23.87	24.44	24.57	24.25	23.48	22.27	20.61	18.51	16.01	13.57	11.18	8.85	6.58	4.36	2.20	0.10	(1.16)	(1.60)	(1.21)
G1		0.00				14.03	16.93	19.37	21.34	22.85	23.90	24.48	24.60	24.25	23.18	21.87	20.31	18.51	16.46	14.17	11.63	8.85	5.85	3.39	1.48	0.10	(0.74)	(1.03)	(0.79)
G2	(1.02)	0.00	3.55	6.81	9.79	12.48	14.89	17.02	18.86	20.42	21.35	21.88	22.01	21.74	21.07	19.99	18.52	16.64	14.31	12.06	9.88	7.78	5.75	3.79	1.91	0.1	(1.06)	(1.47)	(1.11)
G2		0.00				12.48	15.09	17.28	19.06	20.42	21.37	21.91	22.03	21.74	20.82	19.66	18.27	16.64	14.78	12.68	10.35	7.78	5.15	2.99	1.31	0.1	(0.64)	(0.90)	(0.69)
G3	(0.91)	0.00	3.19	6.13	8.82	11.25	13.43	15.36	17.04	18.47	19.32	19.81	19.94	19.71	19.12	18.17	16.86	15.19	13.12	11.10	9.14	7.23	5.38	3.59	1.85	0.17	(0.91)	(1.30)	(1.00)
G3		0.00				11.25	13.62	15.61	17.23	18.47	19.34	19.84	19.96	19.71	18.90	17.88	16.64	15.19	13.52	11.64	9.54	7.23	4.82	2.84	1.29	0.17	(0.52)	(0.78)	(0.60)

$Y=a+b*X+c*X^2$

ai＝ Yi
bi＝ （-3 Yi＋4 $Y_{(i+1)}$—$Y_{(i+2)}$）／8
Ci= (Yi－２$Y_{(i+1)}$＋$Y_{(i+2)}$）／32
$Y_{\alpha i}$＝ai＋biXα＋CiXα^2

X=0、α、2α、3α、4α、‥‥‥8α
X i=　　0
X i+1　　4α
X i+2=　　8α

	ai	0.00								22.85								18.51								0.10			
G1	bi	4.1588								1.2425								−2.529								−1.676			
	ci	−0.163								−0.223								0.0284								0.4128			
	ai					14.03								24.25								8.85							
G1	bi					3.1325								−0.945								−3.269							
	ci					−0.232								−0.123								0.2703							
	ai	0.00								20.42								16.64								0.10			
G2	bi	3.6875								1.1325								−2.363								−1.541			
	ci	−0.142								−0.201								0.0369								0.3791			
	ai					12.48								21.74								7.78							
G2	bi					2.8125								−0.805								−2.868							
	ci					−0.207								−0.118								0.2369							
	ai	0.00								18.47								15.19								0.17			
G3	bi	3.3163								1.03								−2.103								−1.426			
	ci	−0.126								−0.18								0.0281								0.3459			
	ai					11.25								19.71								7.23							
G3	bi					2.5525								−0.7								−2.626							
	ci					−0.187								−0.108								0.2153							

P13 S2				C7				C8				C9				C10				C11				
28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
41125.0	42560.8	43996.5	45432.3	46868.0	48303.8	49739.5	51175.3	52611.0	54046.8	55482.5	56918.3	58354.0	59789.8	61225.5	62661.3	64097.0	65532.8	66968.5	68404.3	69840.0	######	######	######	75583.0
0.00	2.04	4.90	8.59	13.11	18.30	23.47	28.61	33.73	38.83	43.91	48.96	53.99	58.44	62.32	65.62	68.34	70.49	72.06	73.06	73.48				
0.00	2.57	5.62	9.13	13.11	17.56	22.48	27.87	33.73	39.35	44.60	49.48	53.99	58.13	61.90	65.31	68.34	70.59	72.20	73.16	73.48	73.16	72.20	70.59	68.34
0	1.87	4.50	7.89	12.03	16.72	21.39	26.04	30.67	35.28	39.87	44.45	49.00	53.03	56.54	59.53	62.00	63.95	65.38	66.29	66.68				
0	2.39	5.19	8.40	12.03	16.07	20.52	25.39	30.67	35.75	40.50	44.92	49.00	52.75	56.17	59.25	62.00	64.05	65.51	66.39	66.68	66.39	65.51	64.05	62.00
0	1.69	4.07	7.14	10.9	15.17	19.42	23.65	27.86	32.05	36.22	40.36	44.49	48.14	51.32	54.03	56.26	58.02	59.31	60.13	60.48				
0	2.16	3.94	7.61	10.9	14.57	18.62	23.05	27.86	32.47	36.78	40.79	44.49	47.89	50.98	53.77	56.26	57.92	59.18	60.03	60.48	60.53	60.18	59.42	58.26

				13.11								53.99								
				5.2								4.7388								
				−0.011								−0.288								
0.00								33.73								68.34				
2.3388								5.8038								2.57				
0.2347								−0.185								−0.321				
				12.03								49.00								
				4.6988								4.29								
				−0.01								−0.26								
0								30.67								62				
2.1813								5.2488								2.34				
0.2066								−0.167								−0.293				
				10.90								44.49								
				4.2813								3.8863								
				−0.01								−0.236								
0.00								27.86								56.26				
1.9675								4.765								1.86				
0.1894								−0.152								−0.201				

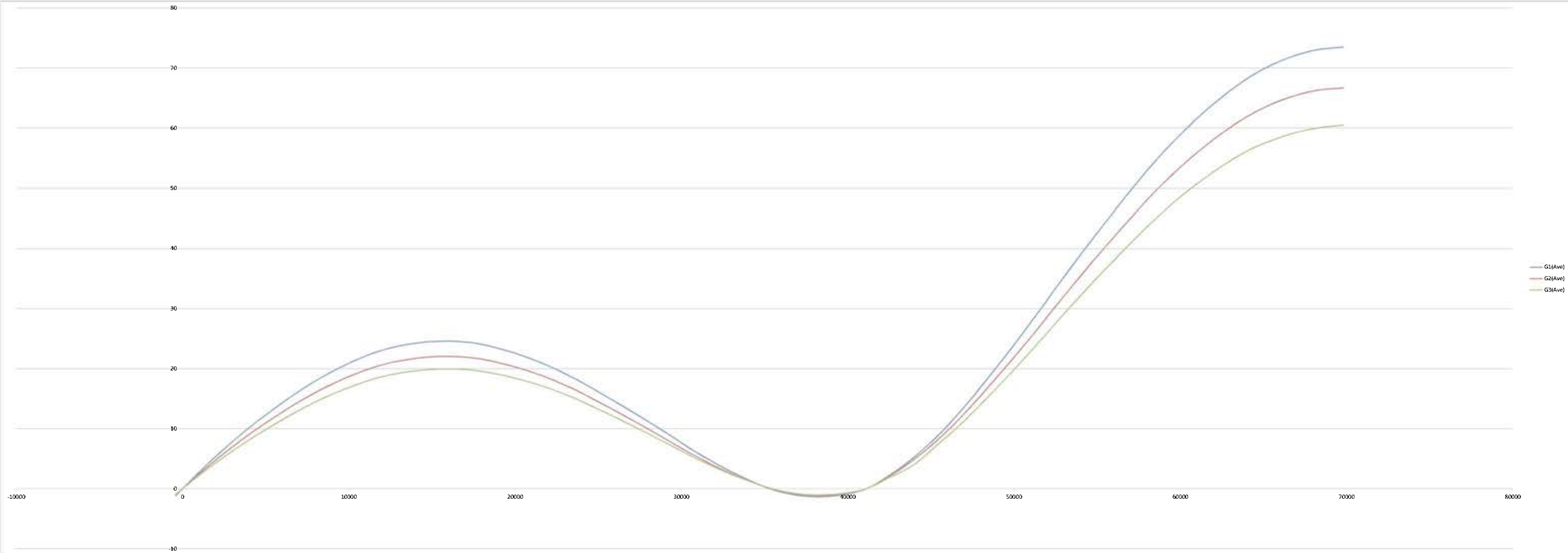
	END	P12 S1				C1				C2				C3			
	-0.2729	0.0	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0
	-400.0	0.0	1465.8	2931.5	4397.3	5863.0	7332.3	8801.5	10270.8	11740.0	13209.3	14678.5	16147.8	17617.0	19086.3	20555.5	22024.8
G1	-1.1	0.0	4.0	7.7	11.0	14.0	16.7	19.1	21.1	22.9	23.9	24.4	24.6	24.3	23.5	22.3	20.6
G1		0.0				14.0	16.9	19.4	21.3	22.9	23.9	24.5	24.6	24.3	23.2	21.9	20.3
G2	-1.0	0.0	3.5	6.8	9.8	12.5	14.9	17.0	18.9	20.4	21.4	21.9	22.0	21.7	21.1	20.0	18.5
G2		0.0				12.5	15.1	17.3	19.1	20.4	21.4	21.9	22.0	21.7	20.8	19.7	18.3
G3	-0.9	0.0	3.2	6.1	8.8	11.3	13.4	15.4	17.0	18.5	19.3	19.8	19.9	19.7	19.1	18.2	16.9
G3		0.0				11.3	13.6	15.6	17.2	18.5	19.3	19.8	20.0	19.7	18.9	17.9	16.6
G1(Ave)	-1.1	0.0	4.0	7.7	11.0	14.0	16.8	19.2	21.2	22.9	23.9	24.5	24.6	24.3	23.3	22.1	20.5
G2(Ave)	-1.0	0.0	3.5	6.8	9.8	12.5	15.0	17.1	19.0	20.4	21.4	21.9	22.0	21.7	20.9	19.8	18.4
G3(Ave)	-0.9	0.0	3.2	6.1	8.8	11.3	13.5	15.5	17.1	18.5	19.3	19.8	20.0	19.7	19.0	18.0	16.8

	C4				C5				C6				P13 S2			
	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0	29.0	30.0	31.0
	23494.0	24963.3	26432.5	27901.8	29371.0	30840.3	32309.5	33778.8	35248.0	36717.3	38186.5	39655.8	41125.0	42560.8	43996.5	45432.3
G1	18.5	16.0	13.6	11.2	8.9	6.6	4.4	2.2	0.1	-1.2	-1.6	-1.2	0.0	2.0	4.9	8.6
G1	18.5	16.5	14.2	11.6	8.9	5.9	3.4	1.5	0.1	-0.7	-1.0	-0.8	0.0	2.6	5.6	9.1
G2	16.6	14.3	12.1	9.9	7.8	5.7	3.8	1.9	0.1	-1.1	-1.5	-1.1	0.0	1.9	4.5	7.9
G2	16.6	14.8	12.7	10.3	7.8	5.1	3.0	1.3	0.1	-0.6	-0.9	-0.7	0.0	2.4	5.2	8.4
G3	15.2	13.1	11.1	9.1	7.2	5.4	3.6	1.9	0.2	-0.9	-1.3	-1.0	0.0	1.7	4.1	7.1
G3	15.2	13.5	11.6	9.5	7.2	4.8	2.8	1.3	0.2	-0.5	-0.8	-0.6	0.0	2.2	3.9	7.6
G1(Ave)	18.5	16.2	13.9	11.4	8.9	6.2	3.9	1.8	0.1	-0.9	-1.3	-1.0	0.0	2.3	5.3	8.9
G2(Ave)	16.6	14.5	12.4	10.1	7.8	5.4	3.4	1.6	0.1	-0.8	-1.2	-0.9	0.0	2.1	4.8	8.1
G3(Ave)	15.2	13.3	11.4	9.3	7.2	5.1	3.2	1.6	0.2	-0.7	-1.0	-0.8	0.0	1.9	4.0	7.4

	C7				C8				C9				C10				C11
	32.0	33.0	34.0	35.0	36.0	37.0	38.0	39.0	40.0	41.0	42.0	43.0	44.0	45.0	46.0	47.0	48.0
	46868.0	48303.8	49739.5	51175.3	52611.0	54046.8	55482.5	56918.3	58354.0	59789.8	61225.5	62661.3	64097.0	65532.8	66968.5	68404.3	69840.0
G1	13.1	18.3	23.5	28.6	33.7	38.8	43.9	49.0	54.0	58.4	62.3	65.6	68.3	70.5	72.1	73.1	73.5
G1	13.1	17.6	22.5	27.9	33.7	39.3	44.6	49.5	54.0	58.1	61.9	65.3	68.3	70.6	72.2	73.2	73.5
G2	12.0	16.7	21.4	26.0	30.7	35.3	39.9	44.4	49.0	53.0	56.5	59.5	62.0	64.0	65.4	66.3	66.7
G2	12.0	16.1	20.5	25.4	30.7	35.8	40.5	44.9	49.0	52.7	56.2	59.2	62.0	64.0	65.5	66.4	66.7
G3	10.9	15.2	19.4	23.7	27.9	32.0	36.2	40.4	44.5	48.1	51.3	54.0	56.3	58.0	59.3	60.1	60.5
G3	10.9	14.6	18.6	23.1	27.9	32.5	36.8	40.8	44.5	47.9	51.0	53.8	56.3	57.9	59.2	60.0	60.5
G1(Ave)	13.1	17.9	23.0	28.2	33.7	39.1	44.3	49.2	54.0	58.3	62.1	65.5	68.3	70.5	72.1	73.1	73.5
G2(Ave)	12.0	16.4	21.0	25.7	30.7	35.5	40.2	44.7	49.0	52.9	56.4	59.4	62.0	64.0	65.4	66.3	66.7
G3(Ave)	10.9	14.9	19.0	23.4	27.9	32.3	36.5	40.6	44.5	48.0	51.2	53.9	56.3	58.0	59.2	60.1	60.5

	P13 S2				C7				C8				C9
	28.0	29.0	30.0	31.0	32.0	33.0	34.0	35.0	36.0	37.0	38.0	39.0	40.0
	41125.0	42560.8	43996.5	45432.3	46868.0	48303.8	49739.5	51175.3	52611.0	54046.8	55482.5	56918.3	58354.0
G1	0.0	2.0	4.9	8.6	13.1	18.3	23.5	28.6	33.7	38.8	43.9	49.0	54.0
G1	0.0	2.6	5.6	9.1	13.1	17.6	22.5	27.9	33.7	39.3	44.6	49.5	54.0
G2	0.0	1.9	4.5	7.9	12.0	16.7	21.4	26.0	30.7	35.3	39.9	44.4	49.0
G2	0.0	2.4	5.2	8.4	12.0	16.1	20.5	25.4	30.7	35.8	40.5	44.9	49.0
G3	0.0	1.7	4.1	7.1	10.9	15.2	19.4	23.7	27.9	32.0	36.2	40.4	44.5
G3	0.0	2.2	3.9	7.6	10.9	14.6	18.6	23.1	27.9	32.5	36.8	40.8	44.5
G1(Ave)	0.0	2.3	5.3	8.9	13.1	17.9	23.0	28.2	33.7	39.1	44.3	49.2	54.0
G2(Ave)	0.0	2.1	4.8	8.1	12.0	16.4	21.0	25.7	30.7	35.5	40.2	44.7	49.0
G3(Ave)	0.0	1.9	4.0	7.4	10.9	14.9	19.0	23.4	27.9	32.3	36.5	40.6	44.5

				C10				C11				
	41.0	42.0	43.0	44.0	45.0	46.0	47.0	48.0	49.0	50.0	51.0	52.0
	59789.8	61225.5	62661.3	64097.0	65532.8	66968.5	68404.3	69840.0	71275.8	72711.5	74147.3	75583.0
G1	58.4	62.3	65.6	68.3	70.5	72.1	73.1	73.5				
G1	58.1	61.9	65.3	68.3	70.6	72.2	73.2	73.5	73.2	72.2	70.6	68.3
G2	53.0	56.5	59.5	62.0	64.0	65.4	66.3	66.7				
G2	52.7	56.2	59.2	62.0	64.0	65.5	66.4	66.7	66.4	65.5	64.0	62.0
G3	48.1	51.3	54.0	56.3	58.0	59.3	60.1	60.5				
G3	47.9	51.0	53.8	56.3	57.9	59.2	60.0	60.5	60.5	60.2	59.4	58.3
G1(Ave)	58.3	62.1	65.5	68.3	70.5	72.1	73.1	73.5				
G2(Ave)	52.9	56.4	59.4	62.0	64.0	65.4	66.3	66.7				
G3(Ave)	48.0	51.2	53.9	56.3	58.0	59.2	60.1	60.5				



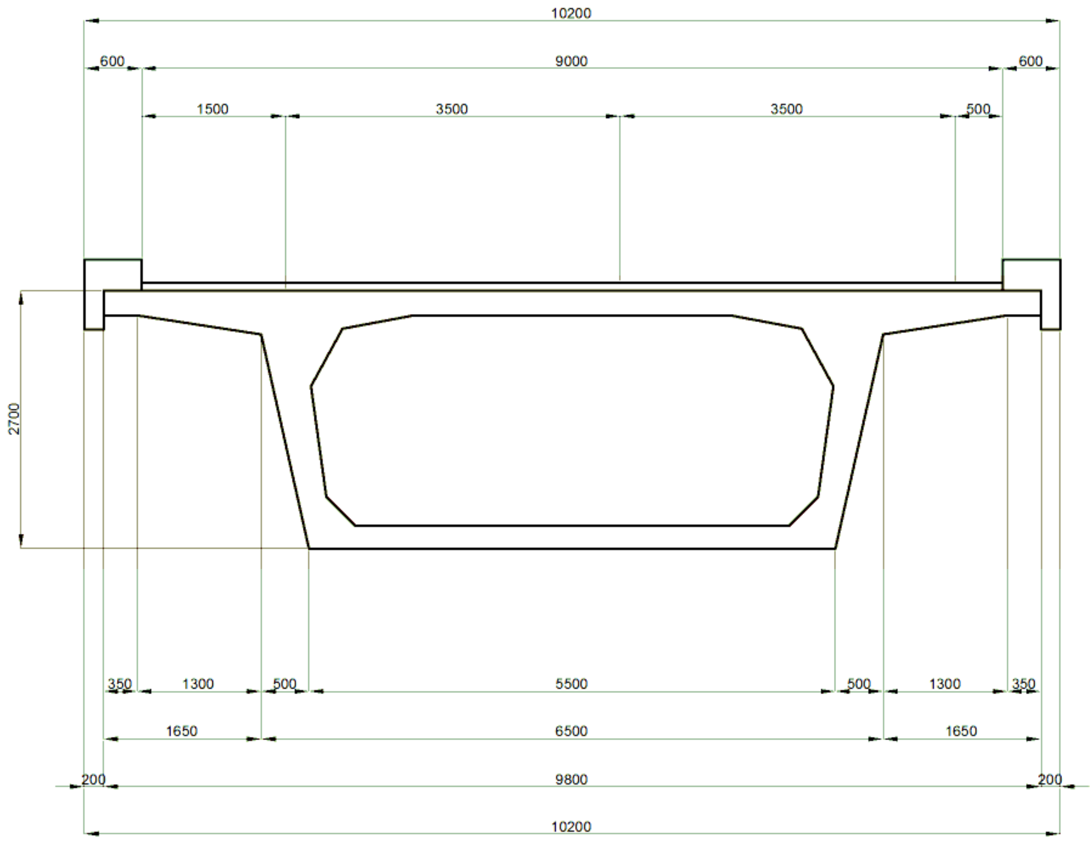
付録 A　　講義及びセミナー資料

A-10　PC 箱桁橋の設計演習

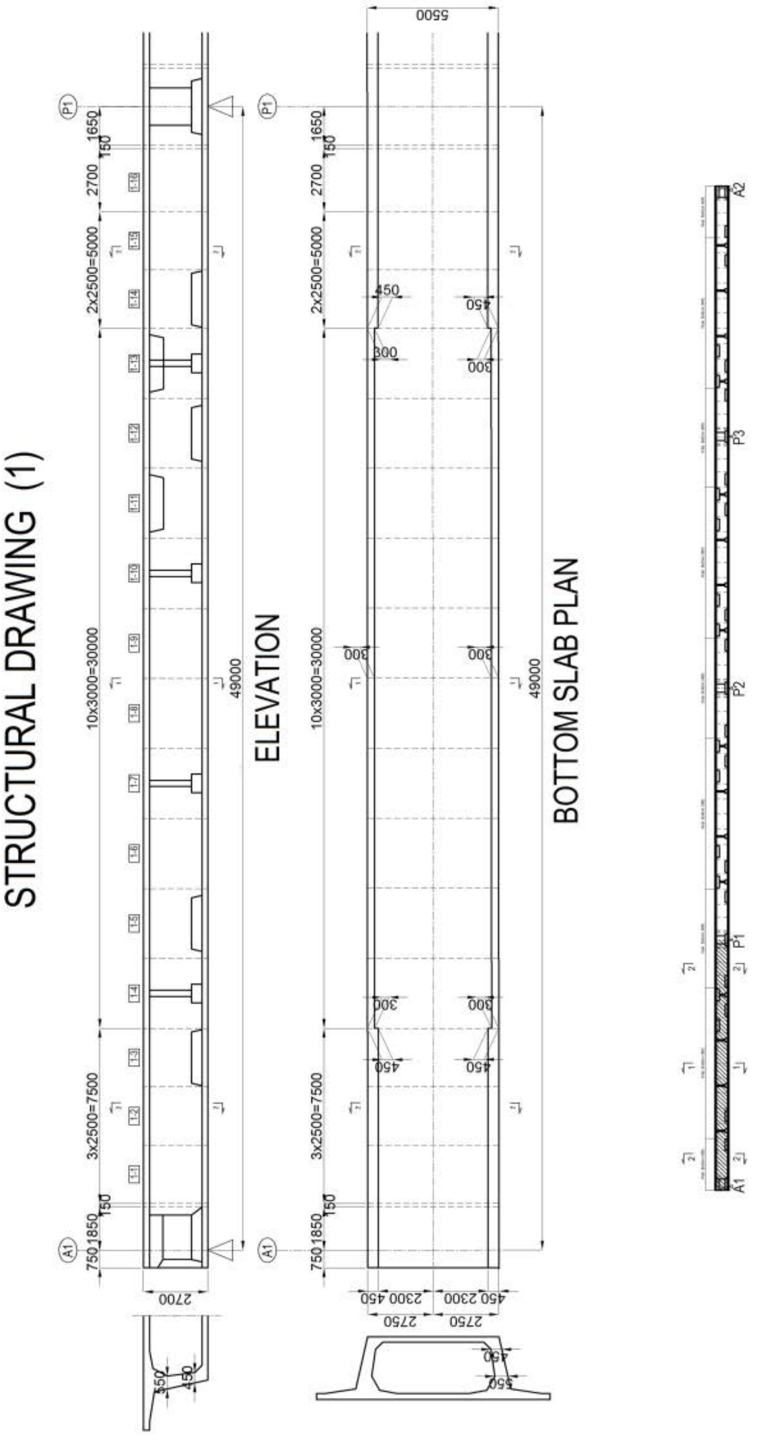
1 GENERAL

1-1 GENERAL CONDITION

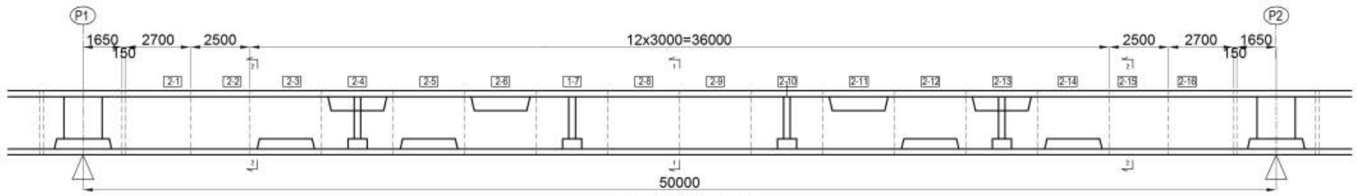
PROJECT	:	STUDY OF BRIDGE DESIGN
BRIDGE	:	PC BOX GIRDER BRIDGE (PROTOTYPE)
STURUCTURE TYPE	:	4 SPAN CONTINUOUS PC BOX GIRDER PRECAST SEGMENT
BRIDGE LENGTH	:	200 m (4 x 50m)
WIDTH COMPOSITION	:	0.600 + 1.500 + 2 x 3.500 + 0.500 + 0.600
LIVE LOAD	:	HL-93 (AASHTO)
DESIGN STANDARD	:	Specifications for highway bridges, (JRA) JAPAN AASHTO LRFD Bridge Design Specifications



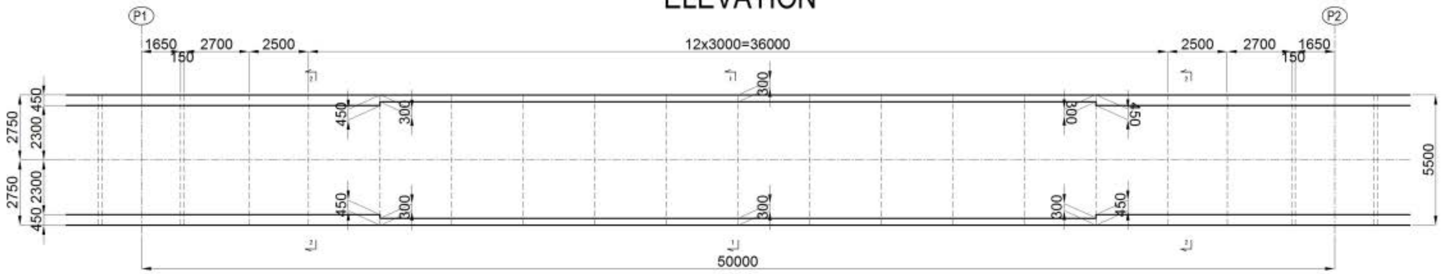
1-2 STRUCTURAL DRAWINGS



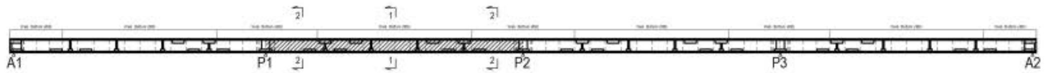
STRUCTURAL DRAWING (2)



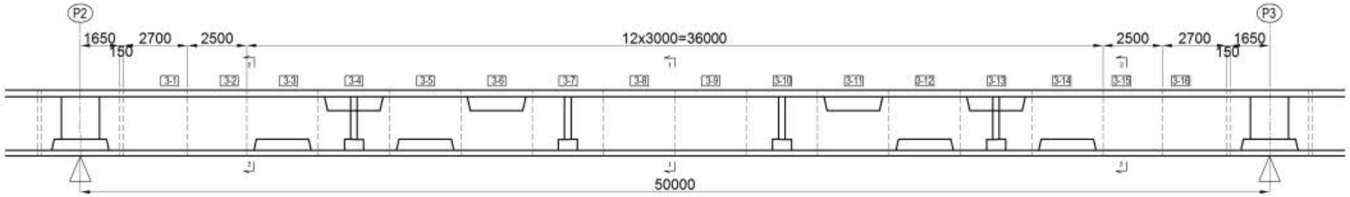
ELEVATION



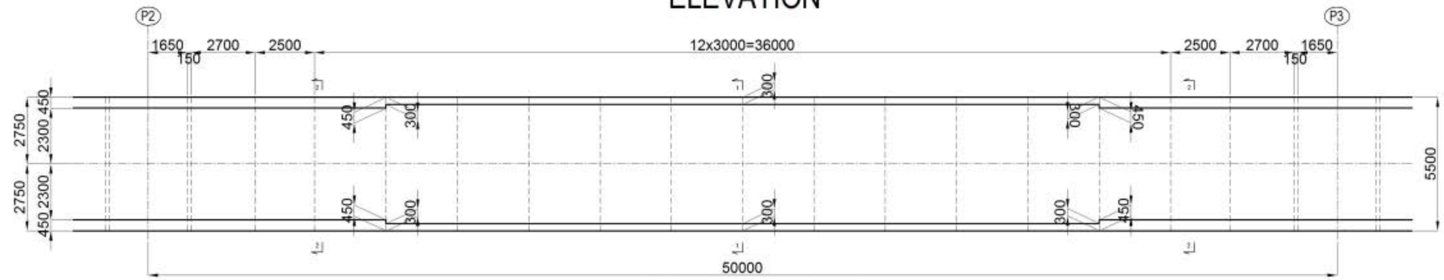
BOTTOM SLAB PLAN



STRUCTURAL DRAWING (3)



ELEVATION



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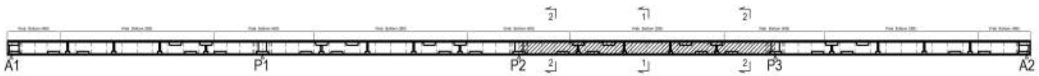
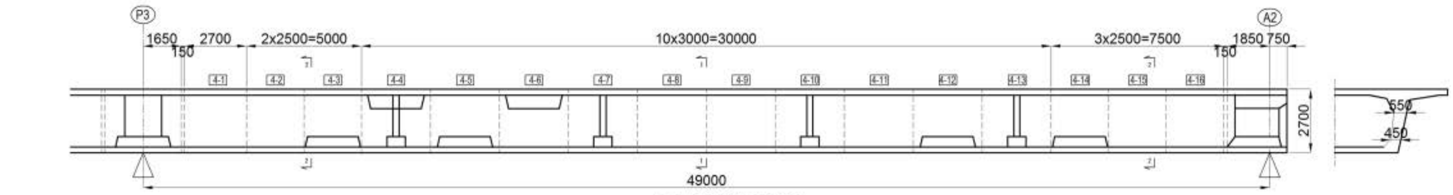


STRUCTURAL DRAWING (4)



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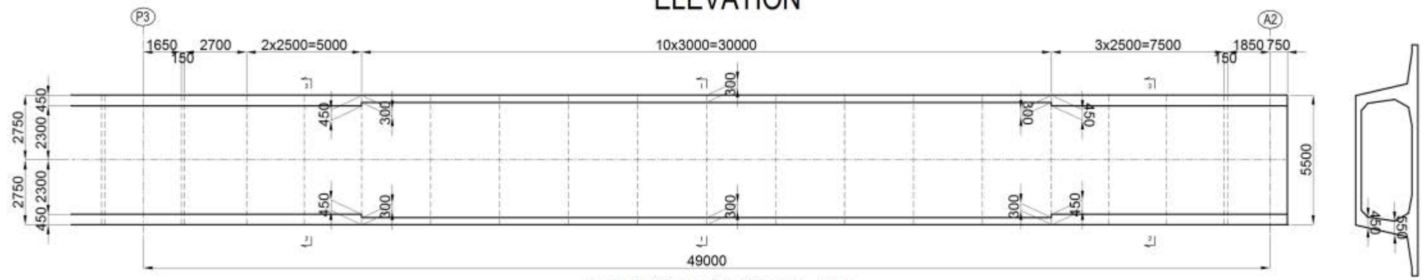

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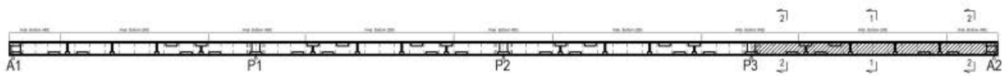
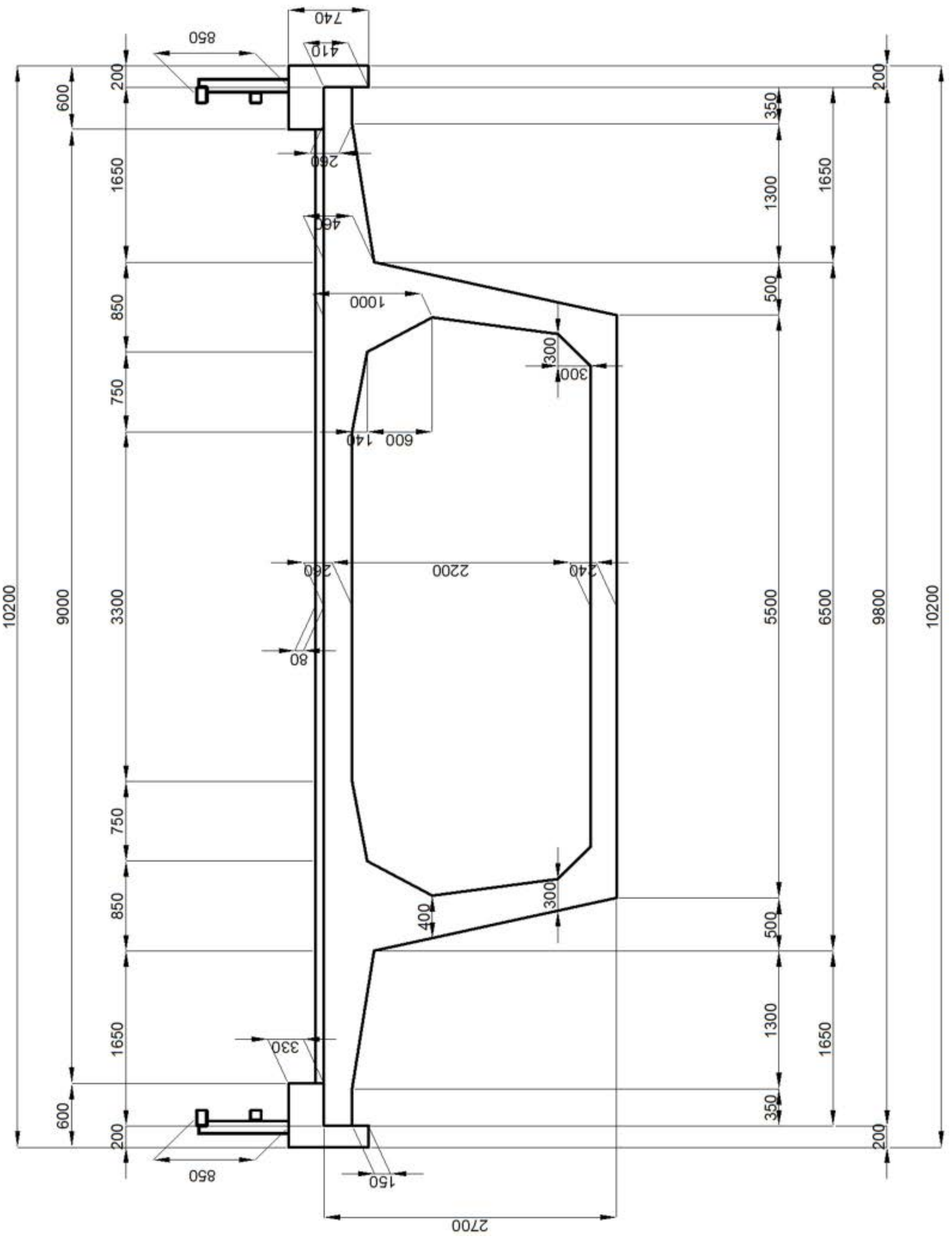
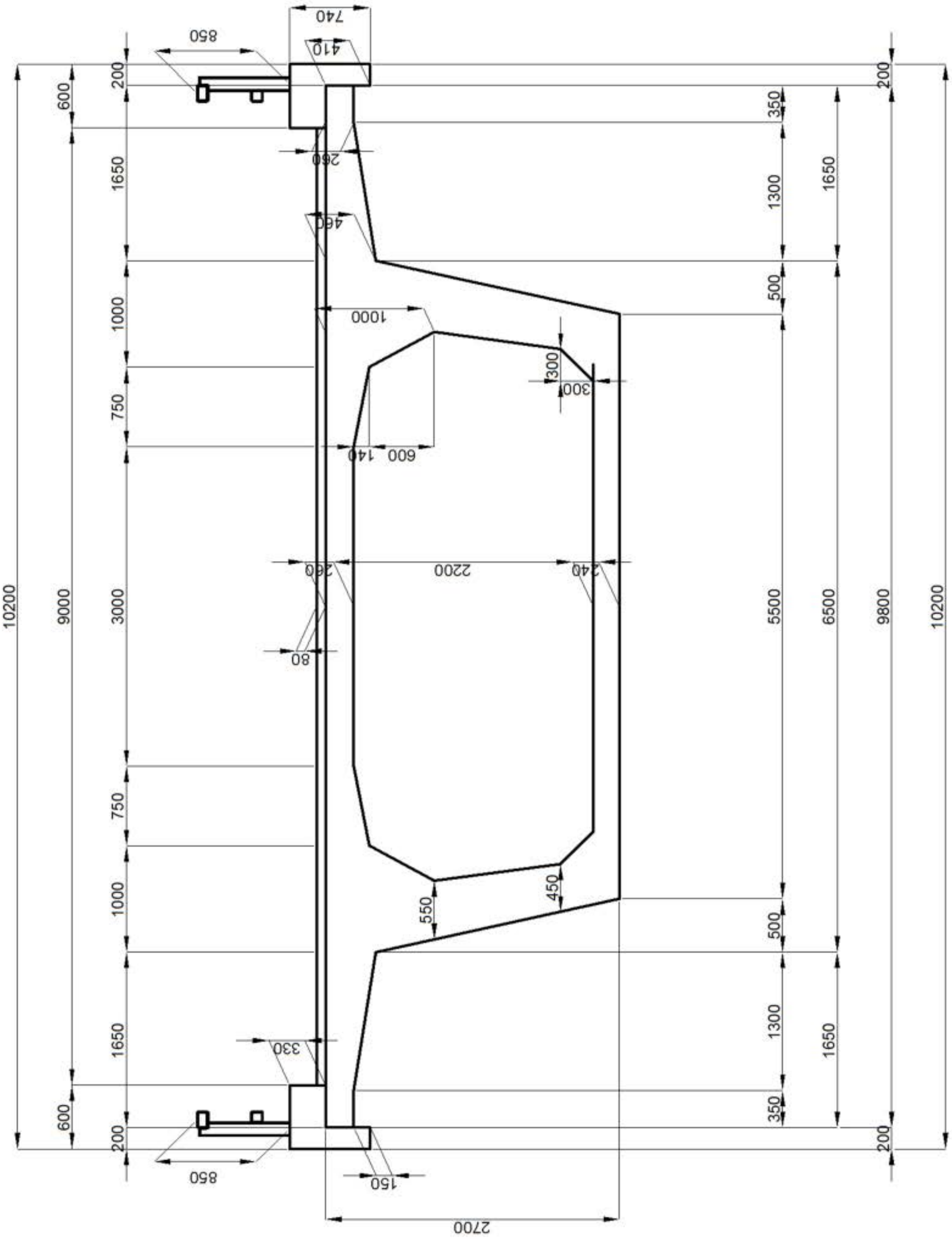


CROSS SECTION @ 1-1

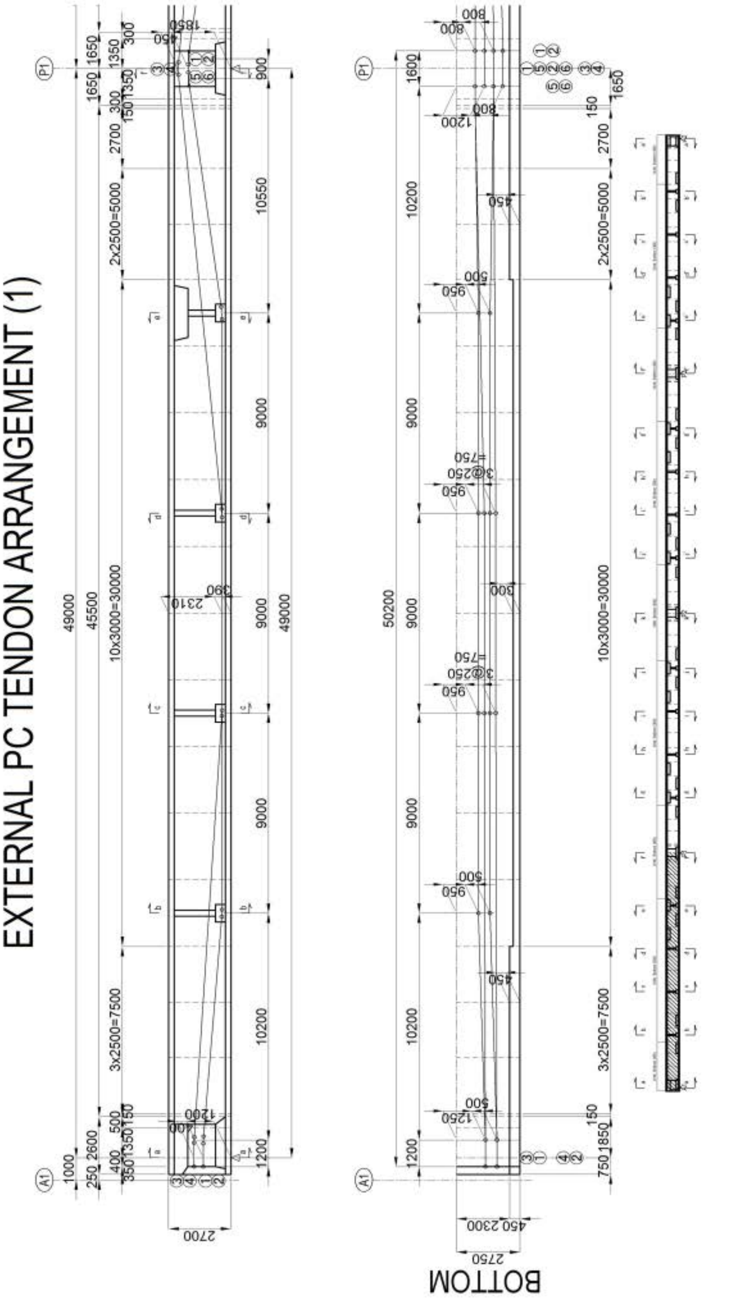


CROSS SECTION @ 2-2

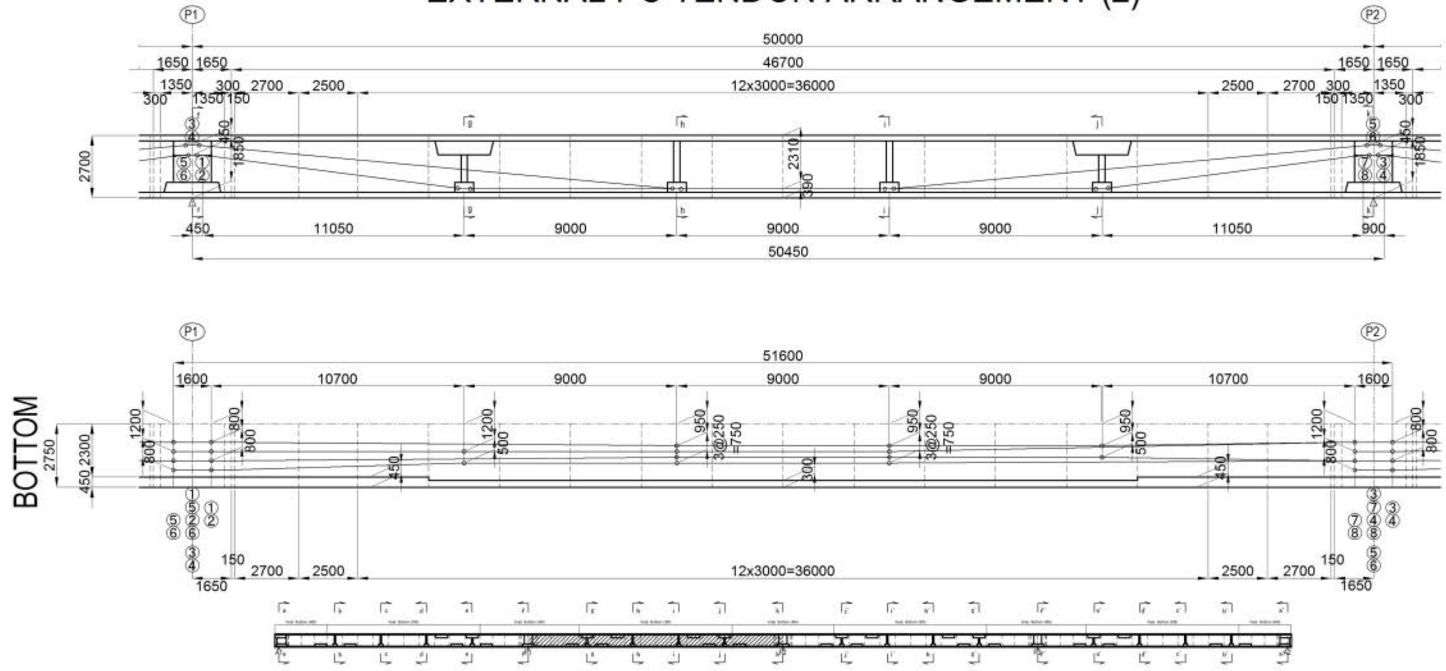


1-3 PC TENDON ARRANGEMENT

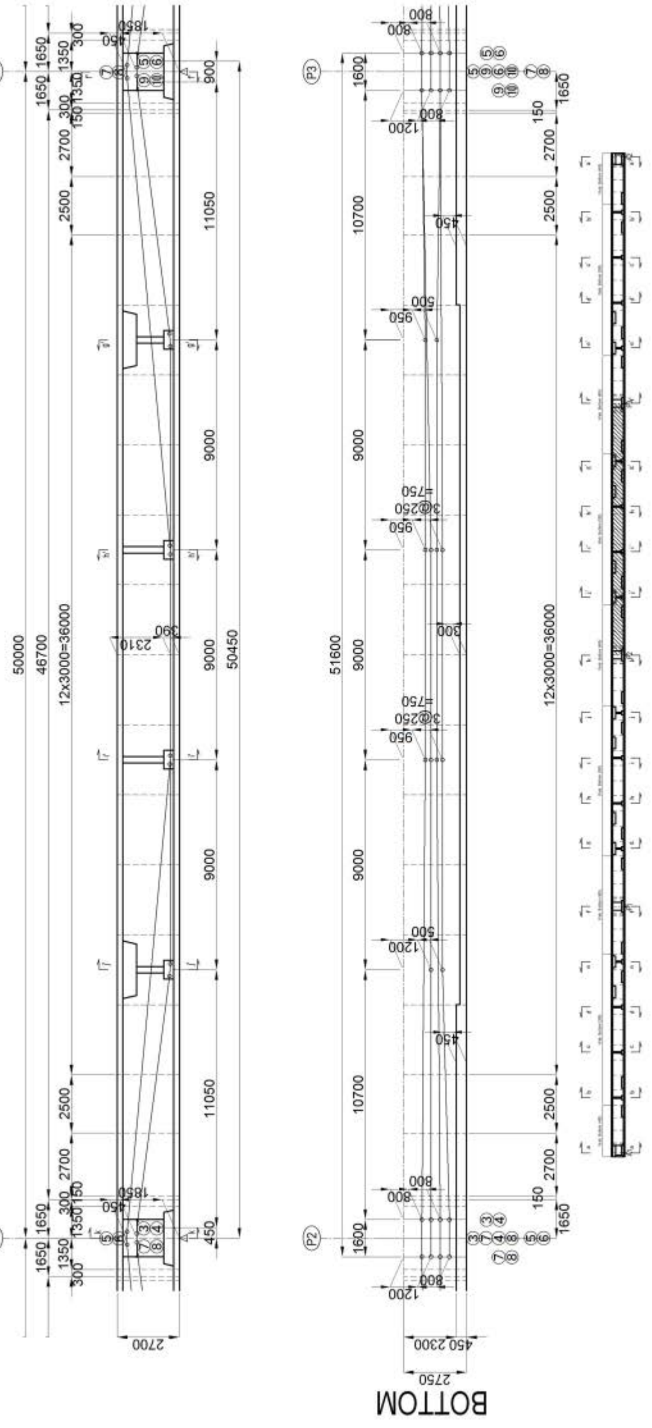
(1) External PC Tendon



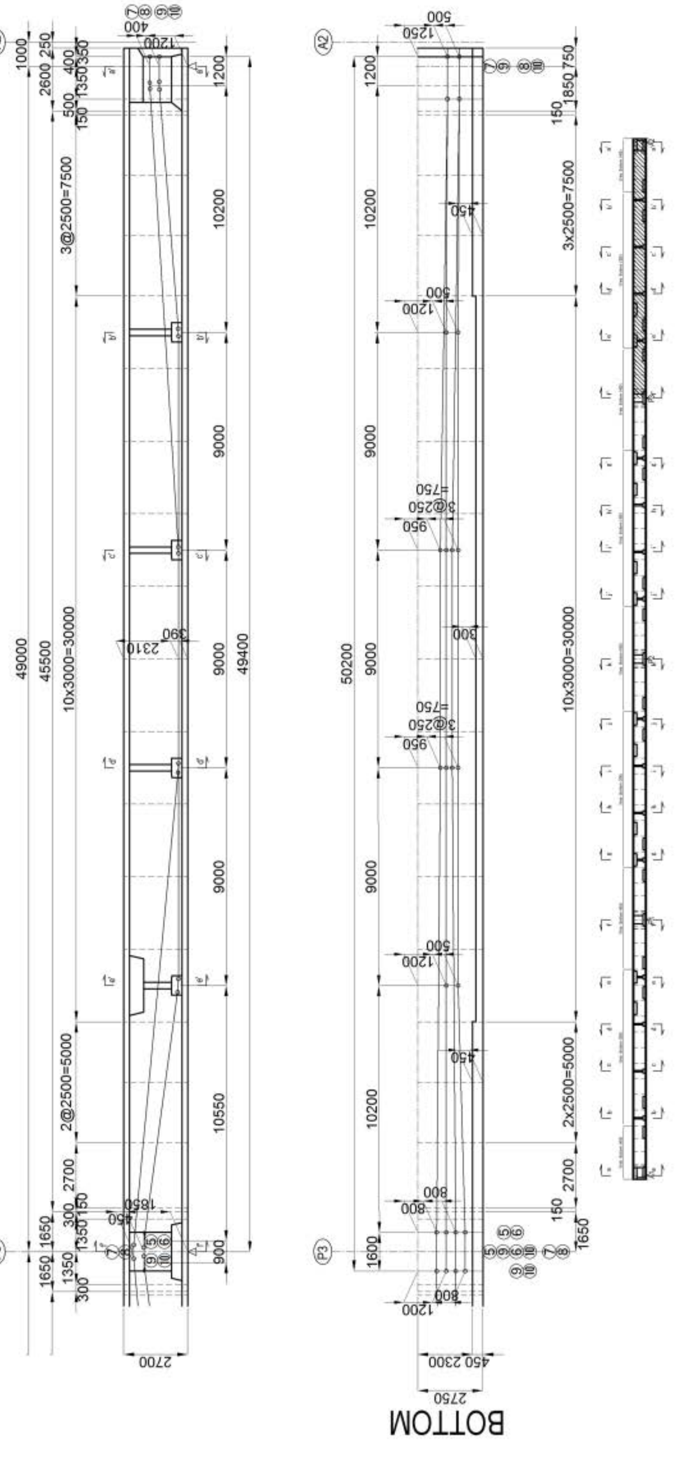
EXTERNAL PC TENDON ARRANGEMENT (2)



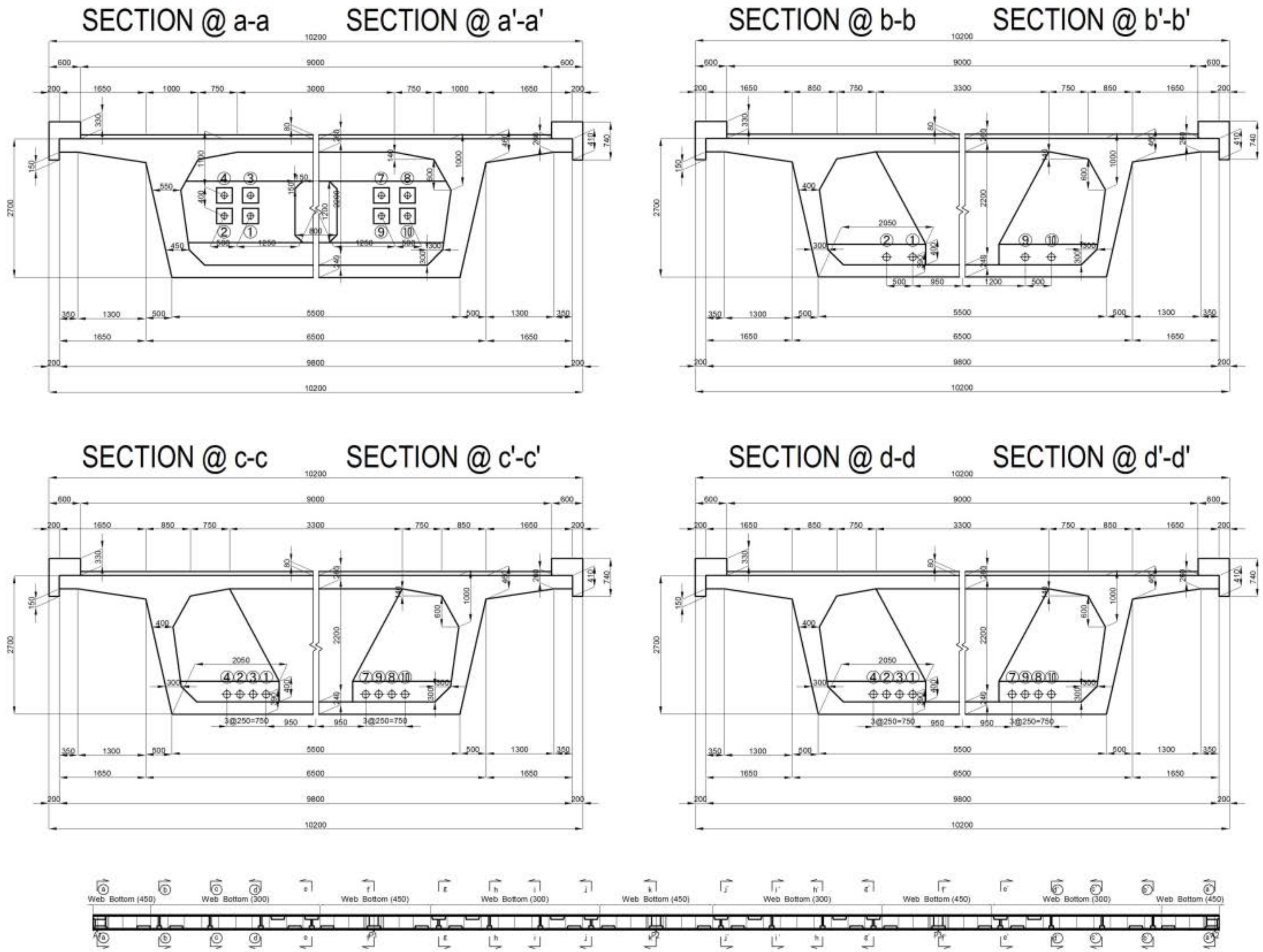
EXTERNAL PC TENDON ARRANGEMENT (3)



EXTERNAL TENDON ARRANGEMENT (4)



EXTERNAL TENDON PC ARRANGEMENT (1)



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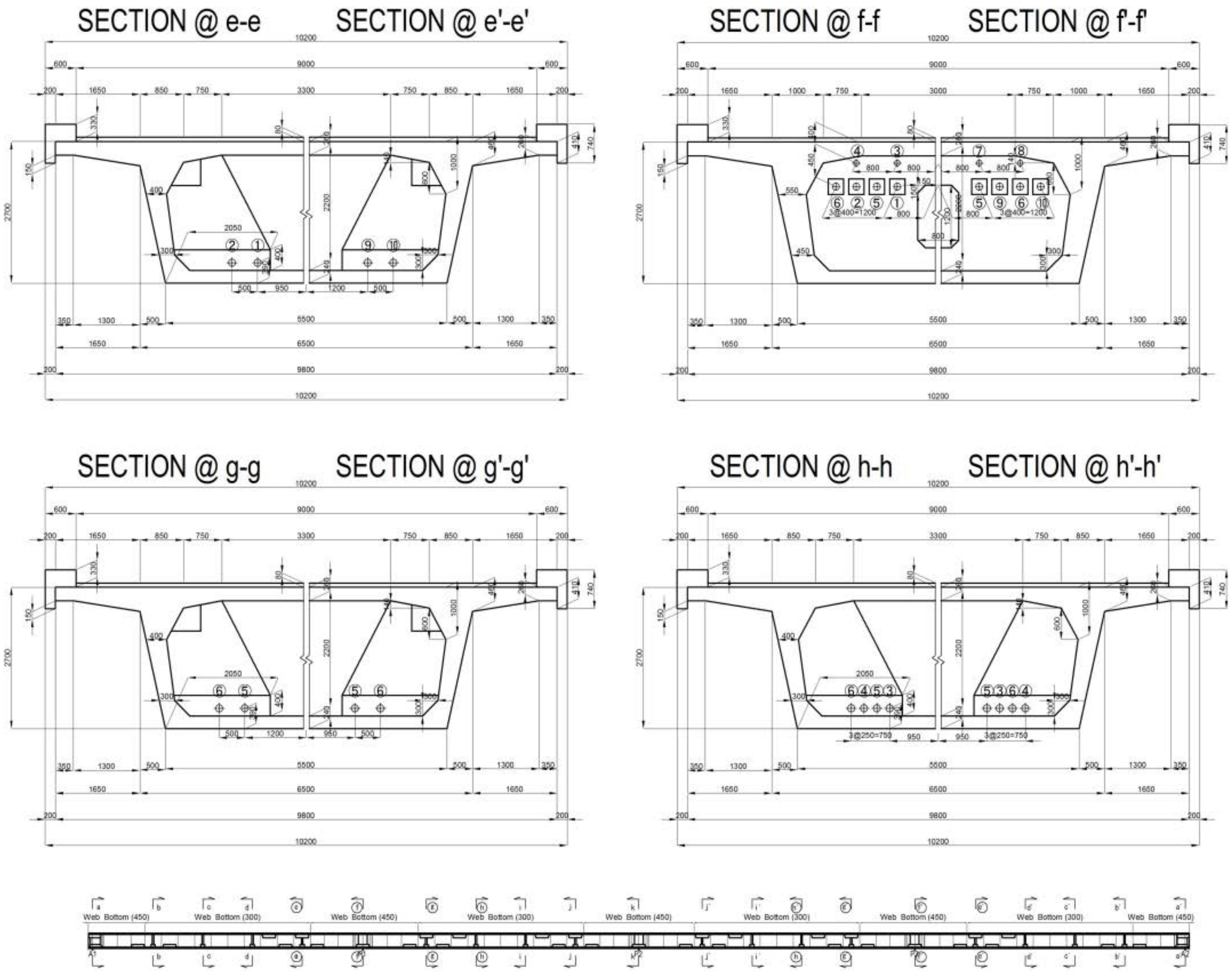
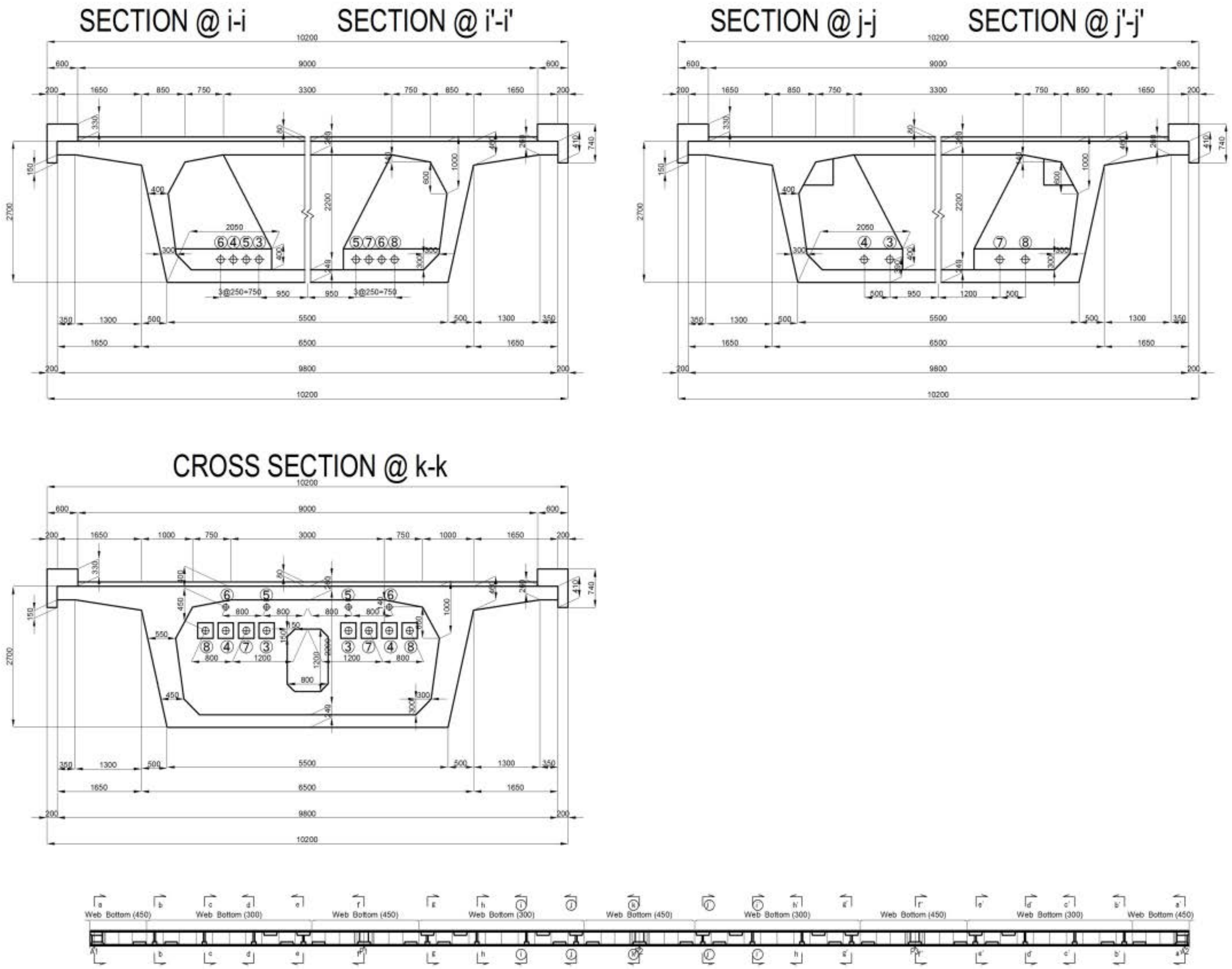
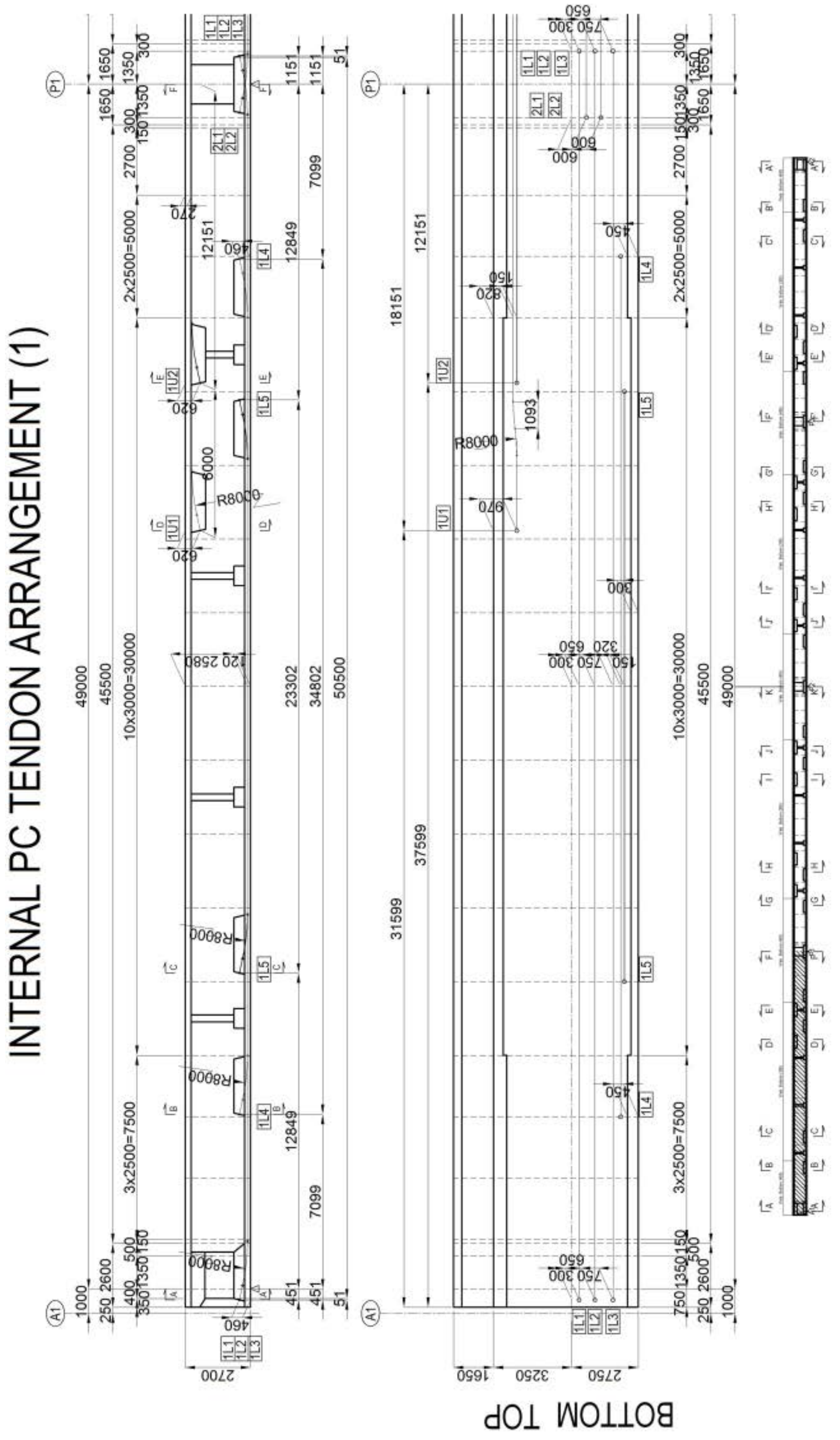


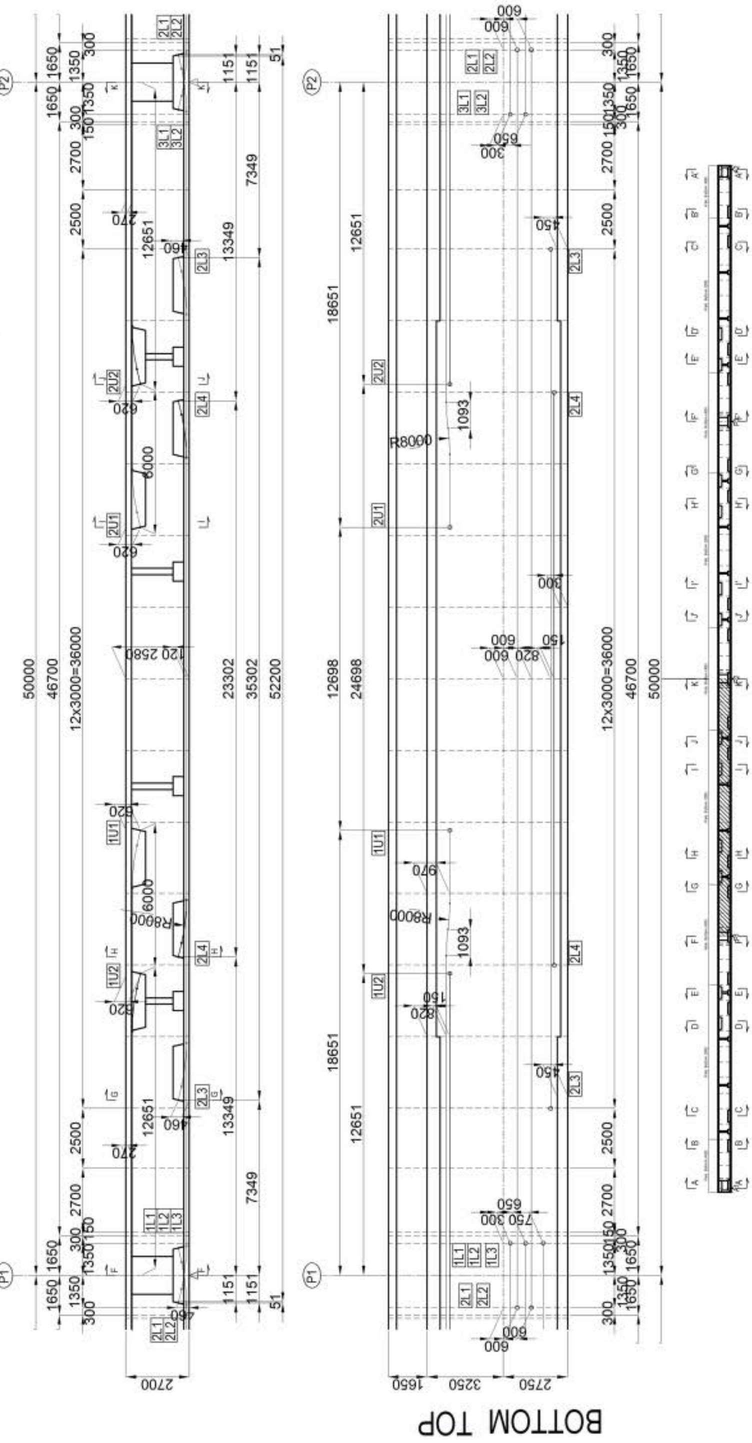
EXTERNAL PC TENDON ARRANGEMENT (3)



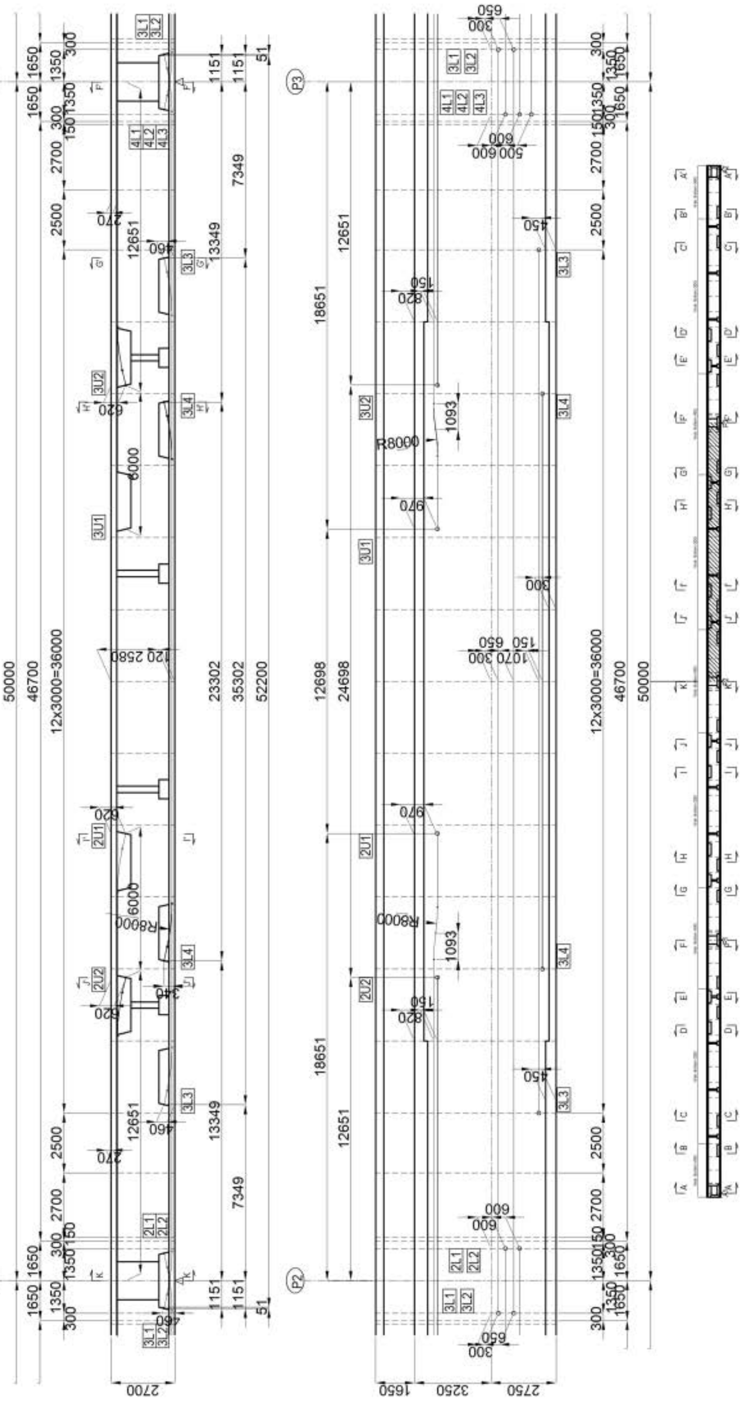
(2) Internal PC Tendon



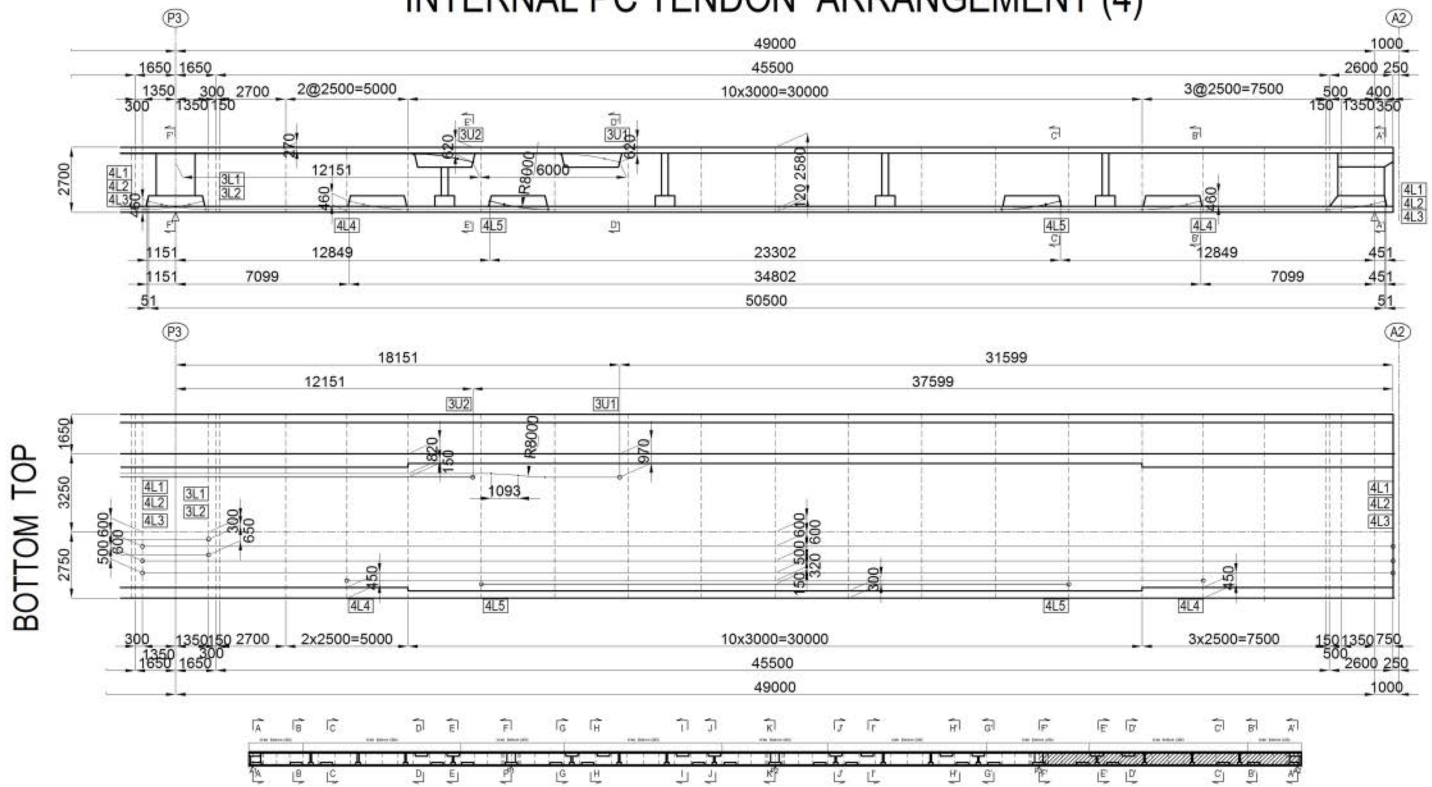
INTERNAL PC TENDON ARRANGEMENT (2)



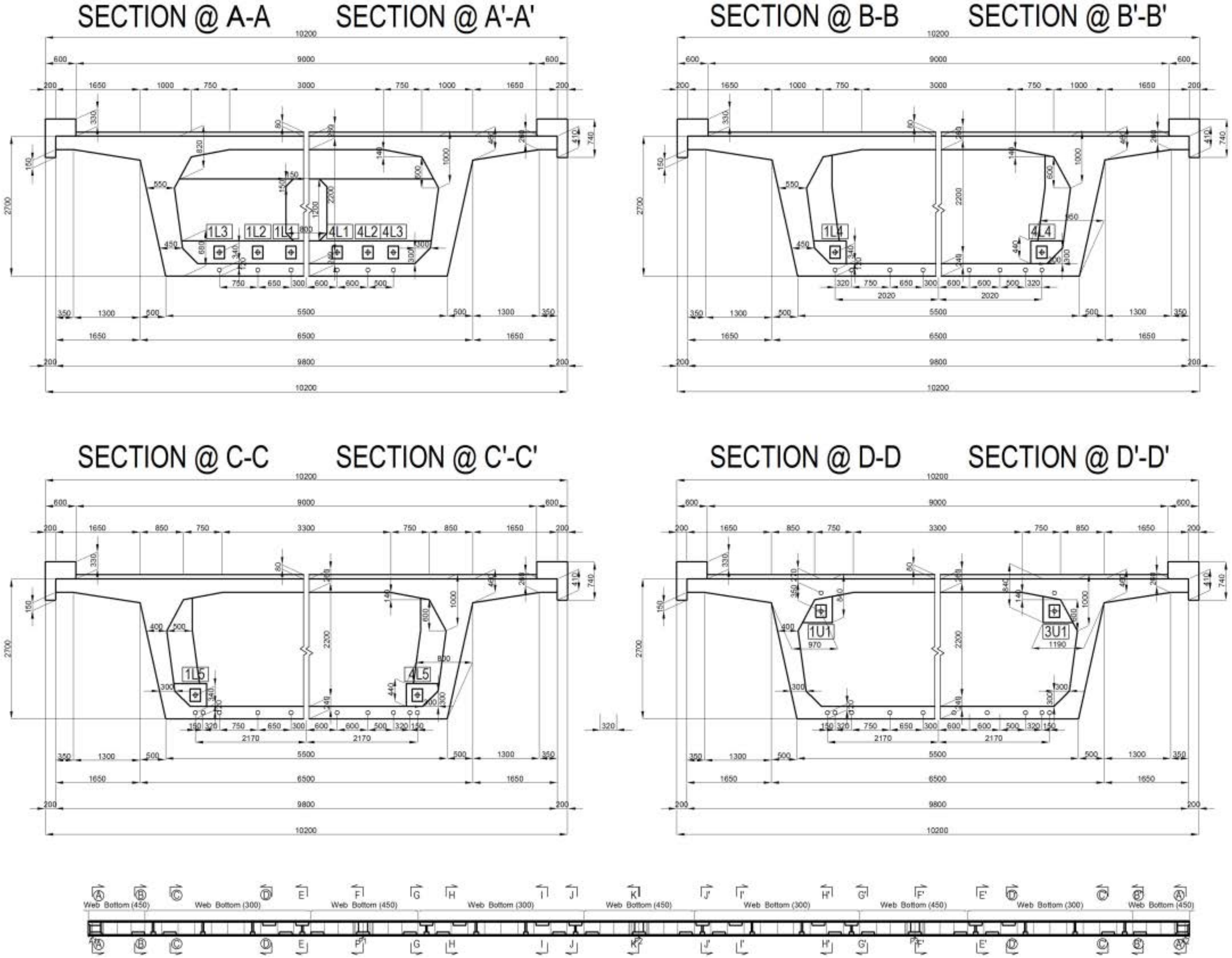
INTERNAL PC TENDON ARRANGEMENT (3)



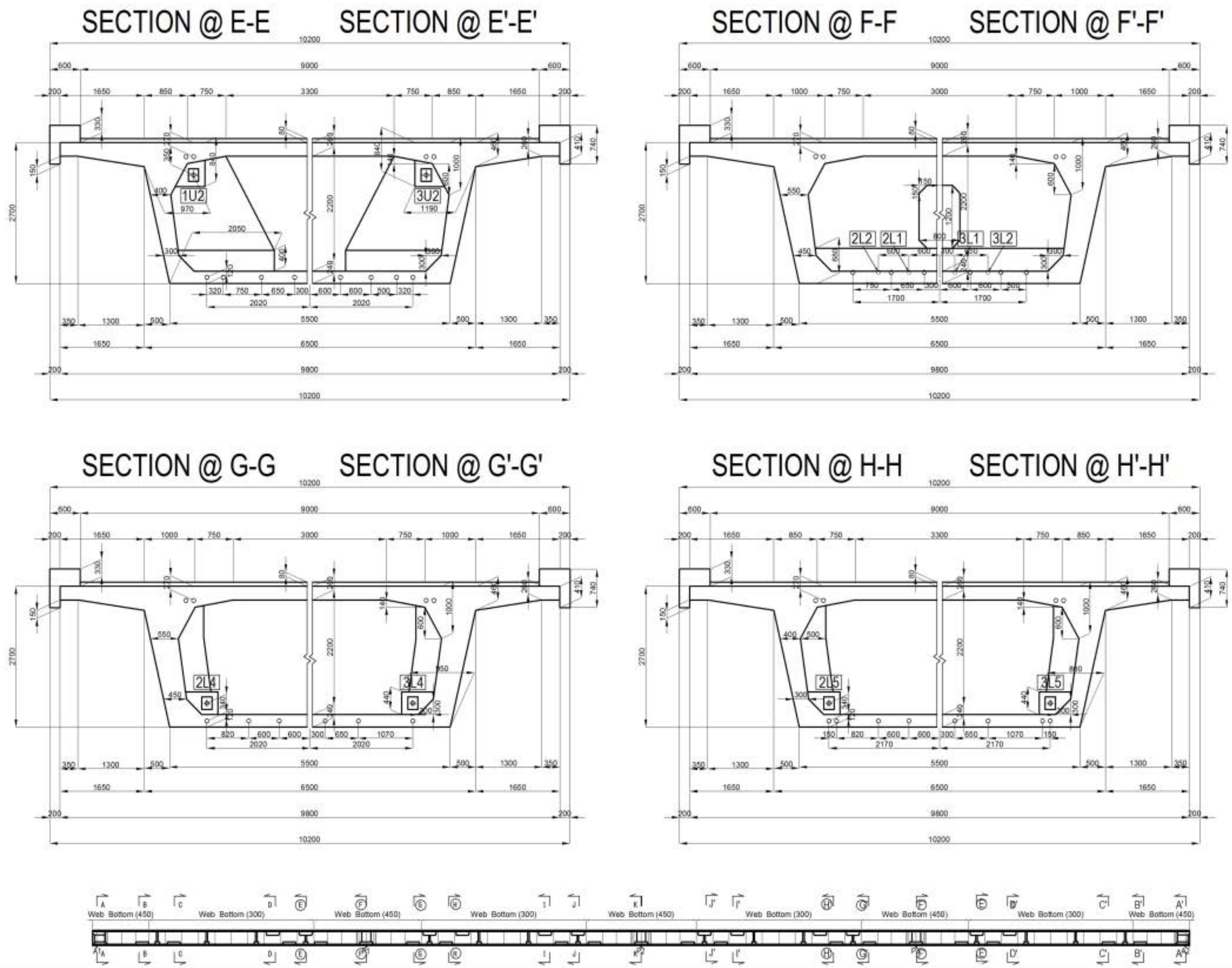
INTERNAL PC TENDON ARRANGEMENT (4)



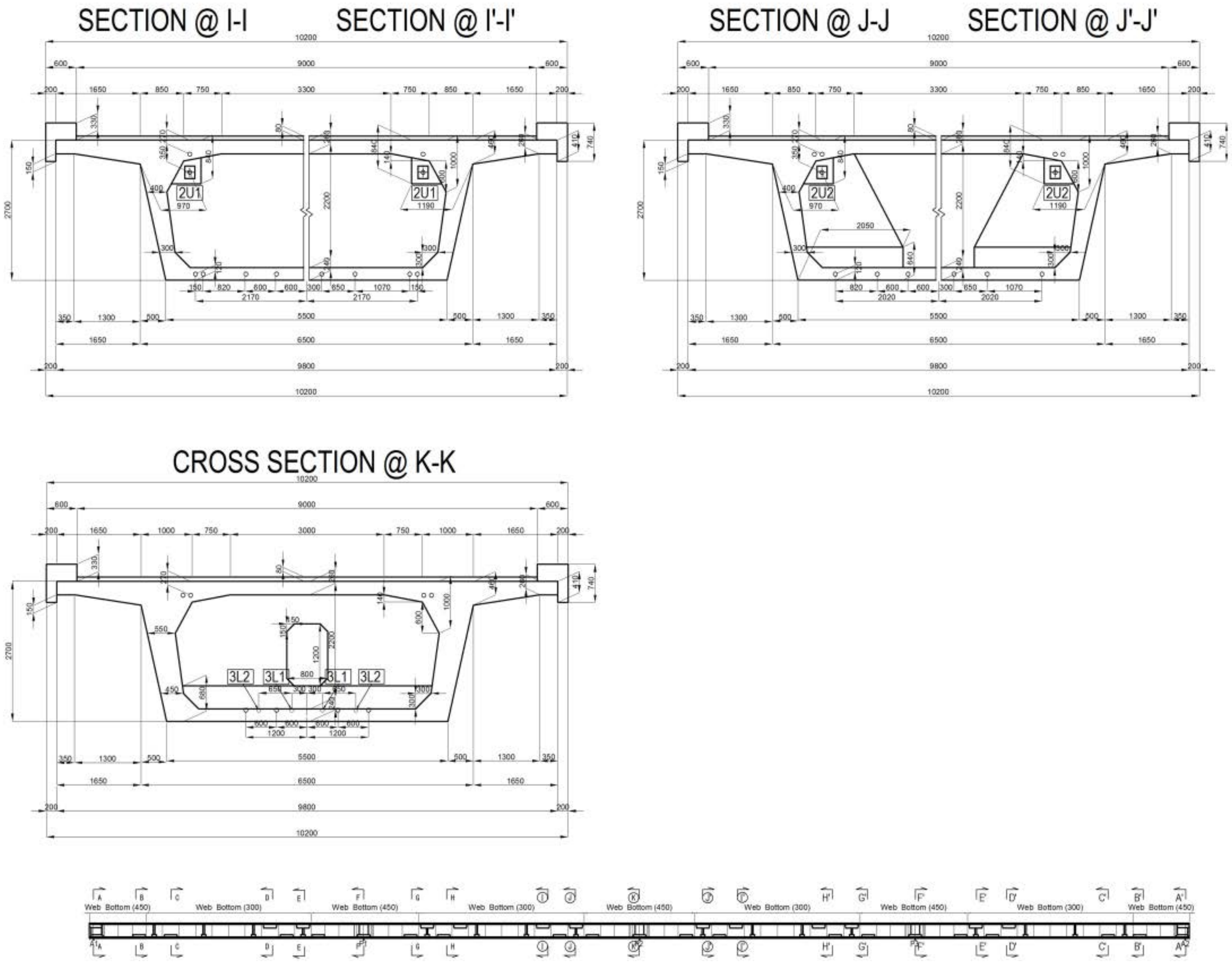
INTERNAL PC TENDON ARRANGEMENT (1)



INTERNAL PC TENDON ARRANGEMENT (2)



INTERNAL PC TENDON ARRANGEMENT (3)



1-3 PC TENDON ARRANGEMENT

(3) External PC Tendon Coordinates

EXTERNAL TENDON INPUT

Span-1

Elem	① x (m)	① y (m)	① z (m)	R (m)
1 to 24	0.600	1.250	1.200	0.0
	1.800	1.250	1.200	4.0
	12.000	0.950	0.390	4.0
	39.000	0.950	0.390	4.0
	49.550	0.800	1.850	4.0
	50.800	0.800	1.850	0.0

Elem	② x (m)	② y (m)	② z (m)	R (m)
1 to 24	0.600	1.750	1.200	0.0
	1.800	1.750	1.200	4.0
	12.000	1.450	0.390	4.0
	39.000	1.450	0.390	4.0
	49.550	1.600	1.850	4.0
	50.800	1.600	1.850	0.0

Span-2

Elem	③ x (m)	③ y (m)	③ z (m)	R (m)
1 to 46	0.600	1.250	1.600	0.0
	1.800	1.250	1.600	4.0
	21.000	1.200	0.390	4.0
	30.000	1.200	0.390	4.0
	50.000	0.800	2.300	3.0
	70.500	0.950	0.390	4.0
	88.500	0.950	0.390	4.0
	99.550	0.800	1.850	4.0
	100.800	0.800	1.850	0.0

Elem	④ x (m)	④ y (m)	④ z (m)	R (m)
1 to 46	0.600	1.750	1.600	0.0
	1.800	1.750	1.600	4.0
	21.000	1.700	0.390	4.0
	30.000	1.700	0.390	4.0
	50.000	1.600	2.300	3.0
	70.500	1.450	0.390	4.0
	88.500	1.450	0.390	4.0
	99.550	1.600	1.850	4.0
	100.800	1.600	1.850	0.0

Span-3

Elem	⑤ x (m)	⑤ y (m)	⑤ z (m)	R (m)
23 to 68	49.200	1.200	1.850	0.0
	50.450	1.200	1.850	4.0
	61.500	1.200	0.390	4.0
	79.500	1.200	0.390	4.0
	100.000	0.800	2.300	3.0
	120.500	0.950	0.390	4.0
	138.500	0.950	0.390	4.0
	149.550	0.800	1.850	4.0
	150.800	0.800	1.850	0.0

Elem	⑥ x (m)	⑥ y (m)	⑥ z (m)	R (m)
23 to 68	49.200	2.000	1.850	0.0
	50.450	2.000	1.850	4.0
	61.500	1.700	0.390	4.0
	79.500	1.700	0.390	4.0
	100.000	1.600	2.300	3.0
	120.500	1.450	0.390	4.0
	138.500	1.450	0.390	4.0
	149.550	1.600	1.850	4.0
	150.800	1.600	1.850	0.0

Note :
1. Similarly consider for Left side of Girder in y-coordinate (negative dir) respectively.

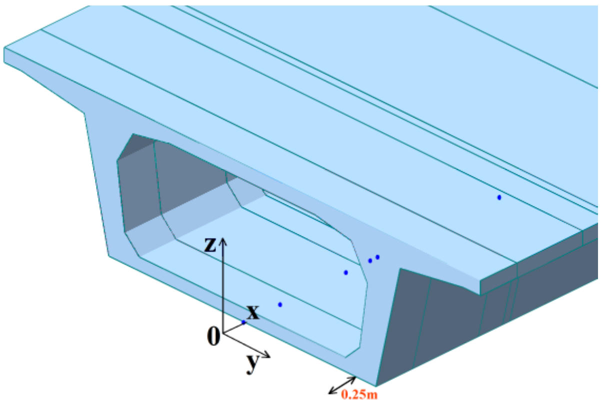
Span-4

Elem	⑦ x (m)	⑦ y (m)	⑦ z (m)	R (m)
45 to 90	99.200	1.200	1.850	0.0
	100.450	1.200	1.850	4.0
	111.500	1.200	0.390	4.0
	129.500	1.200	0.390	4.0
	150.000	0.800	2.300	3.0
	170.000	0.950	0.390	4.0
	179.000	0.950	0.390	4.0
	198.200	0.800	1.600	4.0
	199.400	0.800	1.600	0.0

Elem	⑧ x (m)	⑧ y (m)	⑧ z (m)	R (m)
45 to 90	99.200	2.000	1.850	0.0
	100.450	2.000	1.850	4.0
	111.500	1.700	0.390	4.0
	129.500	1.700	0.390	4.0
	150.000	1.600	2.300	3.0
	170.000	1.450	0.390	4.0
	179.000	1.450	0.390	4.0
	198.200	1.600	1.600	4.0
	199.400	1.600	1.600	0.0

Elem	⑨ x (m)	⑨ y (m)	⑨ z (m)	R (m)
68 to 90	149.200	1.200	1.850	0.0
	150.450	1.200	1.850	4.0
	161.000	1.200	0.390	4.0
	188.000	1.200	0.390	4.0
	198.200	1.250	1.200	4.0
	199.400	1.250	1.200	0.0

Elem	⑩ x (m)	⑩ y (m)	⑩ z (m)	R (m)
68 to 90	149.200	2.000	1.850	0.0
	150.450	2.000	1.850	4.0
	161.000	1.700	0.390	4.0
	188.000	1.700	0.390	4.0
	198.200	1.750	1.200	4.0
	199.400	1.750	1.200	0.0



(4) Internal PC Tendon Coordinates

INTERNAL TENDON INPUT

Span-1

Elem	1L1 x (m)	y (m)	z (m)	R (m)
1 to 24	0.549	0.300	0.460	0.0
	2.022	0.300	0.120	8.0
	49.678	0.300	0.120	8.0
	51.151	0.300	0.460	0.0

Elem	1L2 x (m)	y (m)	z (m)	R (m)
1 to 24	0.549	0.950	0.460	0.0
	2.022	0.950	0.120	8.0
	49.678	0.950	0.120	8.0
	51.151	0.950	0.460	0.0

Elem	1L3 x (m)	y (m)	z (m)	R (m)
1 to 24	0.549	1.700	0.460	0.0
	2.022	1.700	0.120	8.0
	49.678	1.700	0.120	8.0
	51.151	1.700	0.460	0.0

Elem	1L4 x (m)	y (m)	z (m)	R (m)
7 to 18	8.100	2.020	0.460	0.0
	9.572	2.020	0.120	8.0
	41.428	2.020	0.120	8.0
	42.900	2.020	0.460	0.0

Span-2

Elem	1U1 x (m)	y (m)	z (m)	R (m)
15 to 33	31.849	2.280	2.080	0.0
	33.365	2.280	2.430	8.0
	34.907	2.280	2.430	8.0
	36.000	2.430	2.430	8.0
	64.500	2.430	2.430	8.0
	65.593	2.280	2.430	8.0
	67.135	2.280	2.430	8.0
	68.651	2.280	2.080	0.0

Elem	1U2 x (m)	y (m)	z (m)	R (m)
17 to 30	37.849	2.280	2.080	0.0
	39.365	2.280	2.430	8.0
	61.135	2.280	2.430	8.0
	62.651	2.280	2.080	0.0

Elem	1L5 x (m)	y (m)	z (m)	R (m)
9 to 16	13.854	2.170	0.460	0.0
	15.327	2.170	0.120	8.0
	35.673	2.170	0.120	8.0
	37.146	2.170	0.460	0.0

Elem	2L1 x (m)	y (m)	z (m)	R (m)
23 to 46	48.849	0.600	0.460	0.0
	50.322	0.600	0.120	8.0
	99.678	0.600	0.120	8.0
	101.151	0.600	0.460	0.0

Elem	2L2 x (m)	y (m)	z (m)	R (m)
23 to 46	48.849	1.200	0.460	0.0
	50.322	1.200	0.120	8.0
	99.678	1.200	0.120	8.0
	101.151	1.200	0.460	0.0

Elem	2L3 x (m)	y (m)	z (m)	R (m)
29 to 40	57.349	2.020	0.460	0.0
	58.822	2.020	0.120	8.0
	91.178	2.020	0.120	8.0
	92.651	2.020	0.460	0.0

Elem	2L4 x (m)	y (m)	z (m)	R (m)
31 to 38	63.349	2.170	0.460	0.0
	64.822	2.170	0.120	8.0
	85.178	2.170	0.120	8.0
	86.651	2.170	0.460	0.0

Span-3

Elem	2U1 x (m)	y (m)	z (m)	R (m)
37 to 54	81.349	2.280	2.080	0.0
	82.865	2.280	2.430	8.0
	84.407	2.280	2.430	8.0
	85.500	2.430	2.430	8.0
	114.500	2.430	2.430	8.0
	115.593	2.280	2.430	8.0
	117.135	2.280	2.430	8.0
	118.651	2.280	2.080	0.0

Elem	2U2 x (m)	y (m)	z (m)	R (m)
39 to 52	87.349	2.280	2.080	0.0
	88.865	2.280	2.430	8.0
	111.135	2.280	2.430	8.0
	112.651	2.280	2.080	0.0

Note :
1. Similarly consider for Left side of Girder in y-coordinate (negative dir) respectively.

Elem	3L1 x (m)	y (m)	z (m)	R (m)
45 to 68	98.849	0.300	0.460	0.0
	100.322	0.300	0.120	8.0
	149.678	0.300	0.120	8.0
	151.151	0.300	0.460	0.0

Elem	3L2 x (m)	y (m)	z (m)	R (m)
45 to 68	98.849	0.950	0.460	0.0
	100.322	0.950	0.120	8.0
	149.678	0.950	0.120	8.0
	151.151	0.950	0.460	0.0

Elem	3L3 x (m)	y (m)	z (m)	R (m)
51 to 62	107.349	2.020	0.460	0.0
	108.822	2.020	0.120	8.0
	141.178	2.020	0.120	8.0
	142.651	2.020	0.460	0.0

Elem	3L4 x (m)	y (m)	z (m)	R (m)
53 to 60	113.349	2.017	0.460	0.0
	114.822	2.017	0.120	8.0
	135.178	2.017	0.120	8.0
	136.651	2.017	0.460	0.0

Span-4

Elem	3U1 x (m)	y (m)	z (m)	R (m)
59 to 76	131.349	2.280	2.080	0.0
	132.865	2.280	2.430	8.0
	134.407	2.280	2.430	8.0
	135.500	2.430	2.430	8.0
	164.000	2.430	2.430	8.0
	165.093	2.280	2.430	8.0
	166.635	2.280	2.430	8.0
	168.151	2.280	2.080	0.0

Elem	3U2 x (m)	y (m)	z (m)	R (m)
61 to 74	137.349	2.280	2.080	0.0
	138.865	2.280	2.430	8.0
	160.635	2.280	2.430	8.0
	162.151	2.280	2.080	0.0

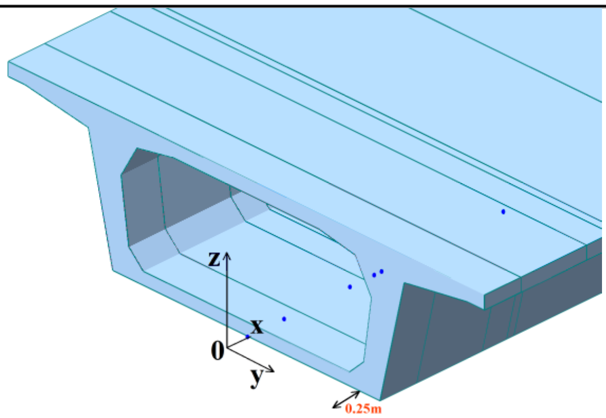
Elem	4L5 x (m)	y (m)	z (m)	R (m)
75 to 82	162.854	2.170	0.460	0.0
	164.327	2.170	0.120	8.0
	184.673	2.170	0.120	8.0
	186.146	2.170	0.460	0.0

Elem	4L1 x (m)	y (m)	z (m)	R (m)
67 to 90	148.849	0.600	0.460	0.0
	150.322	0.600	0.120	8.0
	197.978	0.600	0.120	8.0
	199.451	0.600	0.460	0.0

Elem	4L2 x (m)	y (m)	z (m)	R (m)
67 to 90	148.849	1.200	0.460	0.0
	150.322	1.200	0.120	8.0
	197.978	1.200	0.120	8.0
	199.451	1.200	0.460	0.0

Elem	4L3 x (m)	y (m)	z (m)	R (m)
67 to 90	148.849	1.700	0.460	0.0
	150.322	1.700	0.120	8.0
	197.978	1.700	0.120	8.0
	199.451	1.700	0.460	0.0

Elem	4L4 x (m)	y (m)	z (m)	R (m)
73 to 84	157.100	2.020	0.460	0.0
	158.572	2.020	0.120	8.0
	190.428	2.020	0.120	8.0
	191.900	2.020	0.460	0.0



1-4 CONSTRUCTION STAGES

Each construction stage Cycle duration is 14 days period.

Construction Stage-1

150 days

Construction Stage-2

164 days

Construction Stage-3

178 days

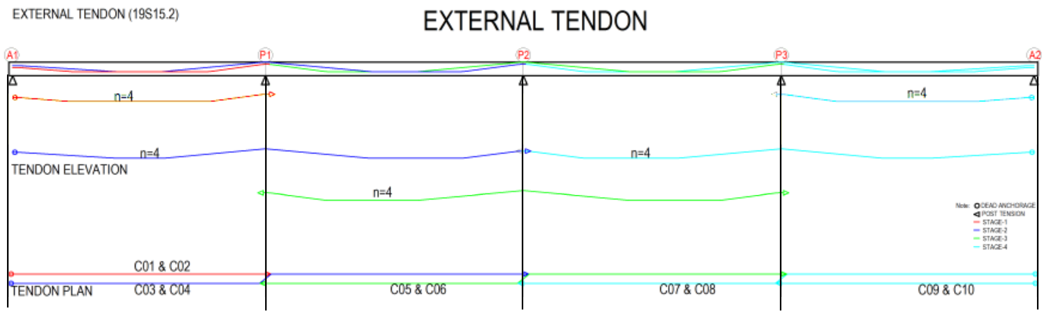
Construction Stage-4

192 days

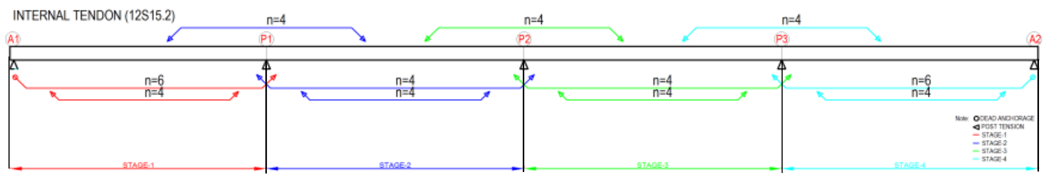
Construction Stage-5 Super Imposed Load 300 days

Construction Stage-6 Design Check 20000 days

EXTERNAL TENDON



INTERNAL TENDON

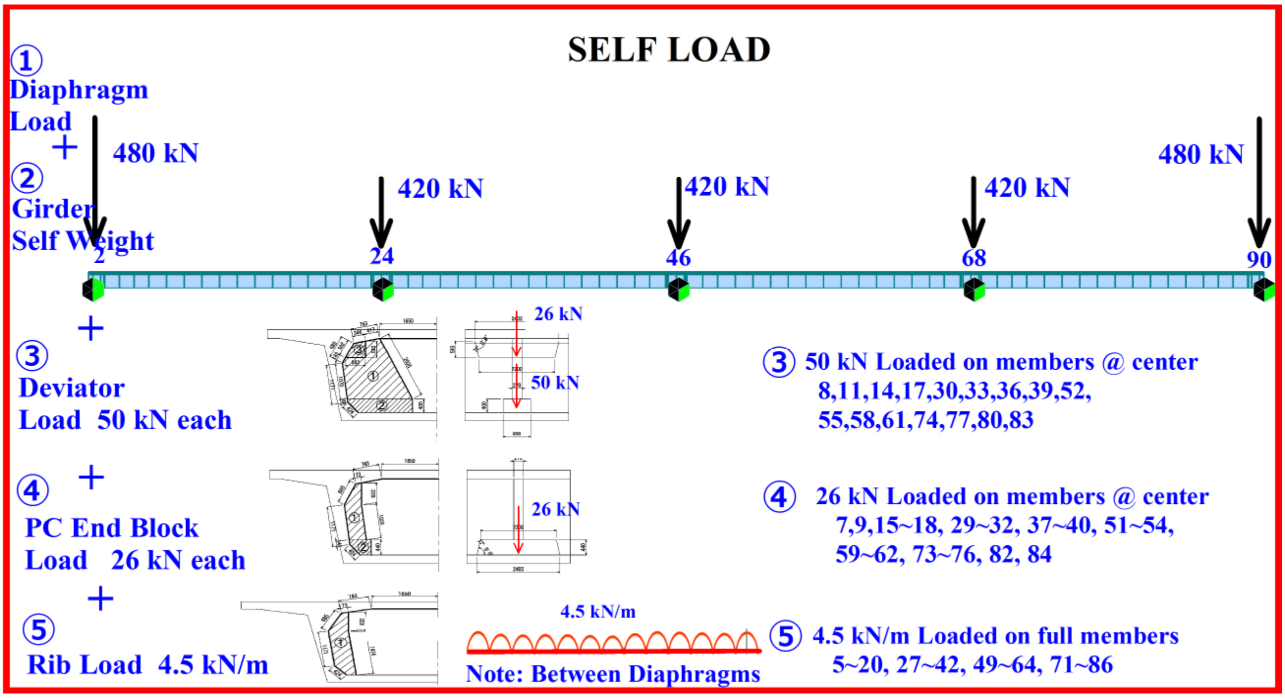


2 DESIGN CONDITIONS

2-1 LOAD CONDITION

(1) SELF WEIGHT

REINFORCED CONCRETE	:	24.5 kN/m^3
PRESTRESSED CONCRETE	:	24.5 kN/m^3
PLAIN CONCRETE	:	23.0 kN/m^3
ASPHALT CONCRETE	:	22.5 kN/m^3
STEEL	:	77.0 kN/m^3



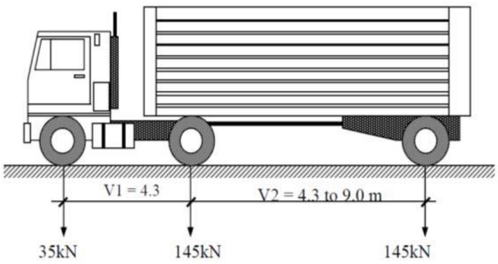
(2) SUPER IMPOSED LOAD

PAVEMENT (t = 80mm)	:	1.8 kN/m^2
OVERLAY	:	0.7 kN/m^2
CURB	:	24.5 kN/m^3
RAILINGS (each side)	:	0.7 kN/m
WATER LINE	:	3.00 kN/m

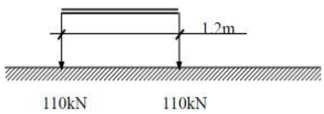
(3) LIVE LOAD

LIVE LOAD is according to AASHTO LRFD Bridge Design Specifications.
IMPACT is according to Specifications for highway bridges, JAPAN.

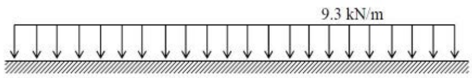
TRUCK



TANDEM



LANE



Design lane width = 3.0 m
Number of design lane = 9.0 m / 3.0 m = 3 Lanes

Table 3.6.1.1.2-1—Multiple Presence Factors, *m*

Number of Loaded Lanes	Multiple Presence Factors, *m*
1	1.20
2	1.00
3	0.85
>3	0.65

(4) CREEP AND SHRINKAGE

According to CEB-FIB-2010 & JRA

Relative humidity : **74.6 %**

Equivalent thickness or Nomial size of member : h (h=2*A/u) , **h = 0.43 m**

Type of Cement : **Normal (32.5 R, 425 N)**

28 days Charcteristic Cylindrical strength of Concrete (time dependent material) : **50.0 N/mm^2**

Age of Concrete beginning : **3days**

Type of Aggregate : **Quartzite**

2-2 MATERIALS

(1) CONCRETE

Specified compressive strength	:	50.0 N/mm^2
Young's modulus	:	3.30E+04 N/mm^2
Shear modulus	:	1.43E+04 N/mm^2
Coefficient of thermal expansion	:	1.00E-05 / ℃

(2) REINFORCEMENT

Reinforcement type	:	SD345
Yeild strength	:	345.0 N/mm^2
Young's modulus	:	2.00E+05 N/mm^2

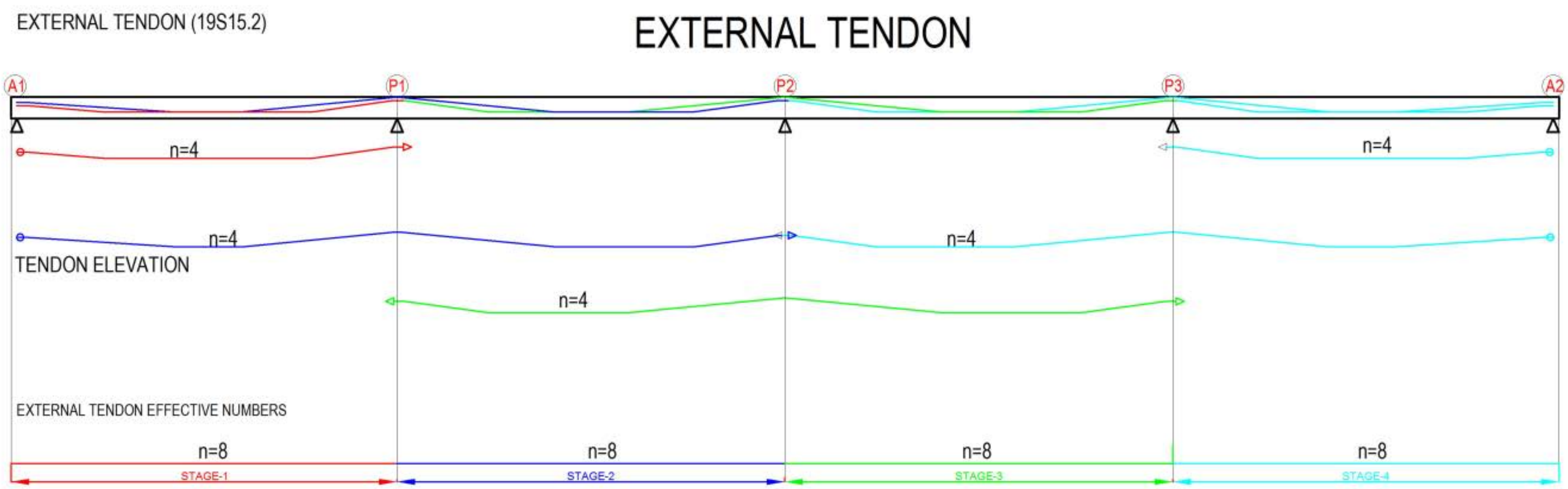
(3) PRESTRESSING TENDON

Tensile strength	:	1860.0 N/mm^2
Yeild strength	:	1600.0 N/mm^2
Young's modulus	:	2.00E+05 N/mm^2
Initial Slip	:	6.0 mm
Relaxaction	:	r_{1000} =1.5% loss ratio after 1000 hours due to steel relaxation
EXTERNAL TENDON		
Post Tension (Stress)	:	1250.0 N/mm^2
Tendon type	:	SWPR7BL, 19S15.2, Low relaxation
Cross section area	:	2635.3 mm^2
Curvature Friction Factor	:	0.3
INTERNAL TENDON		
Post Tension (Stress)	:	1350.0 N/mm^2
Tendon type	:	SWPR7BL, 12S15.2, Low relaxation
Cross section area	:	1664.4 mm^2
Tendon Duct Diameter	:	80.0 mm
Curvature Friction Factor	:	0.3
Wobble Friction Factor	:	0.004 /m

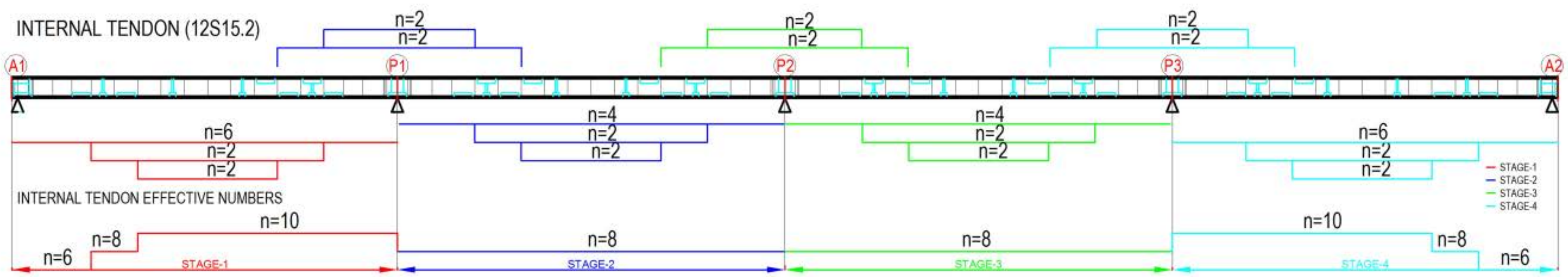
TRANSFER LENGTH (External)		**Begin (m)**	**End (m)**	**Tendon name**
Tendon Dead Anchorage	:	0.000	0.800	①②
________„________	:	0.800	0.000	⑨⑩
Tendon one Side Pull	:	0.000	0.800	③④⑦⑧
Tendon Both Sides Pull	:	0.000	0.000	⑤⑥

TRANSFER LENGTH (Internal)		**Begin (m)**	**End (m)**	**Tendon name**
Tendon Dead Anchorage	:	0.000	2.801	1L1, 1L2, 1L3
________„________	:	2.801	0.000	4L1, 4L2, 4L3
Tendon Both Sides Pull	:	0.000	2.801	2L1, 2L2
________„________	:	0.000	0.000	3L1, 3L2
________„________	:	2.400	2.400	1L4, 2L3, 3L3, 4L4
________„________	:	2.646	2.646	1L5, 2L4, 4L5, 3L4
________„________	:	2.651	2.651	1U1, 1U2, 2U1, 2U2, 3U1, 3U2

EXTERNAL TENDON



INTERNAL TENDON



2-3 ALLOWABLE STRESS

(1) CONCRETE

Table 3.2.2 Allowable compressive stress (N/mm²) for prestressed concrete structure

Stress type \ Design standard strength of concrete			30	40	50	60
Immediately after prestressing	Bending compressive stress	1) Rectangular section	15.0	19.0	21.0	23.0
		2) T-shaped or box-shaped section	14.0	18.0	20.0	22.0
	3) Axial compressive stress		11.0	14.5	16.0	17.0
Others	Bending compressive stress	4) Rectangular section	12.0	15.0	17.0	19.0
		5) T-shaped or box-shaped section	11.0	14.0	16.0	18.0
	6) Axial compressive stress		8.5	11.0	13.5	15.0

Table 3.2.3 Allowable tensile stress (N/mm²) for prestressed concrete structure

Stress type \ Design standard strength of concrete			30	40	50	60
Bending tensile stress	1) Immediately after prestressing		1.2	1.5	1.8	2.0
	2) Principal loads other than live load and impact		0	0	0	0
	Principal loads and special loads corresponding to "principal load"	3) Floor slab	0	0	0	0
		4) Segment joint of precast segment bridges	0	0	0	0
		5) Other cases	1.2	1.5	1.8	2.0
6) Axial tensile stress			0	0	0	0

Table 3.2.5 Allowable diagonal tensile stress (N/mm²) for prestressed concrete structure

Stress type \ Design standard strength of concrete		30	40	50	60
Principal loads other than live load and impact	1) Case where shear force alone or torsional moment alone is to be considered	0.8	1.0	1.2	1.3
	2) Case where both shear force and torsional moment are to be considered	1.1	1.3	1.5	1.6
Combination of loads not considering collision load or the effects of earthquakes	3) Case where shear force alone or torsional moment alone is to be considered	1.7	2.0	2.3	2.5
	4) Case where both shear force and torsional moment are to be considered	2.2	2.5	2.8	3.0

(2) REINFORCEMENT

Table 3.3.1 Allowable stress (N/mm^2) of reinforcement

Stress and member type \ Reinforcement type			SR235	SD295A SD295B	SD345
Tensile stress	1) Principal loads other than live load and impact		80	100	100
	2) Reference value of allowable stress to be used when collision load or the effects of earthquakes are not considered in the combination of loads	General members	140	180	180
		Floor slab and slab bridges with a span of 10 m or less	140	140	140
	3) Reference value of allowable stress to be used when collision load or the effects of earthquakes are considered in the combination of loads		140	180	200
	4) Reference value of allowable stress to be used when calculating the lap joint length or bond length of reinforcement		140	180	200
5) Compressive stress			140	180	200

(3) PRESTRESSING TENDON

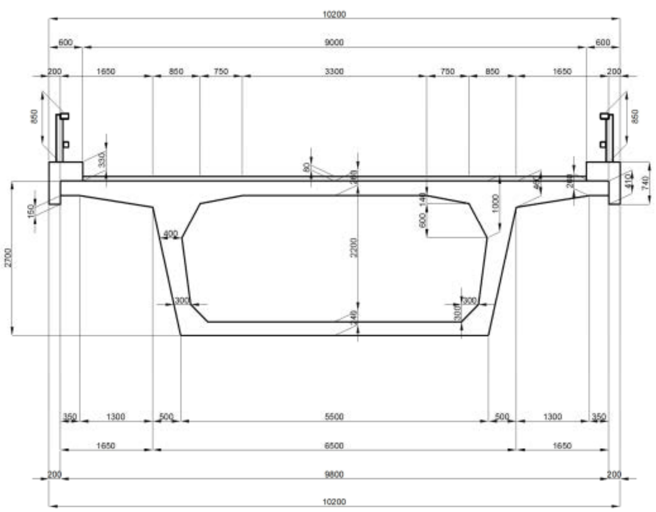
Table C. 3.4.1 Allowable tensile stress (N/mm^2) of PC tendon

PC tendon type \ Allowable tensile stress				During prestressing	Immediately after prestressing	Under design load
Steel wire	SWPR1AN SWPR1AL SWPD1N SWPD1L		5 mm	1260	1120	960
			7 mm	1170	1050	900
			8 mm	1125	1015	870
			9 mm	1080	980	840
	SWPR1BN SWPR1BL		5 mm	1350	1190	1020
			7 mm	1260	1120	960
			8 mm	1215	1085	930
Steel strand	SWPR2N SWPR2L		2.9 mm (2-strand wire)	1530	1365	1170
	SWPR7AN (7-strand wire) SWPR7AL (7-strand wire)			1305	1190	1020
	SWPR7BN (7-strand wire) SWPR7BL (7-strand wire)			1440	1295	1110
	SWPR19N SWPR19L (19-strand wire)		17.8 mm	1440	1295	1110
			19.3 mm	1440	1295	1110
			20.3 mm	1440	1260	1080
			21.8 mm	1440	1260	1080
			28.6 mm	1350	1260	1080
Steel bar	Round bar Type A	2	SBPR785/1030	706	667	588
	Round bar Type B	1	SBPR930/1080	837	756	648
		2	SBPR930/1180	837	790	697

Calculation of Cross-sectional Properties

Gross concrete section

CROSS SECTION @ 1-1



Element No.	Shape	Nos.	Dimension		Cross-sectional area	Distance from top of section to centroid	A • y' [m³]	A • y'² [m⁴]	Moment of Inertia
			Width	Height					
			b [m]	h [m]	A [m²]	y' [m]			I_0 [m⁴]
Total									

Cross-sectional area : $A_c = \sum A$

Centroid of section : $y_c{}' = \frac{\sum(A \cdot y')}{\sum A}$

From bottom to centroid of section : $y_c = -(H - y_c')$

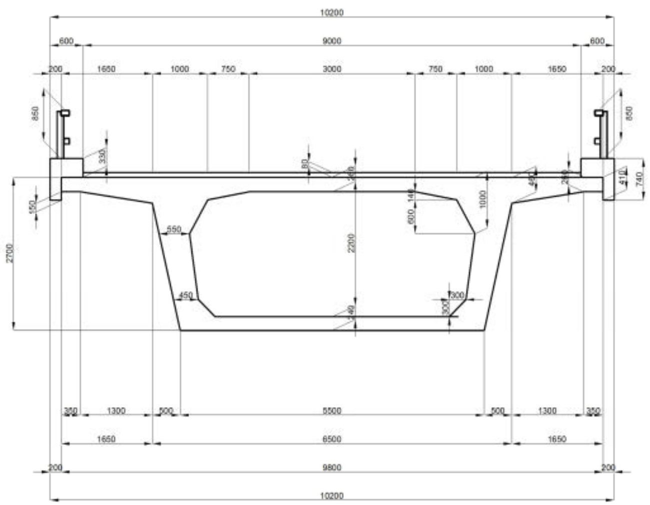
Moment of inertia : $I_c = \sum\left(A \cdot y'^2\right) + \sum I_0 - \sum A \cdot y_c{}'^2$

Section modulus

at top fiber : $Z_c{}' = \frac{I_c}{y_c{}'}$

at bottom fiber : $Z_c = \frac{I_c}{y_c}$

CROSS SECTION @ 2-2



Element No.	Shape	Nos.	Dimension		Cross-sectional area	Distance from top of section to centroid	A • y' [m³]	A • y'² [m⁴]	Moment of Inertia
			Width	Height					
			b [m]	h [m]	A [m²]	y' [m]			I_0 [m⁴]
Total									

Cross-sectional area : $A_c = \sum A$

Centroid of section : $y_c{}' = \frac{\sum(A \cdot y')}{\sum A}$

From bottom to centroid of section : $y_c = -(H - y_c')$

Moment of inertia : $I_c = \sum\left(A \cdot y'^2\right) + \sum I_0 - \sum A \cdot y_c{}'^2$

Section modulus

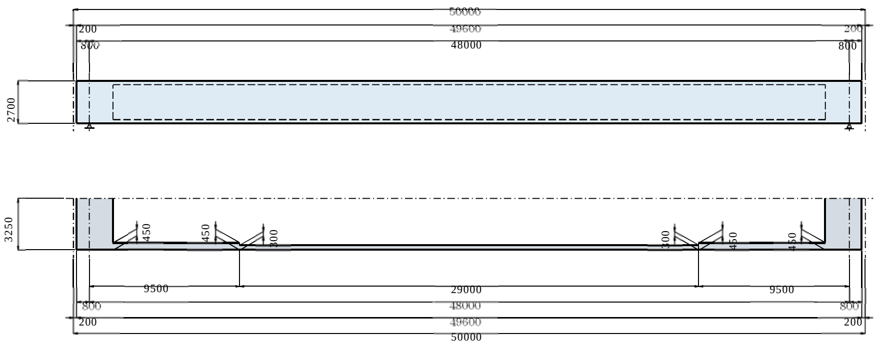
at top fiber : $Z_c{}' = \frac{I_c}{y_c{}'}$

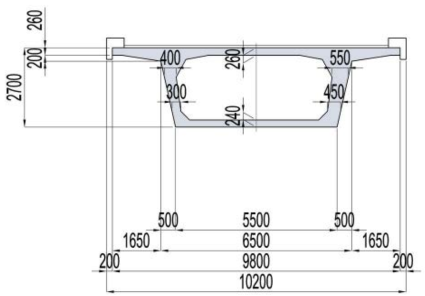
at bottom fiber : $Z_c = \frac{I_c}{y_c}$

Calculation of Sectional Forces

Loads

1) Self-Weight





- At span center

A	=	_______ m^2
unit weight	=	24.5 kN/m^3
w	=	_______ kN/m

- At pier

A	=	_______ m^2
unit weight	=	24.5 kN/m^3
w	=	_______ kN/m

- Deviators, ribs, anchor blisters

w	=	8.0 kN/m (assumed)

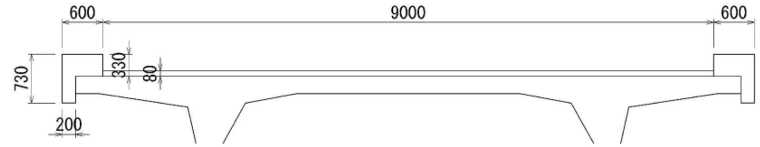
- Crossbeams at supports

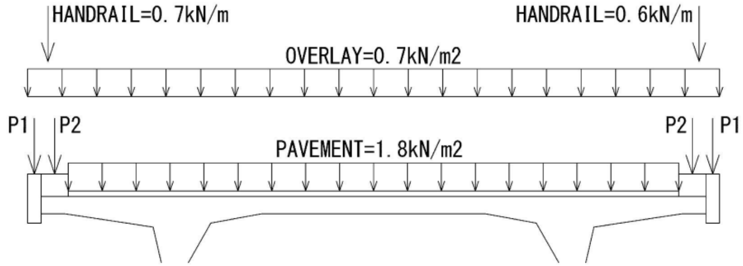
P	=	700.0 kN/EA (assumed)

Calculation of Sectional Forces

Loads

2) Superimposed Dead Load





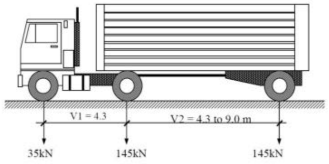
Pavement :	w =	_______	kN/m
Wheelguards: (per each)	w =		kN/m
	w x 2 =	_______	kN/m
Handrails :	w =	_______	kN/m
Overlay :	w =	_______	kN/m
Total	w =	_______	kN/m

Calculation of Sectional Forces

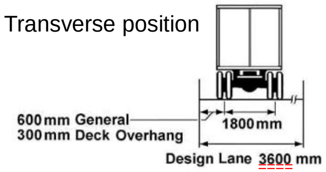
Loads

3) Live Load

(1)-1 Design Truck



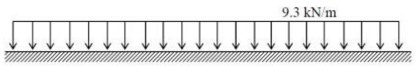
Transverse position



3000 mm

In Bago Bridge, Design Lane width is assumed to be **3000mm** to be on the safer side.

(2) Design lane load



(3) Multiple presence factor

Number of Loaded Lanes	Multiple Presence Factors, *m*
1	1.20
2	1.00
3	0.85
>3	0.65

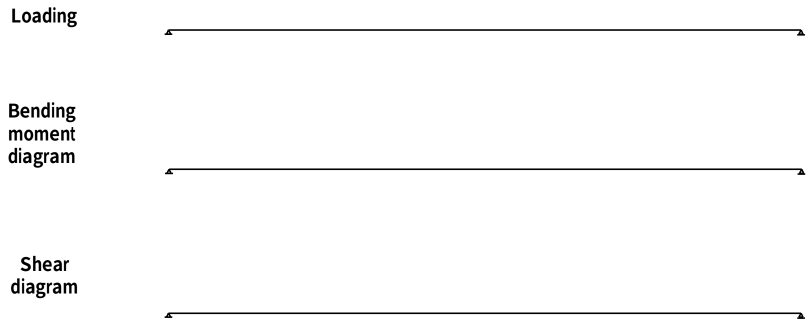
Note: Nominal lane width is assumed to be 3.0m.

- Impact (dynamic allowance):
  i = 10 / (25 + L) = ________
  (assume L = 48.0m)
- Design truck:
  P = (35 + 145 + 145) x 3 lanes x m x (1 + i) = ________ kN
- Design lane load :
  w = 9.3 x 3 lanes x m x (1 + i) = ________ kN

Calculation of Sectional Forces

Sectional Forces

1) Self-Weight



Calculation of Sectional Forces

Sectional Forces

2) Superimposed Dead Load

Loading

Bending moment diagram

Shear diagram

Calculation of Sectional Forces

Sectional Forces

3) Live Load

Loading

Bending moment diagram

Shear diagram

Calculation of Sectional Forces

Sectional forces

Summary of sectional forces due to loads

	at Span center	at Support
	Bending moment	Shear
	[kNm]	[kN]
Self-weight		
Superimposed dead load		
Live load		
All dead loads		
Dead loads + live load		

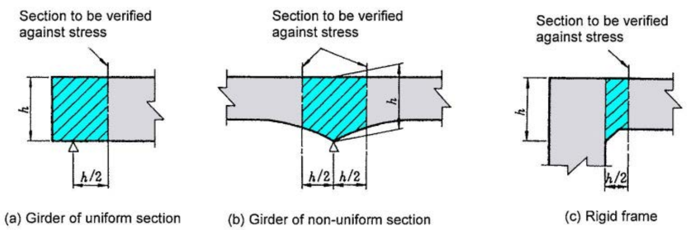


Figure 4.3.2 Section to be verified against shear force

(4), (5) Near a support of a girder and near a joint of a rigid frame, a compressive force due to support reaction acts on the web, so the tensile force acting on the diagonal tensile reinforcement is smaller than in the other portions. Therefore, the verification against shear force need not be performed in the area from the support to half the member height, and it is sufficient to place diagonal tensile reinforcement in the hatched area of Figure 4.3.2 in an such an amount that the member section satisfies the verification in Clauses (1) and (2) against the shear force at the distance of half the member height from the support.

Calculation of Bending Stress

1) Sectional Forces and stresses due to loads

	Bending moment	Section modulus		Stress due to loads	
		at top	at bottom	at top	at bottom
	M_d [kNm]	Z_c' [mm^3]	Z_c' [mm^3]	σ_d' [N/mm^2]	σ_d [N/mm^2]
Self-weight					
Superimposed dead load					
Live load					
All dead loads					
Dead loads + live load					

2) Calculation of Required Prestress

$$\sigma = \left(\frac{N}{A} + \frac{M}{Z}\right) + P\left(\frac{1}{A} + \frac{e_p}{Z}\right)$$

Where

σ : Resultant stress

$\left(\frac{N}{A} + \frac{M}{Z}\right)$: Stress due to loads (axial force + flexure)

$P\left(\frac{1}{A} + \frac{e_p}{Z}\right)$: Stress due to prestressing (total prestress x (axial force + flexure))

A : Cross-sectional area of the section

Z : Section modulus

N, M : Axial force and bending moment at the section

P : Total prestressing force

e_p : Eccentricity of tendons from centroid of the section

- For required prestress : P_e and allowable tensile stress of concrete : σ_{ca}' ,

$$\Sigma\sigma_c + \frac{P_e}{A_c} + \frac{P_e \cdot e_p}{Z} \geqq \sigma_{ca}'$$

Where

$\Sigma\sigma_c$: Total stress due to loads at extreme tensile fiber

σ_{ca}' : Allowable tensile stress of concrete

- The above expression is transformed to obtain P_e,

$$\frac{P_e}{A_c}\left(1 + \frac{A_c \cdot e_p}{\frac{I_c}{y_c}}\right) \geqq -\Sigma\sigma_c + \sigma_{ca}' \quad \rightarrow \quad \frac{P_e}{A_c}\left(1 + \frac{y_c}{r_c^2} \cdot e_p\right) \geqq -\Sigma\sigma_c + \sigma_{ca}'$$

Hence, $P_e = \frac{(-\Sigma\sigma_c + \sigma_{ca}') \cdot A_c}{1 + \frac{y_c}{r_c^2} e_p}$

Where

e_p : Eccentricity of centroid of tendons from centroid of the section

I_c : Moment of inertia of the section

A_c : Cross-sectional area of the section

y_c ' : Distance from centroid to extreme tensile fiber of the section

Z : Section modulus (= I/y_c)

r_c : Radius of gyration (= $\sqrt{I_c/A_c}$)

- Required number of tendons can be initially estimated assuming

$\sigma_{pe} \fallingdotseq 0.5\,\sigma_{pu}$ (for tendons using strands)

Where

σ_{pe} : Assumed effective prestress

σ_{pu} : Tensile strength of prestressing steel

P_e = $A_p \cdot \sigma_{pe}$ = = ____________ kN / tendon

(Tendon type : _______ , A_p = mm2 / tendon,

Pe _______ kN/tendon (assumed))

3) Resultant Stress

- At span center

		Immediately after anchor set		At service load state	
		at top	at bottom	at top	at bottom
		σ_t [N/mm^2]	σ [N/mm^2]	σ_t [N/mm^2]	σ [N/mm^2]
Internal prestress	immediately after anchor-set				
	Effective prestress				
External prestress	immediately after anchor-set				
	Effective prestress				
Total prestress	immediately after anchor-set				
	Effective prestress				
Self-weight					
Superimposed dead load					
Live load					
Immediately after anchor set					
All dead loads					
Dead loads + Live load					
Allowable stress σ_a [N/mm^2]	compression	20.00	20.00	16.00	16.00
	tension	0.00	0.00	0.00	0.00

Load Combinations for Design

Concrete Bridges, JRA Specifiction

Load Combination Load State		D0 (Self-weight)	D1 (Superimposed Dead Load)	2P (Secondary Prestress)	SH (Shrinkage)	CR (Creep)	L (Live Load w/ impact)	T (Temperature Change)	DT (Differential Temperature)	PS (Prestress)
Immediately after prestressing		1.0		1.0 (Immediately after prestressing)						1.0 (Immediately after prestressing)
Service Load State	All dead loads (D)	1.0	1.0	1.0 (Effective prestress)	1.0	1.0				1.0 (Effective prestress)
	D + L	1.0	1.0	1.0 (Effective prestress)	1.0	1.0	1.0 (maximum & minimum)			1.0 (Effective prestress)
	D + L + T	1.0	1.0	1.0 (Effective prestress)	1.0	1.0	1.0 (maximum & minimum)	1.0 (rise & fall)	0.0 / 1.0	1.0 (Effective prestress)
Ultimate Load State	(a)	1.3	1.3	1.0	1.0	1.0	2.5 (maximum & minimum)			1.0 (Effective prestress)
	(b)	1.0	1.0	1.0	1.0	1.0	2.5 (maximum & minimum)			1.0 (Effective prestress)
	(c)	1.7	1.7	1.0	1.0	1.0	1.7 (maximum & minimum)			1.0 (Effective prestress)

Stress Increase in External Tendons at ULS

(Specified in "Design Guidelines Part-2: Bridge Construction" by NEXCO, Japan)

When L/dp ＞ 50, $\Delta\sigma_p = 0$ (N/mm2) 式（8-2-3）

When L/dp ≦ 50, $\Delta\sigma_p = k \times dp / L < \Delta\sigma_{pmax}$ (N/mm2) 式（8-2-4）

Where, L : Distance between anchorages of the external tendon [mm]

dp : Effective depth of the external tendon (from extreme compressive fiber to the centroid of the tendon) [mm]

k : Coefficient related to tendon type, section location and type of webs [N/mm2]

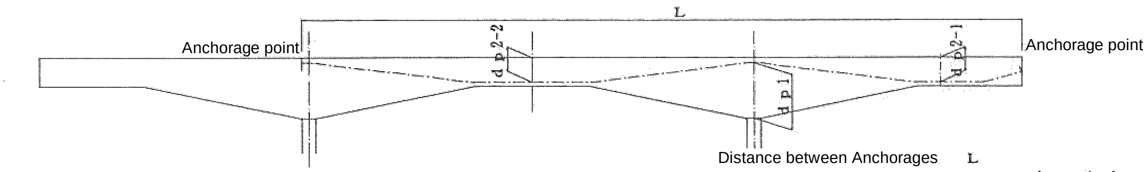
$\Delta\sigma_{pmax}$: Upper limit corresponding to type of structure and tendon

Table 8-2-7 Value of k, Δσpmax

			Concrete Webs		Corrugated Steel Webs	
Structure	Type of Tendon	Section Location	k	$\Delta\sigma_{pmax}$	k	$\Delta\sigma_{pmax}$
Rigid Frame	Cantilever Tendon	Center Span	1, 200	350	1, 500	400
		Side Span			1, 000	200
	Continuous Tendon	Center Span	4, 000	400	4, 000	400
		Side Span				
Continuous Girder	Cantilever Tendon	Center Span	1, 200	350	1, 500	400
		Side Span			1, 000	200
	Continuous Tendon	Center Span	4, 000	450	4, 000	400
		Side Span			2, 000	

Effective Depth of External Tendon

For continuous tendons

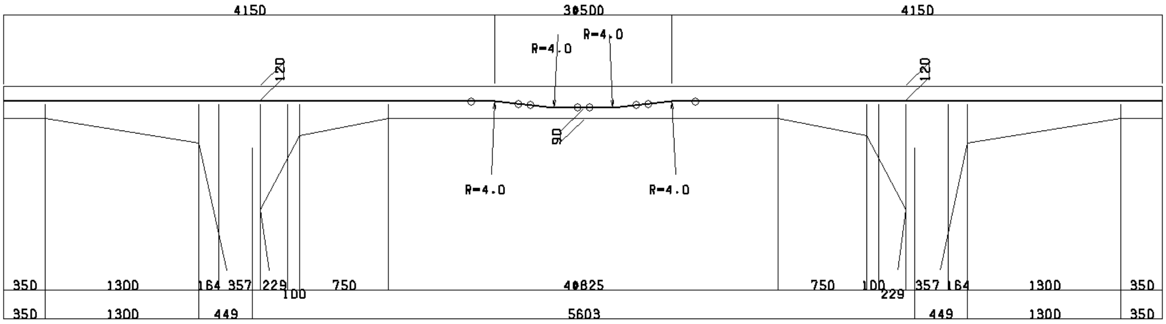


Distance between Anchorages L

Effective Depth $dp = \frac{dp1 + dp2}{2}$

For multiple dp2s (more than 2 nos), their avarage value is applied. $dp2 = \frac{dp2\text{-}1 + dp2\text{-}2}{2}$

Transverse Prestressing of Deck Slab



ep (m)	0.010	0.010	0.110	0.137	0.111	0.089	0.080	0.010	0.008	-0.040	0.008	0.010	0.080	0.089	0.111	0.137	0.110	0.010	0.010
yp (m)	0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.122	0.170	0.122	0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120
tu (m)	0.260	0.260	0.460	0.515	0.462	0.419	0.400	0.260	0.260	0.260	0.260	0.260	0.400	0.419	0.462	0.515	0.460	0.260	0.260

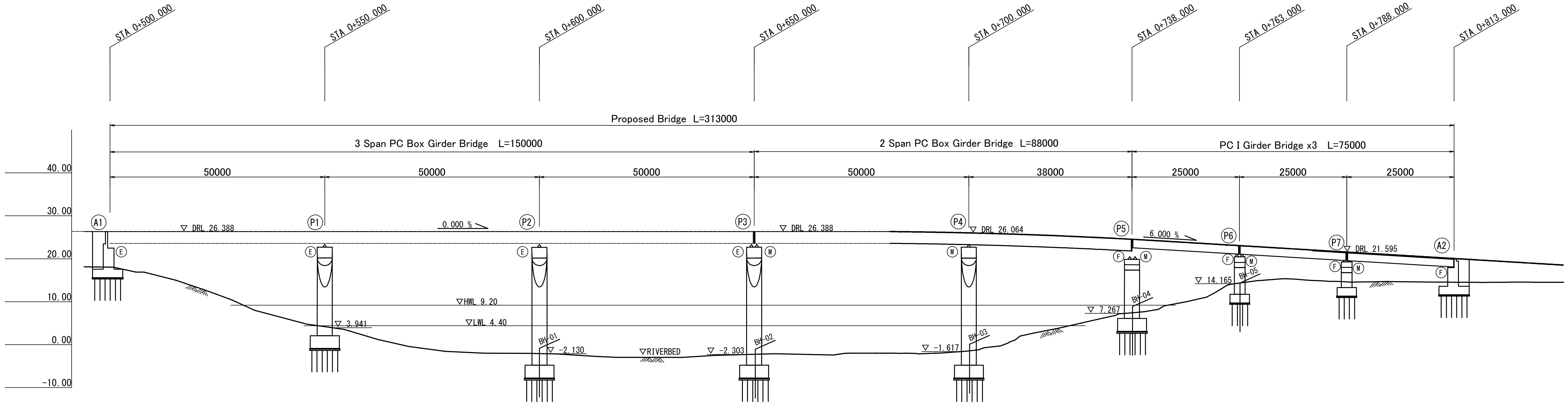
Type	=	Strand Cable 3S12.7
Stressing	=	One side (Alternation)
$\sigma pt0$	=	1350.0 N/mm2
λ	=	0.004
μ	=	0.300

付録 A　　講義及びセミナー資料

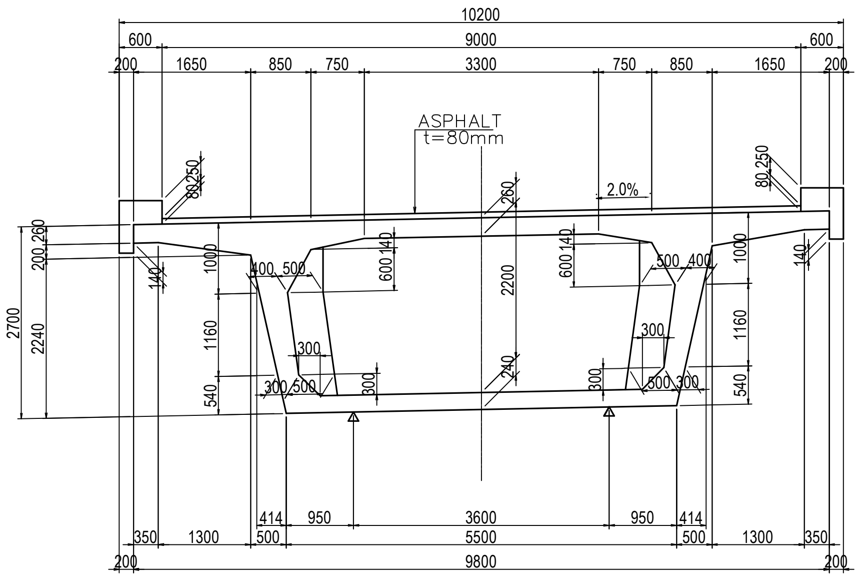
A-11　下部工・基礎工の設計演習

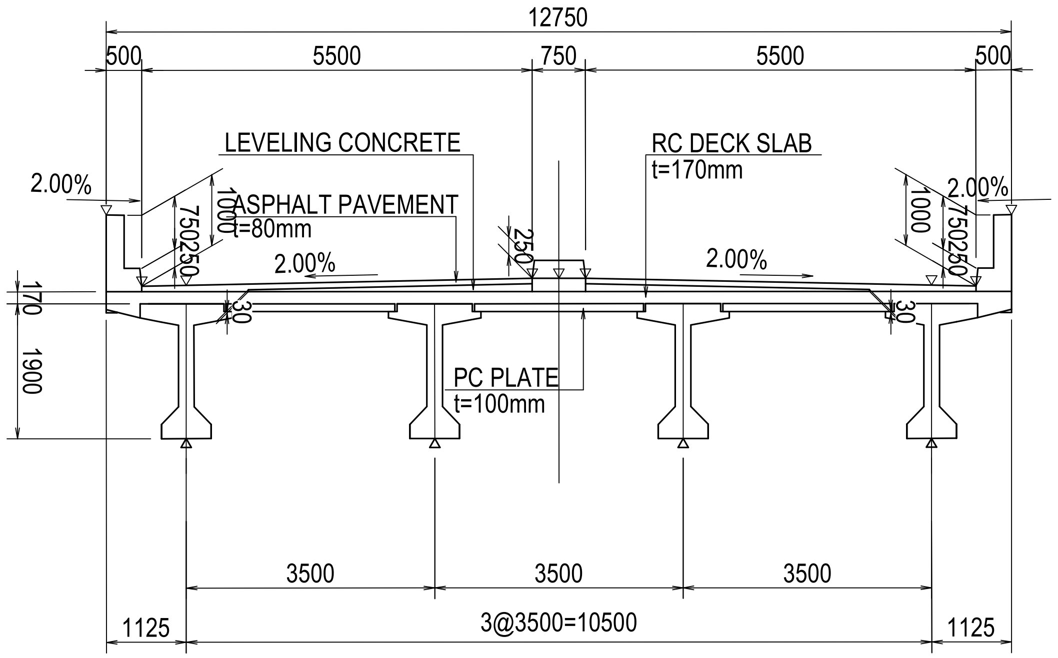
GENERAL VIEW OF THE BRIDGE

SIDE VIEW



CROSS SECTION OF SUPERSTRUCTURES





Notes:	Client	Consultant	Approved		Project:
			Checked		Job:
			Designed		Scale:

Superstructure Reaction Force (For Substructure design)

	P2			P3 (B.P. side)			P3 (E.P. side)			P4		
	V (kN)	H (kN)	M (kN)	V (kN)	H (kN)	M (kN)	V (kN)	H (kN)	M (kN)	V (kN)	H (kN)	M (kN)
Selfweight	13,000.0	0.0	0.0	6,600.0	0.0	0.0	6,600.0	0.0	0.0	11,620.0	0.0	0.0
Superimposed load	6,000.0	0.0	0.0	3,000.0	0.0	0.0	3,000.0	0.0	0.0	5,280.0	0.0	0.0
Dead Load all	19,000.0	0.0	0.0	9,600.0	0.0	0.0	9,600.0	0.0	0.0	16,900.0	0.0	0.0
Live Load (Max)	5,000.0	0.0	0.0	3,500.0	0.0	0.0	3,500.0	0.0	0.0	5,000.0	0.0	0.0
Live Load (Min)	-800.0	0.0	0.0	-400.0	0.0	0.0	-500.0	0.0	0.0	-700.0	0.0	0.0
Dead + Live (Max)	24,000.0	0.0	0.0	13,100.0	0.0	0.0	13,100.0	0.0	0.0	21,900.0	0.0	0.0
Dead + Live (Min)	18,200.0	0.0	0.0	9,200.0	0.0	0.0	9,100.0	0.0	0.0	16,200.0	0.0	0.0
Seismic Effeict (Bridge Axial)	19,000.0	5,700.0	0.0	9,600.0	2,850.0	0.0	9,600.0	2,700.0	0.0	16,900.0	5,060.0	0.0
Seismic Effeict (Transverse)	19,000.0	6,000.0	0.0	9,600.0	2,550.0	0.0	9,600.0	2,500.0	0.0	16,900.0	5,300.0	0.0

	P5 (B.P. side)			P5 (E.P. side)			P6 (B.P. side)			P6 (E.P. side)		
	V (kN)	H (kN)	M (kN)	V (kN)	H (kN)	M (kN)	V (kN)	H (kN)	M (kN)	V (kN)	H (kN)	M (kN)
Selfweight	5,020.0	0.0	0.0	4,500.0	0.0	0.0	4,500.0	0.0	0.0	4,500.0	0.0	0.0
Superimposed load	2,280.0	0.0	0.0	2,000.0	0.0	0.0	2,000.0	0.0	0.0	2,000.0	0.0	0.0
Dead Load all	7,300.0	0.0	0.0	6,500.0	0.0	0.0	6,500.0	0.0	0.0	6,500.0	0.0	0.0
Live Load (Max)	3,000.0	0.0	0.0	2,500.0	0.0	0.0	2,500.0	0.0	0.0	2,500.0	0.0	0.0
Live Load (Min)	-500.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dead + Live (Max)	10,300.0	0.0	0.0	9,000.0	0.0	0.0	9,000.0	0.0	0.0	9,000.0	0.0	0.0
Dead + Live (Min)	6,800.0	0.0	0.0	6,500.0	0.0	0.0	6,500.0	0.0	0.0	6,500.0	0.0	0.0
Seismic Effeict (Bridge Axial)	7,300.0	2,350.0	0.0	6,500.0	390.0	0.0	6,500.0	3,510.0	0.0	6,500.0	390.0	0.0
Seismic Effeict (Transverse)	7,300.0	2,310.0	0.0	6,500.0	1,950.0	0.0	6,500.0	1,950.0	0.0	6,500.0	1,950.0	0.0

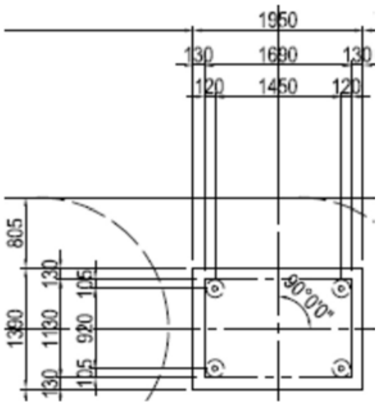
Superstructure Reaction Force (For design of bearings/beam)

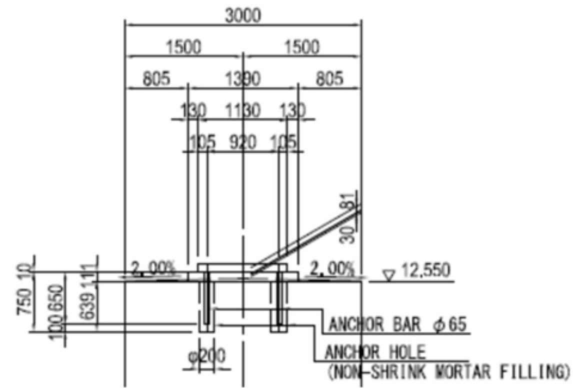
	P2			P3 (B.P. side)			P3 (E.P. side)			P4			P5 (B.P. side)		
	SL Rz (kN)	SR Rz (kN)	Sum Rz (kN)	SL Rz (kN)	SR Rz (kN)	Sum Rz (kN)	SL Rz (kN)	SR Rz (kN)	Sum Rz (kN)	SL Rz (kN)	SR Rz (kN)	Sum Rz (kN)	SL Rz (kN)	SR Rz (kN)	Sum Rz (kN)
Selfweight	6,500.0	6,500.0	13,000.0	3,300.0	3,300.0	6,600.0	3,300.0	3,300.0	6,600.0	5,810.0	5,810.0	11,620.0	2,510.0	2,510.0	5,020.0
Superimposed load	3,000.0	3,000.0	6,000.0	1,500.0	1,500.0	3,000.0	1,500.0	1,500.0	3,000.0	2,640.0	2,640.0	5,280.0	1,140.0	1,140.0	2,280.0
Dead Load all	9,500.0	9,500.0	19,000.0	4,800.0	4,800.0	9,600.0	4,800.0	4,800.0	9,600.0	8,450.0	8,450.0	16,900.0	3,650.0	3,650.0	7,300.0
Live Load (Max)	3,500.0	3,500.0	−	2,400.0	2,400.0	−	2,400.0	2,400.0	−	3,500.0	3,500.0	−	2,000.0	2,000.0	−
Live Load (Min)	−500.0	−500.0	−	−300.0	−300.0	−	−300.0	−300.0	−	−500.0	−500.0	−	−300.0	−300.0	−
Dead + Live (Max)	13,000.0	13,000.0	−	7,200.0	7,200.0	−	7,200.0	7,200.0	−	11,950.0	11,950.0	−	5,650.0	5,650.0	−
Dead + Live (Min)	9,000.0	9,000.0	−	4,500.0	4,500.0	−	4,500.0	4,500.0	−	7,950.0	7,950.0	−	3,350.0	3,350.0	−

	P5 (E.P. side)					P6 (B.P. side)					P6 (E.P. side)				
	SL Rz (kN)	SCL Rz (kN)	SCR Rz (kN)	SR Rz (kN)	Sum Rz (kN)	SL Rz (kN)	SCL Rz (kN)	SCR Rz (kN)	SR Rz (kN)	Sum Rz (kN)	SL Rz (kN)	SCL Rz (kN)	SCR Rz (kN)	SR Rz (kN)	Sum Rz (kN)
Selfweight	1,200.0	1,050.0	1,050.0	1,200.0	4,500.0	1,200.0	1,050.0	1,050.0	1,200.0	4,500.0	1,200.0	1,050.0	1,050.0	1,200.0	4,500.0
Superimposed load	550.0	450.0	450.0	550.0	2,000.0	550.0	450.0	450.0	550.0	2,000.0	550.0	450.0	450.0	550.0	2,000.0
Dead Load all	1,750.0	1,500.0	1,500.0	1,750.0	6,500.0	1,750.0	1,500.0	1,500.0	1,750.0	6,500.0	1,750.0	1,500.0	1,500.0	1,750.0	6,500.0
Live Load (Max)	850.0	950.0	950.0	850.0	−	850.0	950.0	950.0	850.0	−	850.0	950.0	950.0	850.0	−
Live Load (Min)	600.0	700.0	700.0	600.0	−	600.0	700.0	700.0	600.0	−	600.0	700.0	700.0	600.0	−
Dead + Live (Max)	2,600.0	2,450.0	2,450.0	2,600.0	−	2,600.0	2,450.0	2,450.0	2,600.0	−	2,600.0	2,450.0	2,450.0	2,600.0	−
Dead + Live (Min)	2,350.0	2,200.0	2,200.0	2,350.0	−	2,350.0	2,200.0	2,200.0	2,350.0	−	2,350.0	2,200.0	2,200.0	2,350.0	−

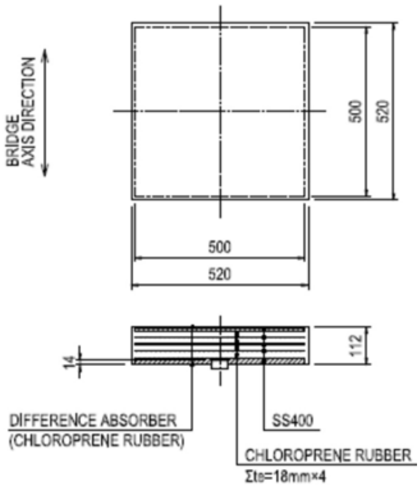
Design Practice for "Pier with Cast-in-place RC pile"

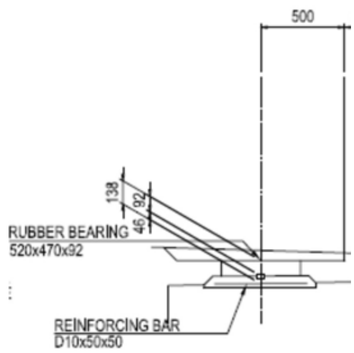
1. Bearing details
- PC BOX Girder Bridge
  (A1 / P1 / P2 / P3 at B.P. side / P3 at E.P. side / P4 / P5 at B.P. side)





- PC I Girder Bridge
  (P5 at E.P. side / P6 at B.P. side / P6 at E.P. side / P7 at B.P. side / P7 at E.P. side / A2)



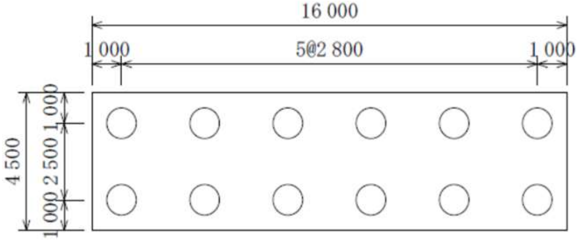
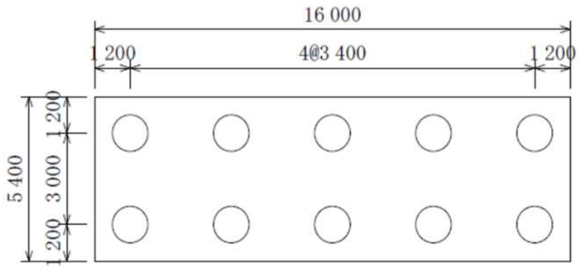
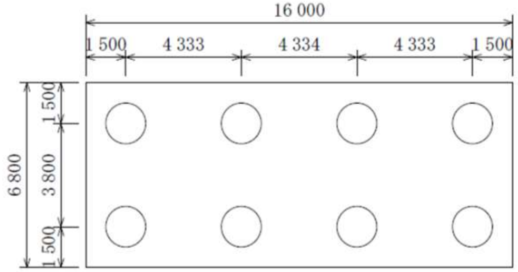


2. Required joint gap

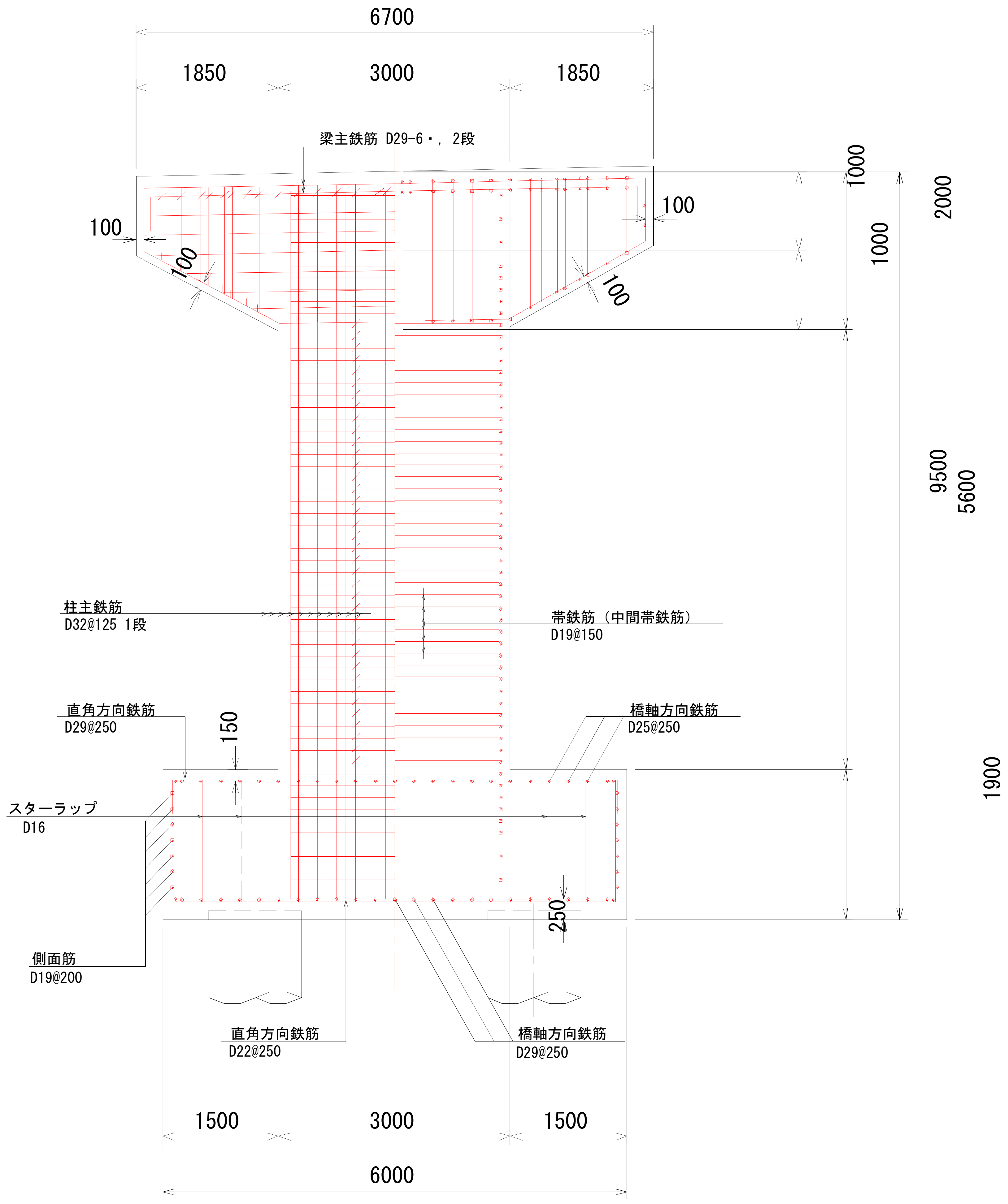
Location	Joint gap
P3/P5	250mm
A1	200mm
P6/P7	150mm
A2	100mm

A Comparison in Pile Diameter and Numbers (Example)

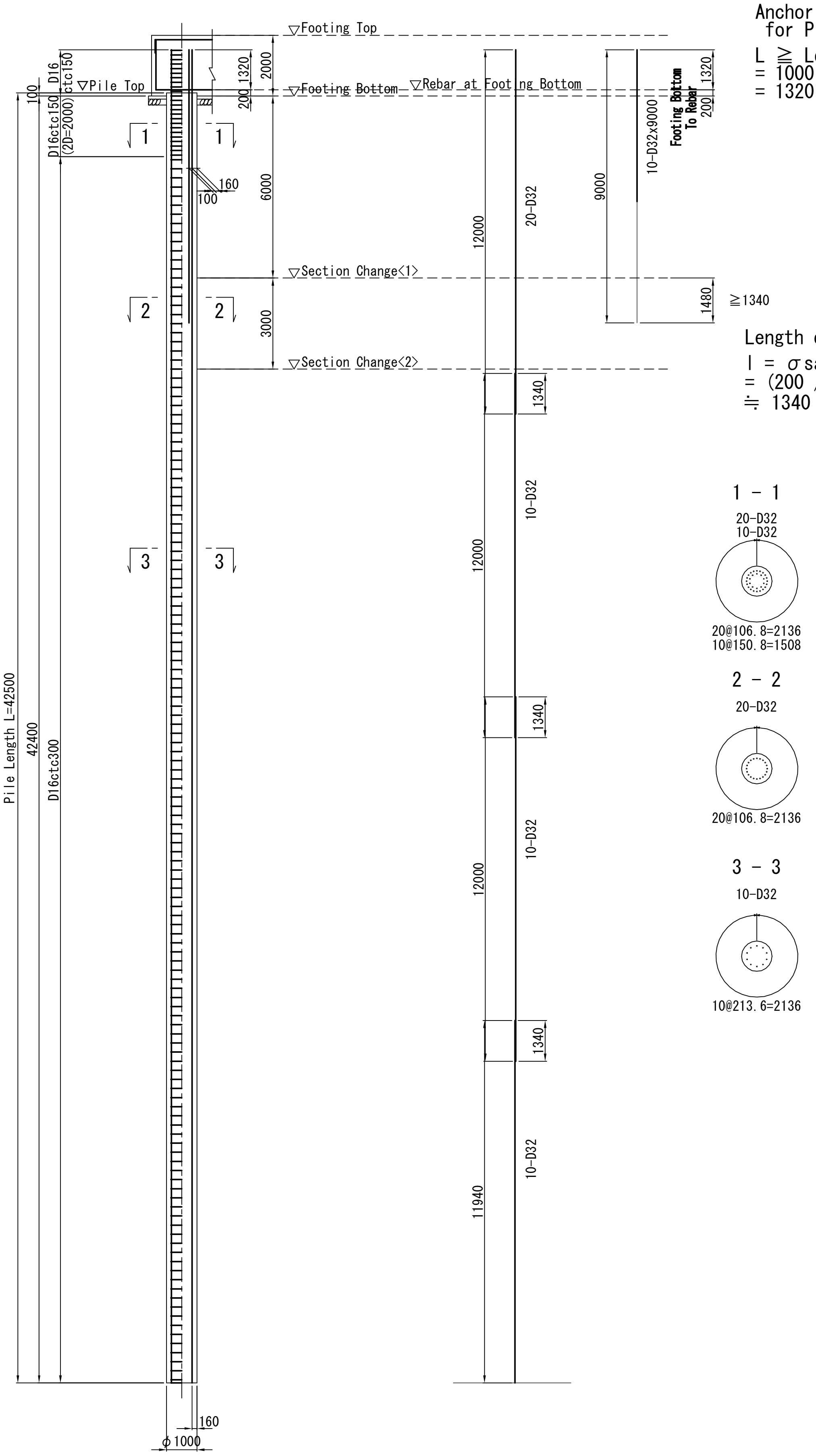
Pile type : Cast in placed RC pile

No.	1				2				3			
Arrangement Plan	 Pile Diameter : ϕ=1.0m Pile Number 2x6=12 Pile Length : 39.0m				 Pile Diameter : ϕ=1.2m Pile Number 2x5=10 Pile Length : 39.0m				 Pile Diameter : ϕ=1.5m Pile Number 2x4=8 Pile Length : 39.0m			
Main Rebar (1st section)	1st low : D29 – 20 (@107mm) 2nd low : D29 – 16 (@118mm)				1st low : D25 – 24 (@118mm)				1st low : D25 – 30 (@126mm)			
External Force	Ordinary Load Case (D + L)		Seismic Load Case		Ordinary Load Case (D + L)		Seismic Load Case		Ordinary Load Case (D + L)		Seismic Load Case	
	Vo (kN)	29657.3	Vo (kN)	26963.3	Vo (kN)	30636.5	Vo (kN)	27942.5	Vo (kN)	32159.7	Vo (kN)	29465.7
	Ho (kN)	0	Ho (kN)	3538.6	Ho (kN)	0	Ho (kN)	3644.4	Ho (kN)	0	Ho (kN)	3809.1
	Mo (kN・m)	0	Mo (kN・m)	20822.1	Mo (kN・m)	0	Mo (kN・m)	20928.0	Mo (kN・m)	0	Mo (kN・m)	21092.6
Stability Check	δ (mm)	0.0 ≦ 15.0	δ (mm)	12.72 ≦ 15.00	δ (mm)	0.0 ≦ 15.0	δ (mm)	12.08 ≦ 15.00	δ (mm)	0.0 ≦ 15.0	δ (mm)	11.45 ≦ 15.00
	Pmax (kN/pile)	2471.4 ≦ 2933.0	Pmax (kN/pile)	3759.6 ≦ 4479.0	Pmax (kN/pile)	3063.7 ≦ 3511.0	Pmax (kN/pile)	4391.5 ≦ 5383.0	Pmax (kN/pile)	4020.0 ≦ 4375.0	Pmax (kN/pile)	5404.4 ≦ 6743.0
	Pmin (kN/pile)	2471.4 ≧ 0.0	Pmin (kN/pile)	734.3 ≧ −3415.0	Pmin (kN/pile)	3063.7 ≧ 0.0	Pmin (kN/pile)	1197.0 ≧ −4206.0	Pmin (kN/pile)	4020.0 ≧ 0.0	Pmin (kN/pile)	1962.0 ≧ −5460.0
Approximate Cost (Pile)	Item	Quantity	Unit Cost (USD)	Amount (USD)	Item	Quantity	Unit Cost	Amount (USD)	Item	Quantity	Unit Cost	Amount (USD)
	Concrete (m3)	367.4	83.4	30,641.2	Concrete (m3)	440.9	83.4	36,771.1	Concrete (m3)	551.1	83.4	45,961.7
	Re-bar (t)	41.6	731.9	30,447.0	Re-bar (t)	29.0	731.9	21,225.1	Re-bar (t)	31.3	731.9	22,908.5
	Works		Assumed as 10% of material cost	6,108.8	Works		Assumed as 10% of material cost	5,799.6	Works		Assumed as 10% of material cost	6,887.0
			Sub-Total	67,197.0			Sub-Total	63,795.8			Sub-Total	75,757.2
Approximate Cost (Footing)	Concrete (m3)	144.0	103.5	14,904.0	Concrete (m3)	172.8	103.5	17,884.8	Concrete (m3)	217.6	103.5	22,521.6
	Re-bar (t)	14.4	731.9	10,539.4	Re-bar (t)	17.3	731.9	12,661.9	Re-bar (t)	21.8	731.9	15,955.4
	Works		Assumed as 10% of material cost	2,544.3	Works		Assumed as 10% of material cost	3,054.7	Works		Assumed as 10% of material cost	3,847.7
			Sub-Total	27,987.7			Sub-Total	33,601.3			Sub-Total	42,324.7
Total Approx.Cost	95,000				97,000				118,000			
Recommendation	✔											

Rebar Arrangement Plan of Pier　　　(Sample)



Reinforcement Arrangement Plan
Cast-in-place RC pile φ1000



Anchor Length for Pile Top

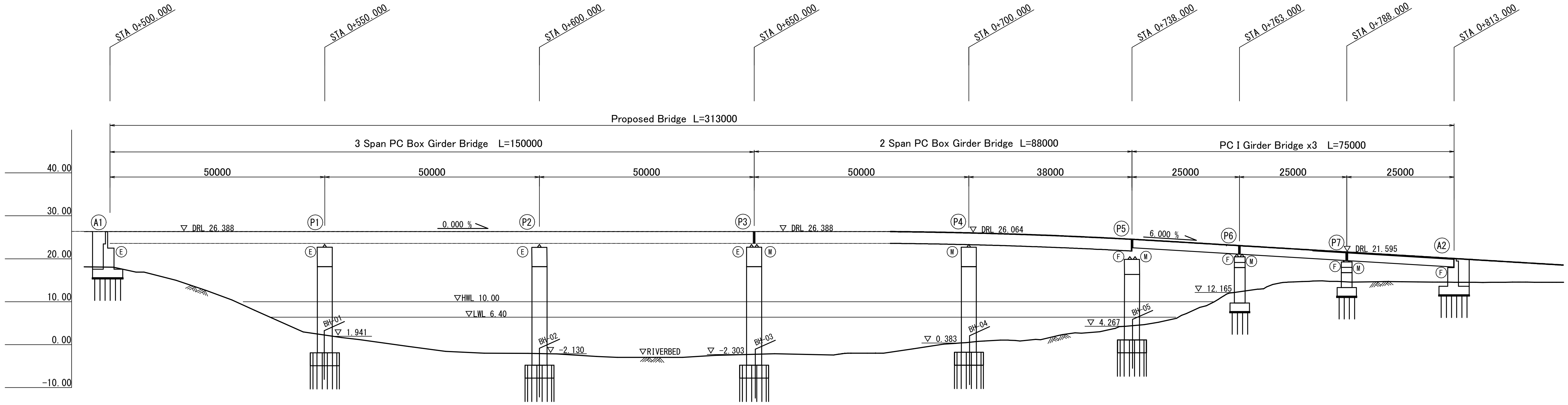
L ≧ Lof +10φ
= 1000 + 320
= 1320

Length of Lap Joints

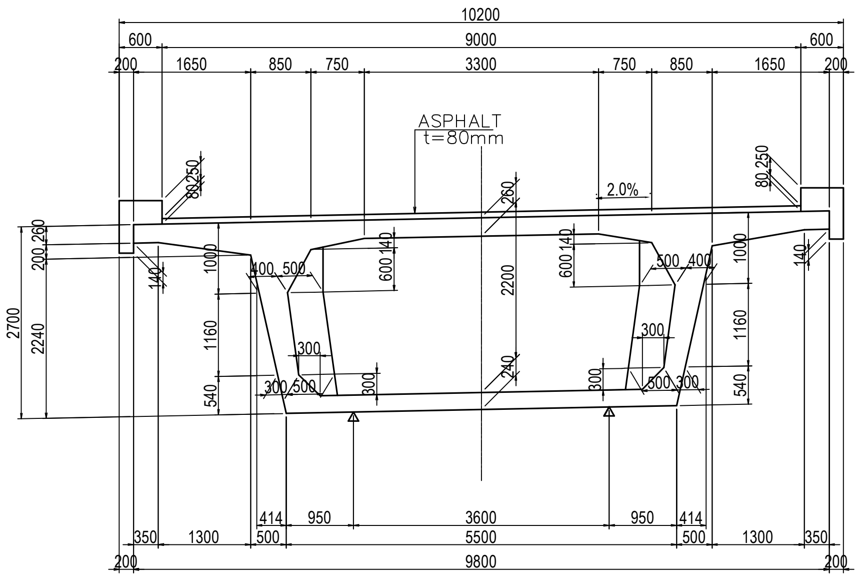
l = σsa / 4τ x φ
= (200 / 4x1.2) x 32
≒ 1340

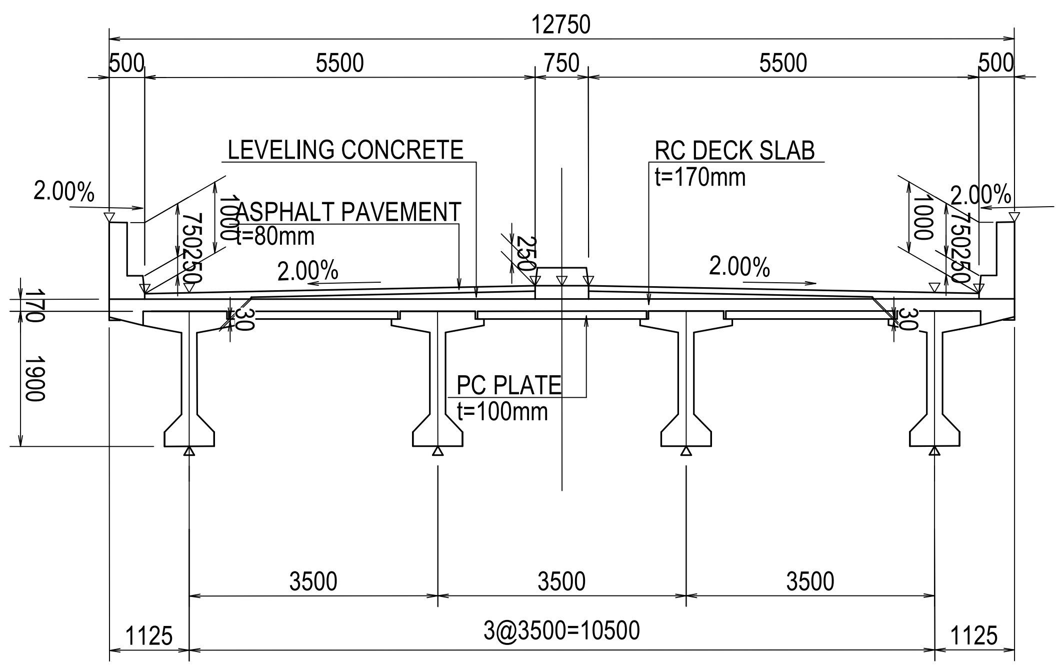
GENERAL VIEW OF THE BRIDGE (2)

SIDE VIEW



CROSS SECTION OF SUPERSTRUCTURES





Notes:	Client	Consultant	Approved		Project:
			Checked		Job:
			Designed		Scale:

Superstructure Reaction Force 2 (For Substructure design)

	P1			P2			P3 (B.P. side)			P3 (E.P. side)		
	V (kN)	H (kN)	M (kN)	V (kN)	H (kN)	M (kN)	V (kN)	H (kN)	M (kN)	V (kN)	H (kN)	M (kN)
Selfweight	13,000.0	0.0	0.0	13,000.0	0.0	0.0	6,600.0	0.0	0.0	6,600.0	0.0	0.0
Superimposed load	6,000.0	0.0	0.0	6,000.0	0.0	0.0	3,000.0	0.0	0.0	3,000.0	0.0	0.0
Dead Load all	19,000.0	0.0	0.0	19,000.0	0.0	0.0	9,600.0	0.0	0.0	9,600.0	0.0	0.0
Live Load (Max)	5,000.0	0.0	0.0	5,000.0	0.0	0.0	3,500.0	0.0	0.0	3,500.0	0.0	0.0
Live Load (Min)	−800.0	0.0	0.0	−800.0	0.0	0.0	−400.0	0.0	0.0	−500.0	0.0	0.0
Dead + Live (Max)	24,000.0	0.0	0.0	24,000.0	0.0	0.0	13,100.0	0.0	0.0	13,100.0	0.0	0.0
Dead + Live (Min)	18,200.0	0.0	0.0	18,200.0	0.0	0.0	9,200.0	0.0	0.0	9,100.0	0.0	0.0
Seismic Effeict (Bridge Axial)	19,000.0	5,700.0	0.0	19,000.0	5,700.0	0.0	9,600.0	2,850.0	0.0	9,600.0	2,700.0	0.0
Seismic Effeict (Transverse)	19,000.0	6,000.0	0.0	19,000.0	6,000.0	0.0	9,600.0	2,550.0	0.0	9,600.0	2,500.0	0.0

	P4			P5 (B.P. side)			P5 (E.P. side)					
	V (kN)	H (kN)	M (kN)	V (kN)	H (kN)	M (kN)	V (kN)	H (kN)	M (kN)			
Selfweight	11,620.0	0.0	0.0	5,020.0	0.0	0.0	4,500.0	0.0	0.0			
Superimposed load	5,280.0	0.0	0.0	2,280.0	0.0	0.0	2,000.0	0.0	0.0			
Dead Load all	16,900.0	0.0	0.0	7,300.0	0.0	0.0	6,500.0	0.0	0.0			
Live Load (Max)	5,000.0	0.0	0.0	3,000.0	0.0	0.0	2,500.0	0.0	0.0			
Live Load (Min)	−700.0	0.0	0.0	−500.0	0.0	0.0	0.0	0.0	0.0			
Dead + Live (Max)	21,900.0	0.0	0.0	10,300.0	0.0	0.0	9,000.0	0.0	0.0			
Dead + Live (Min)	16,200.0	0.0	0.0	6,800.0	0.0	0.0	6,500.0	0.0	0.0			
Seismic Effeict (Bridge Axial)	16,900.0	5,060.0	0.0	7,300.0	2,350.0	0.0	6,500.0	390.0	0.0			
Seismic Effeict (Transverse)	16,900.0	5,300.0	0.0	7,300.0	2,310.0	0.0	6,500.0	1,950.0	0.0			

Superstructure Reaction Force 2 (For design of bearings/beam)

	P1			P2			P3 (B.P. side)			P3 (E.P. side)		
	SL Rz (kN)	SR Rz (kN)	Sum Rz (kN)	SL Rz (kN)	SR Rz (kN)	Sum Rz (kN)	SL Rz (kN)	SR Rz (kN)	Sum Rz (kN)	SL Rz (kN)	SR Rz (kN)	Sum Rz (kN)
Selfweight	6,500.0	6,500.0	13,000.0	6,500.0	6,500.0	13,000.0	3,300.0	3,300.0	6,600.0	3,300.0	3,300.0	6,600.0
Superimposed load	3,000.0	3,000.0	6,000.0	3,000.0	3,000.0	6,000.0	1,500.0	1,500.0	3,000.0	1,500.0	1,500.0	3,000.0
Dead Load all	9,500.0	9,500.0	19,000.0	9,500.0	9,500.0	19,000.0	4,800.0	4,800.0	9,600.0	4,800.0	4,800.0	9,600.0
Live Load (Max)	3,500.0	3,500.0	-	3,500.0	3,500.0	-	2,400.0	2,400.0	-	2,400.0	2,400.0	-
Live Load (Min)	-500.0	-500.0	-	-500.0	-500.0	-	-300.0	-300.0	-	-300.0	-300.0	-
Dead + Live (Max)	13,000.0	13,000.0	-	13,000.0	13,000.0	-	7,200.0	7,200.0	-	7,200.0	7,200.0	-
Dead + Live (Min)	9,000.0	9,000.0	-	9,000.0	9,000.0	-	4,500.0	4,500.0	-	4,500.0	4,500.0	-

	P4			P5 (B.P. side)			P5 (E.P. side)				
	SL Rz (kN)	SR Rz (kN)	Sum Rz (kN)	SL Rz (kN)	SR Rz (kN)	Sum Rz (kN)	SL Rz (kN)	SCL Rz (kN)	SCR Rz (kN)	SR Rz (kN)	Sum Rz (kN)
Selfweight	5,810.0	5,810.0	11,620.0	2,510.0	2,510.0	5,020.0	1,200.0	1,050.0	1,050.0	1,200.0	4,500.0
Superimposed load	2,640.0	2,640.0	5,280.0	1,140.0	1,140.0	2,280.0	550.0	450.0	450.0	550.0	2,000.0
Dead Load all	8,450.0	8,450.0	16,900.0	3,650.0	3,650.0	7,300.0	1,750.0	1,500.0	1,500.0	1,750.0	6,500.0
Live Load (Max)	3,500.0	3,500.0	-	2,000.0	2,000.0	-	850.0	950.0	950.0	850.0	-
Live Load (Min)	-500.0	-500.0	-	-300.0	-300.0	-	600.0	700.0	700.0	600.0	-
Dead + Live (Max)	11,950.0	11,950.0	-	5,650.0	5,650.0	-	2,600.0	2,450.0	2,450.0	2,600.0	-
Dead + Live (Min)	7,950.0	7,950.0	-	3,350.0	3,350.0	-	2,350.0	2,200.0	2,200.0	2,350.0	-

INSTALLATION PROCEDURE OF TEMPORARY SUPPORTS IN SPSP
Sample