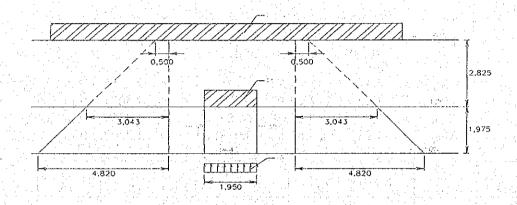
# CHAPTER 6 DRAINAGE SLUICEWAY AND OUTLET WORKS

# 6.1 Drainage Sluiceway at WF.172R+15.0m

### 6.1.1 Standard Box Culvert

### (a) Normal Condition



### Load Diagram for Normal Case

Uniform Load				
Weight of live load			= 1.0	tf/m²
	ddi. Vistai			
Weight of soil	=	2.65 x 1.8	= 4.77	tf/m²
Weight of top slab	=	0.35 x 2.5	= 0.875	tf/m²
			= 6.645	tf/m²
Reaction Subgrade				
Weight of live load		2,30 x 1	= 2.30	tf/m
Weight of soil	=	2.65 x 2.30 x 1.8	= 10.971	tf/m
Weight of top slab	=	0.35 x 2.3 x 2.5	= 2.013	tf/m
Weight of wall	=	2 x (0.35 x 1.6 x 2.5)	= 2.80	tf/m
Weight of other concrete	=	$4 \times \frac{0.15 \times 0.15}{2} \times 2.5$	= 0.113	tf/m
			= 18.197	tf/m
$q_{K} = \frac{18.197}{2.30} = 7.912$	t/m	2		ing se Basis Land

0.001832E

$$\mu_{DC} = \frac{1/2 \times 1 \times 0.4^3 \, E}{1.95} = 0.002735$$
 
$$= 0.002735$$
 
$$\begin{cases} k_{AB} = \frac{0.001832E}{0.001832E + 0.001809E} = 0.5032 \\ k_{AD} = \frac{0.001809E}{0.001832E + 0.001809E} = 0.4968 \end{cases}$$
 
$$\begin{cases} k_{DA} = \frac{0.001809E}{(0.001809E + 0.002735)E} = 0.3981 \\ k_{DC} = \frac{0.002735E}{(0.001809E + 0.002735)E} = 0.6019 \end{cases}$$
 
$$M_{AB} = -M_{BA} = 1/12 \times 6.645 \times 1.95^2 = 2.1056 \, \text{ ff m} \\ M_{DC} = -M_{CD} = 1/12 \times 7.912 \times 1.95^2 = 2.5071 \, \text{ tf m} \\ M_{DA} = M_{CB} = 1.975^2 (2 \times 3.043 + 3 \times 4.82)/60 = 1.3357 \, \text{ tf m} \\ M_{AD} = M_{BC} = 1.975^2 (2 \times 4.82 + 3 \times 3.043)/60 = 1.2202 \, \text{ tf m} \end{cases}$$

Α		F	<b>3</b>	(		I	) sta
AD	AB	BA	BC	СВ	CD	DC	DA
0.4968	0.5032	0.5032	0.4968	0.3981	0.6019	0.6019	0.3981
+1.2202	-2.1056	2.1056	-1.2202	1.3354	-2.5071	+2.5071	-1.3354
+0.4399	+0.4455	+0.2228	+0.2332	+0.4665	+0.7052	+0.3526	+0.2199
-0.3472	-0.3375	-0.6750	-0.6664	-0.3332	-0.5249	-1.0498	-0.6944
+0.3402	+0.3445	+0.1723	+0.1708	+0.3416	+0.5165	+0.2582	+0.1701
-0.0853	-0.0863	-0.1726	-0.1705	-0.0852	-0.1289	-0.2578	-0.1705
+0.0853	+0.0863	+0.0432	+0.0426	+0.0852	+0.1289	+0.0644	+0.0426
-0.0213	-0.0216	-0.0432	-0.0426	-0.0213	-0.0332	-0.0644	-0.0426
+0.0213	+0.0216	+0.0108	+0.0106	+0.0213	+0.0322	+0.0161	+0.0107
-0.0053	0.0054	-0.0108	-0.0106	-0.0053	-0.0081	-0.0161	-0.0107
+0.0053	+0.0054	+0.0027	+0.0027	+0.0053	+0.0081	+0.0040	+0.0027
		-0.0027	-0.0027			+0.0040	-0.0027
1.6531	-1.6531	+1.6531	-1.6531	+1.8103	-1.8103	+1.8103	-1.8103

#### Top Slab AB

$$S_{AB} = \frac{1}{2} \times 1.95 \times 6.645$$
 = 6.479 tf  
 $M_{max} = \frac{1}{8} \times 6.645 \times 1.95^2 - 1.6531$  = 1.5054 tf m

#### **Bottom Slab BC**

#### **Bottom Slab BC**

$$S_{CD} = \frac{1}{2} \times 1.95 \times 7.912 = 7.714 \text{ t}$$
  
 $M_{max} = \frac{1}{8} \times 7.912 \times 1.95^2 - 1.8103 = 1.9504 \text{ tf.m}$ 

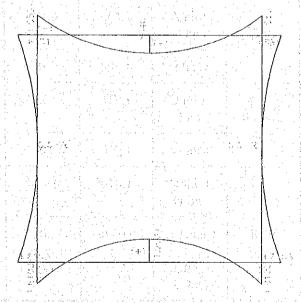
#### Wall AD

$$S_{AD} = \frac{(2 \times 3.043 + 4.82) \times 1.975}{6} - \frac{1.8103 - 1.6531}{1.975} = 3.5103$$

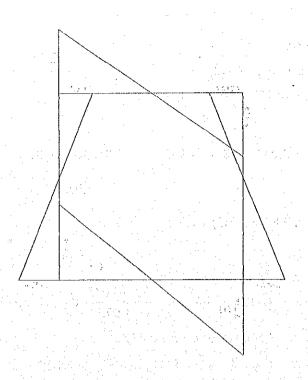
$$S_{BA} = \frac{(2 \times 4.82 + 3.043) \times 1.975}{6} - \frac{1.6531 - 1.8103}{1.975} = 4.2544$$

S = 0 \rightarrow 3.5103 - 3.043 
$$x - \frac{4.82 - 3.043}{2 \times 1.975} x^2 = 0$$
  
3.51031 - 3.043  $x - 0.449 x^2 = 0$   
 $x^2 + 6.764 x - 7.8024 = 0$   
 $x = \frac{-6.764 \pm \sqrt{6.764^2 + 4 \times 7.8024}}{2}$   
 $x = 1.0041 \text{ m}^2$ 

$$M_{\text{max}} = 3.5103 \times 1.0041 - \frac{3.043}{2} \times 1.0041^2 - \frac{4.82 - 3.042}{6 \times 1.975} \times 1.0041^3 - 1.6531$$
$$= +0.0376 \text{ tf.m}$$



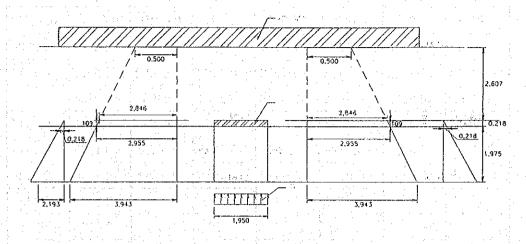
Bending Moment Diagram for Normal Case



Shearing Force Diagram for Normal Case

Loca	ation	Bending Moment (tf.m)	Shearing Force (tf)	Axial load (tf)
Top Slab	Join A and B	1.653	6.476	3.510
	Center	1.504	0	3,510
Bottom	Joint C and D	1.810	7.714	4.254
Slab	Center	1.950	0	4.254
	Joint C and D	1.810	4.254	7.414
Wali	Center B	0.0376	0	6.947
	Joint A and B	1.6531	3.510	6.479

### (b) Flooding Case



Load Diagram for Flooding Case

### Uniform Load

Om	TOTHI LUAG	선명 가는 내용 사람들이 되는 것이 되었다.		
	Weight of live load			tf/m²
	Weight of soil	$= 2.65 \times 1.8$	= 4.77	tf/m²
	Weight of top slab	= 0.35 x 2.5	= 0.875	tf/m²
			= 6.645	tf/m²
Rea	ction Subgrade			
	Weight of live load	= 2.30 x 1	= 2.30	tf/m
	Weight of soil	$= 2.65 \times 2.30 \times 1.8$	= 10.971	tf/m
	Weight of top slab	$= 0.35 \times 2.3 \times 2.5$	= 2.013	tf/m
	Weight of wall	$= 2 \times (0.35 \times 1.6 \times 2.5)$	= 2.80	tf/m
	Weight of other concr	ete = $4 \times \frac{0.15 \times 0.15}{2} \times 2.5$	= 0.113	tf/m
			= 18.197	tf/m
	$q_K = \frac{18.197}{2.30} = 2$	7.612 t/m²		
	$M_{AB} = M_{-BA} =$	$= 1/12 \times 6.645 \times 1.95^2$	= 2.1056 tf	m
	$M_{DC} = -M_{CD} =$	$= 1/12 \times 7.912 \times 1.95^2$	= 2.5071 tf	m
	$M_{DA} = M_{CB} =$	= $1.975^2 \times \{2 \times (2.9553 + 0.213)$		
		+ 3 (3.9428 + 2.193)}/60	= 1.6086	
	$M_{AD} = M_{BC} =$	$= 1.975^2 \times \{2 \times (3.9428 + 2.193)$		
		+ 3 (3.9553 + 0.213)}/60	= 1.4157	

Α		E	3	С		\	)
AD	AB	BA	BC	СВ	CD	DC	DA
0.4968	0.5032	0,5032	0.4968	0,3981	0.6019	0.6019	0.3981
+1.4157	-2.1056	2.1056	-1.4157	+1.6086	-2.5071	0.6019	-1.6086
+0.3428	+0.3472	+0.1736	+0.1788	+0.3577	+0.5408	2.5071	+0.1714
-0,2668	-0.2622	-0.5245	-0.5178	-0.2589	-0.4033	+0.2704	-0.5336
+0.2628	+0.2662	+0.1331	+0.1318	+0.2636	+0.3986	-0.8067	+0.1314
-0.0658	-0.0666	+0.1333	+0.1316	-0.0658	-0.0995	+0.1993	-0.1317
+0.0658	+0.0666	+0.0333	+0.0329	+0.0658	+0.0995	-0.1990	+0.0329
		-0.0333	-0.0329			+0.0497	-0.0329
						-0.0497	
+1.7545	-1.7545	+1.7545	-1.7545	+1.9711	-1.9711	+1.9711	1.9711

#### Top Slab BC

$$S_{AB} = \frac{1}{2} \times 1.95 \times 6.645$$
 = 6.479 tf  
 $M_{max} = \frac{1}{8} \times 6.645 \times 1.95^2 - 1.7545$  = 1.4040 tf.m

#### **Bottom Slab**

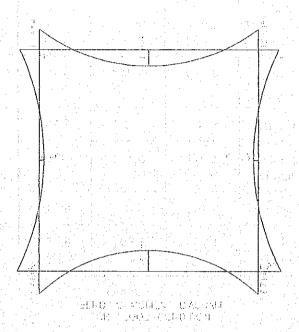
$$M_{CD} = \frac{1}{2} \times 1.95 \times 7.912$$
 = 7.714 t  
 $M_{max} = \frac{1}{8} \times 7.912 \times 1.95^2 - 1.9711$  = 1.7896 tf.m

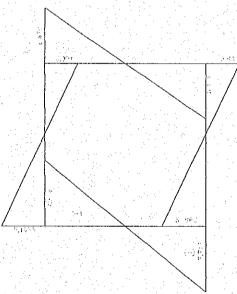
#### Wall

AB = 
$$\frac{2(2.9553 + 0.218) + (3.9428 + 2.193)}{6} \times 1.975$$
  
 $-\frac{(1.9711 - 1.7545)}{1.975} = 3.999$   
BA =  $\frac{2(3.428 + 2.193) + (2.9553 + 0.218)}{6} \times 1.975$   
 $-\frac{(1.7545 - 1.9711)}{1.975} = 5.1936$ 

S = 0 \rightarrow 3.9991 - (2.9553 + 0.218) 
$$x - \{(3.9428 + 2.198)\}$$
  
- (2.9553 + 0.218)  $x^2 = 0$   
 $3.9991 - 3.1733 x - 0.7513 x^2 = 0$   
 $x^2 + 4.2239 x - 5.323 = 0$   
 $x = \frac{-4.2239 \pm \sqrt{4.2239^2 + 4 \times 5.323}}{2}$   
 $x = 1.0159 \text{ m}^2$ 

$$M_{\text{max}} = 3.9991 \times 1.0159 - \frac{(2.9553 + 0.218)}{2} \times x^{2}$$
$$-\frac{(3.9428 + 2.198) - (2.9553 + 0.218)}{6 \times 1.975} \times x^{3} - 1.7545 = 0.4081 \quad \text{tf}$$





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Loc	ation	Bending Moment (tf.m)	Shearing Force (tf)	Axial load (tf)
Top Slab	Join A and B	1.7545	6.479	3.991
	Center	1.404	0	3.991
Bottom	Joint C and D	1.789	7.414	5.194
Slab	Center	0	0	5.194
	Joint C and D	1.971	5.194	7.414
Wall	Center B	0.408	0	6.947
	Joint A and B	1.754	3.991	6.479

Item	Unit	Normal Condition	Flood Condition
Top Slab			
$S_{max}$	kgf	6479	6479
<b>h</b>	cm	26	26
$\tau = \frac{S}{\frac{7}{8} \times 100 \times h}$	kgf/cm²	2.878	2.878
Bottom Slab			
S <sub>max</sub>	kgf	7414	7414
h .	cm	31	31
$\tau = \frac{S}{\frac{1}{8} \times 100 \times h}$	kgf/cm <sup>2</sup>	2.733	2.733
Wall			
S <sub>max</sub>	kgf	4254	5194
h e e e e e e e e e e e e e e e e e e e	cm	26	26
$\tau = \frac{S}{\frac{7}{8} \times 100 \times h}$	kgf/cm²	1.870	2.283
All of $\tau \leq \overline{\tau} = 7.5$	kgf/cm <sup>2</sup>		

Top Slab (Joint A and B)

Top Slab (Joint A and B)			
Description	Unit	Flood Condition	Normal Condition
M*	tfin	1.755	1.653
N es	t	3.991	3.510
ht in a second second	m	0.35	0.35
ala <b>h</b> ala a kala sa	m	0.26	0.26
LK		1.95	1.95
$eo_1 = M/N$	m	0.440	0.471
$eo_2 = 1/30 \text{ ht and } \ge 0.02 \text{ m}$	m	0.020	0.02
$eo = eo_1 + eo_2$	m	0.460	0.491
eo/ht	-	1.314	1.403
$C_2$	-	7	7
$e_1 = C_2 \left(\frac{ek}{100 \text{ ht}}\right)^2 \times \text{ht}$	m	0.008	0.008
$e_2 = 0.5 \text{ x ht}$	m	0.053	0.053
$e = e_0 + e_1 + e_2$	m	0.520	0.551
$ea = eo + \frac{1}{2} ht - d$	m	0.605	0.636
N·ea	tfm	2.414	2.233
$Ca = \frac{h}{\sqrt{n \cdot N \cdot ea}}$	_	5.465	5,683
V b·σa			
δ		0	0
<b>ф</b>	-	3.243	3.395
nw		0.0363	0.0335
οί <b>ζ</b> η το μου μου μου μου μου μου μου μου μου μο	-	0.914	0,924
	-	1.656	1.607
iA = first out to the first of the	cm <sup>2</sup>	6.297	5.807
<b>A</b> 11 - 12 12 - 13 - 14 - 15 - 15 - 15 - 15 - 15 - 15 - 15	cm <sup>2</sup>	3.803	3.613
A	CIII	3.803	3.013

Top Slab (Center)

	<del>,</del>	<del></del>	
Description	Unit	Flood	Normal
2 dou.p.on	Cint.	Condition	Condition
M	tfm	1.404	1.504
of N and all A Same and a state of	t	3.991	3,510
ht	m	0.35	0.35
h h h h h h h h h h h h h h h h	m	0.26	0.26
LK		1.975	1.975
$eo_1 = M/N$	m	0.352	0.428
$eo_2 = 1/30 \text{ ht and } \ge 0.02 \text{ m}$	m	0.02	0.02
$e_0 = e_{0_1} + e_{0_2}$	m	0.372	0.448
eo/ht	-	1.062	1.281
$C_2$	-	7	7
( 1 )2			
$e_1 = C_2 \left(\frac{ek}{1001}\right)^2 \times ht$	m	0.008	0.008
(100 ht)		Specific and the second	
$e_2 = 0.5 \times ht$	m	0.053	0.53
$e = e_0 + e_1 + e_2$	m	0.432	0.509
$ea = eo + \frac{1}{2} ht - d$	m	0.517	0.594
N · ea	tfin	2.064	2.084
Ca = h			
$\int \mathbf{n} \cdot \mathbf{N} \cdot \mathbf{ea}$	_	5.911	5.882
$\sqrt{b \cdot \sigma a}$			
δ	_	0	0
		3.555	3,534
nw	-	0.031	0.0312
	. Fig. ≟ trap	0.927	10.926
		1.873	1.683
iA	cm <sup>2</sup>	5.353	5.408
	cm <sup>2</sup>	2.858	3.214
		<del></del>	

### Bottom Slab Joint C and D

Description	Unit	Flood Condition	Normal Condition
	4.0		
M	tfm	1.971	1.810
N	t	5.194	4.254
ht	m	0.40	0.40
h	m	0.31	0.31
LK		1.95	1.95
$e_{0_1} = M/N$	m	0.379	0.425
$eo_2 = 1/30 \text{ ht and } \ge 0.02 \text{ m}$	m	0,02	0.02
$eo = eo_1 + eo_2$	m	0.399	0.445
eo/ht	- L	0.999	1.114
C <sub>2</sub>	1	6.99	7
( , )2			
$e_1 = C_2 \left( \frac{ek}{e} \right)^2 \times ht$	m	0.007	0.007
(100 ht)		182.4	
$e_2 = 0.5 \text{ x ht}$	m	0.06	0.06
$e = e_0 + e_1 + e_2$	ın	0.466	0.512
$ea = eo + \frac{1}{2}ht - d$	m	0.576	0.622
N · ea	tfm	2.992	2.647
h h			
$Ca = \frac{n}{\sqrt{n \cdot N \cdot ea}}$	-	5.853	6.223
$\sqrt{b \cdot \sigma a}$			
διαδιαδία	_	0	0
•	_	3.514	3.776
nw	-	0.0312	0.028
A Commence of the Commence of	-	0.926	0.930
	-	1.993	1.864
iA.	cm <sup>2</sup>	6.514	5.736
	cm <sup>2</sup>	3.268	3.078

### Bottom Slab (Center)

		Flood	Normal
Description	Unit	Condition	Condition
M	tfm	1.790	1.950
No. 1997 September 1997	t	5.194	4.251
ht	m	0.40	0.40
i <b>h</b>	m	0.31	0.31
LK		1.95	1.95
$eo_1 = M/N$	m	0.345	0.459
$eo_2 = 1/30 \text{ ht and } \ge 0.02 \text{ m}$	m	0.02	0.02
$eo = eo_1 + eo_2$	m	0.365	0.479
eo/ht	- 1 1 - 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	0.912	1.197
$C_2$	•	6.99	7
( ek \2			
$e_1 = C_2 \left(\frac{ek}{100 \text{ ht}}\right)^2 \times \text{ht}$	m	0.007	0.007
$e_2 = 0.5 \text{ x ht}$	m	0.06	0.06
$e = e_0 + e_1 + e_2$	m	0.431	0.545
$ea = eo + \frac{1}{2}ht - d$	m	0.541	0.655
N·ea	tfin	2.811	2.786
$Ca = \frac{h}{}$			
$n \cdot N \cdot ea$	-	6.038	6.066
√ b·σa			
δ	- A	0	0
$\phi$	-	3.644	3.663
nw		0.0295	0.0293
	-	0.928	0.929
	<b>-</b>	2.135	1.783
tA in the second second	cm <sup>2</sup>	6.106	6.049
A. Landing to the state of the	cm <sup>2</sup>	2.860	3.392

Wall (Joint D and C)

		<u> </u>	
Description	Unit	Flood Condition	Normal Condition
M	tfin	1.971	1.810
N N N N N N N N N N N N N N N N N N N	t	7.414	7.414
ht	m	0.35	0.35
<b>h</b>	m	0.26	0.26
LK is a second of the second of		1.975	1.975
$eo_1 = M/N$	m	0.266	0.266
$eo_2 = 1/30 \text{ ht and } \ge 0.02 \text{ m}$	m	0.02	0.02
$eo = eo_1 + eo_2$	m	0.286	0.286
eo/ht	•	0.817	0.817
$\mathbb{C}_2$		6.98	6.98
( ok )2	10.00		
$e_1 = C_2 \left(\frac{ek}{100 \text{ ht}}\right)^2 \times \text{ht}$	m	0.008	0.008
$e_2 = 0.5 \text{ x ht}$	m	0.053	0.053
$e = e_0 + e_1 + e_2$	m	0.346	0.346
$ea = eo + \frac{1}{2}ht - d$	m	0.431	0.431
N·ea	tfm	3.196	3.196
$Ca = \frac{h}{}$			
$n \cdot N \cdot ea$	_	4.750	4.327
√ b·σa			
$\delta$ . The second secon	<u>-</u>	0	0
ø		2.744	2.744
nw	_	0.0487	0.0487
	-	0.939	0.919
	•	2.280	3.280
iA.	cm <sup>2</sup>	8.435	8.435
	cm <sup>2</sup>	3.301	3.301

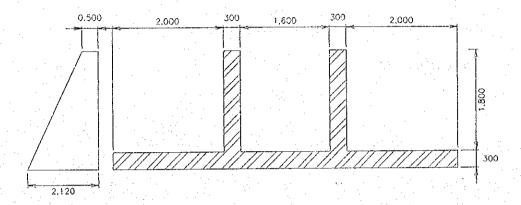
### Wall (Joint A and B)

		Flood	Normal
Description	Unit	Condition	Condition
y <b>M</b> who is a second	tfm	1,755	1.653
N	t	6.479	6.479
ht	m	0.35	0.35
h	m	0.26	0.26
LK		1.975	1.975
$eo_1 = M/N$	m	0.275	0.255
$eo_2 = 1/30 \text{ ht and } \ge 0.02 \text{ m}$	m	0.02	0.02
$e_0 = e_{0_1} + e_{0_2}$	m	0.291	0.275
eo/ht	<b>-</b>	0.831	0.786
$C_2$	-	6.98	6.96
( at 12			
$e_1 = C_2 \left(\frac{e_k}{100 h}\right)^2 \times ht$	m	0.008	0.008
(100 ht)			2 2 2 2
$e_2 = 0.5 \text{ x ht}$	m	0.053	0.053
$e = e_0 + e_1 + e_2$	m	0.351	0.0335
$ea = eo + \frac{1}{2}ht - d$	m	0.436	0.420
N·ea	tfin	2.826	2.724
$Ca = \frac{h}{a}$			
$\frac{Ca}{\ln \cdot N \cdot ea}$	-	5.051	5.145
$\sqrt{b \cdot \sigma a}$			
δ	-	0	0
$\phi$	-	2.954	3.098
nwasin arang palabaga ang pa	_ :	0.0428	0.0412
100 <b>C</b> 100 C 100	1 57 <b>-</b> 125	0.916	0.917
		2.202	2.231
iA en la	cm <sup>2</sup>	7.418	7.139
$\mathbf{A}$	cm <sup>2</sup>	3.369	3.090

# Wall (Center)

	Unit	Flood	Normal
Description	Unit	Condition	Condition
M	tfin	0.408	0.0376
N	t	6.947	6.947
ht	m	0.35	0.35
h	m	0.29	0.29
LK		1.975	1.975
$eo_1 = M/N$	m	0.0059	0.0054
$eo_2 = 1/30 \text{ ht and } \ge 0.02 \text{ m}$	m	0.02	0.02
$e_0 = e_{0_1} + e_{0_2}$	m	0.079	0.0254
eo/ht	<b>.</b>	0.225	0.073
$C_2$	•	6.66	5.86
		a di diga di Au	
$e_1 = C_2 \left(\frac{ek}{100 \text{ ht}}\right)^2 \times \text{ht}$	m :	0.007	0.007
		0000	0.050
$e_2 = 0.5 \text{ x ht}$	m	0.053	0.053
$e = e_0 + e_1 + e_2$	m	0.0139	0.084
$ea = eo + \frac{1}{2}ht - d$	m	0.254	0.199
N · ea	tfin	1.762	1.386
$Ca = \frac{h}{\sqrt{1 - \frac{h}{2}}}$		5.5 (4) 5 (4)	
$\frac{\sqrt{n \cdot N \cdot ea}}{\sqrt{n \cdot N \cdot ea}}$	_	7.135	8.046
$\sqrt{\frac{b \cdot \sigma a}{b}}$			
δ	_	. 0	0
of the state of th		4.413	5.053
nw data data data da	•	0.021	0.0163
ζ	-	0.938	0.945
unitipa Nerra Nerra area establicar		-13.719	-2.674
iA	cm <sup>2</sup>	4.046	3.160
$oldsymbol{A}$ which is a second constant $oldsymbol{A}$	cm <sup>2</sup>	-0.295	-1.182

### 6.1.2 Wing Wall



Wall

$$P = \frac{0.5 + 2.12}{2} \times 1.80 = 2.358 \text{ tf}$$

$$Z = \frac{2 \times 0.5 + 2.12}{3(0.5 + 2.12)} \times 1.80 = 0.715 \text{ m}$$

$$M = 2.358 \times 0.715 = 1.686 \text{ tfm}$$

Check Shear Stress

$$C = \frac{2358}{\frac{7}{8} \times 100 \times 21} = 1.283 \text{ kgf/m} < \overline{\tau} = 7.5 \text{ kgf/m}$$

$$Z = 1.686 \text{ tf}$$

$$Ca = \frac{21}{\sqrt{\frac{15 \times 168600}{100 \times 1600}}} = 5.282$$

$$Ca = 5.282 \qquad \phi = 3.065$$

$$\delta = 0 \qquad \text{nw} = 0.04013$$

$$\text{nw} = \frac{0.0403}{15} \times 100 \times 21 = 5.642$$

$$\text{Used D16 a 250} \rightarrow A = 8.042 \text{ cm}^2$$

Slab A - B

$$M = 2.358 \times (0.715 + 0.15) = 2.040$$

Ca = 
$$\frac{21}{\sqrt{\frac{15 \times 204000}{100 \times 1600}}}$$
 = 4.802

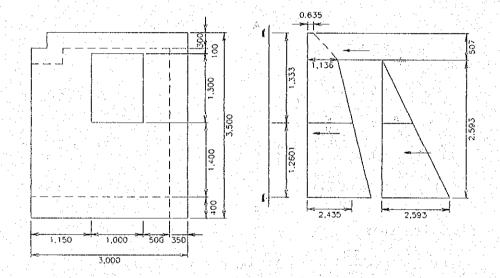
Ca = 
$$4.802$$
  $\phi = 0.774$   $\rho_{\text{NW}} = 0.04777$ 

$$A = \frac{0.04777}{15} \times 100 \times 21 = 6.6878 \text{ cm}^2$$

Used D16 a 250

### 6.1.3 Connecting Box

### Wall Type I



$$- P_1 = \frac{0.635 + 1.136}{2} \times 0.557 = 0.493$$

$$Z_1 = \frac{2 \times 0.635 + 1.136}{3(0.635 + 1.136)} \times 0.557 + 2.593 = 2.845$$

$$P_2 = \frac{1.136 + 2.435}{2} \times 2.593 = 4.633 \text{ tf}$$

$$Z_2 = \frac{2 \times 1.136 + 2.436}{3(1.136 + 2.435)} \times 2.593 = 1.140 \text{ m}$$

$$- P_3 = \frac{1}{2} \times 2.395^2 = 2.868 \text{ tf}$$

$$Z_3 = 1/3 \times 2.395 = 0.798 \text{ m}$$

$$R_A = \frac{(0.493 \times 2.845) + (4.633 \times 1.140) + (2.868 \times 0.798)}{3.15} = 2.849$$
 $R_B = 0.493 + 4.633 + 2.868 - 2.849 = 5.145$ 

$$S = 0 \rightarrow 5.145 - (2.435 + 2.93) \times \frac{1.136 - (2.435 + 2.593)}{2 \times 2.593} x^{2}$$

$$5.145 - 5.028 x + 0.7505 x^{2} = 0$$

$$x^{2} - 6.700 x + 6.8555 = 0$$

$$x = \frac{6700 \pm \sqrt{6.700^{2} - 4 \times 6.8555}}{2}$$

$$x = 1.2601 \text{ m}$$

$$x_{1} + x_{2} = \frac{1.2601 \times 1.136 + 1.333 \times (2.435 + 2.593)}{2.593} = 3.1366$$

$$Z = \frac{2 \times (2.435 + 2.593) + 3.1366}{3(2.435 + 2.593) + 3.1366} \times 1.2601 = 0.6787$$

$$M_{\text{max}} = 5.145 \times 1.2601 - 5.145 \times 0.6787 = 2.991 \text{ tfin}$$

$$M = 2.991 \text{ tfm}$$

$$b = 50 \text{ cm}$$

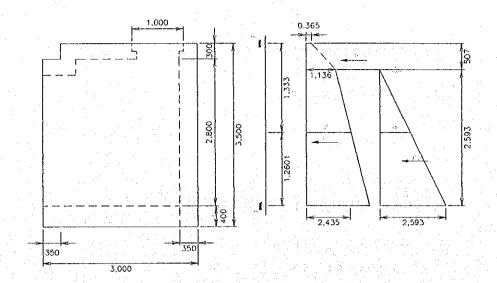
$$h = 26 \text{ cm}$$

Ca = 
$$\frac{26}{\sqrt{\frac{15 \times 299100}{50 \times 1600}}}$$
 = 3.472

$$A = \frac{0.0942}{15} \times 50 \times 26 = 8.164 \text{ cm}^2$$

Used D16 a 125  $\rightarrow A = 16.085 \text{ cm}^2$ 

#### Wall Type 2



$$- P_1 = \frac{0.635 + 1.136}{2} \times 0.557 = 0.493 \text{ tf}$$

$$Z_1 = \frac{2 \times 0.635 + 1.136}{3(0.635 + 1.136)} \times 0.557 + 2.593 = 2.845 \text{ m}$$

$$- P_2 = \frac{1.136 + 2.435}{2} \times 2.593 = 4.633 \text{ tf}$$

$$Z_2 = \frac{2 \times 1.136 + 2.436}{3(1.136 + 2.435)} \times 2.593 = 1.140 \text{ m}$$

$$P_3 = \frac{1}{2} \times 2.395^2 = 2.868 \text{ tf}$$
 $Z_3 = \frac{1}{3} \times 2.395 = 0.798 \text{ m}$ 

$$R_A = \frac{(0.493 \times 2.845) + (4.633 \times 1.140) + (2.868 \times 0.798)}{3.15} = 2.849$$
 $R_B = 0.493 + 4.633 + 2.868 - 2.849 = 5.145$ 

$$S = 0 \rightarrow 5.145 - (2.435 + 2.593) \times \frac{1.136 - (2.435 + 2.593)}{2 \times 2.593} x^{2}$$

$$5.145 - 5.028 x + 0.7505 x^{2} = 0$$

$$x^{2}-6.700 x+6.8555 = 0$$

$$x = \frac{6700 \pm \sqrt{6.700^{2} + 4 \times 6.8555}}{2}$$

$$x = 1.2601 \text{ m}$$

$$x_{1} + x_{2} = \frac{1.2601 \times 1.136 + 1.333 \times (2.435 + 2.593)}{2.593} = 3.1366$$

$$Z = \frac{2 \times (2.435 + 2.593) + 3.1366}{3(2.435 + 2.593) + 3.1366} \times 1.2601 = 0.6787$$

$$M_{\text{max}} = 5.145 \times 1.2601 - 5.145 \times 0.6787 = 2.991 \text{ tfm}$$

$$M = 2.991 \text{ tfm}$$

$$Assume b = 0.55 \text{ cm}$$

$$h = 26 \text{ cm}$$

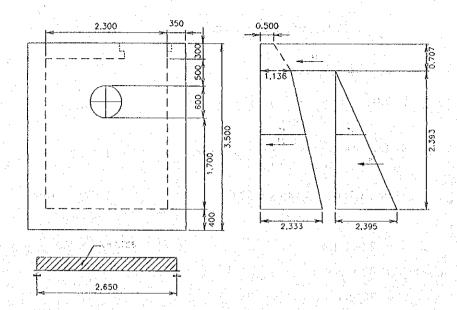
$$Ca = \frac{26}{\sqrt{\frac{15 \times 299100}{55 \times 1600}}} = 3.641$$

$$\delta = 0$$

$$0.08501 \text{ nw} = 0.08501$$

$$A = \frac{0.08501}{15} \times 100 \times 26 = 14.328 \text{ cm}^{2}$$

### Wall Type 3



$$q = 2.333 + 2.395 = 4.728 \text{ tf/m}^{2}$$

$$M = \frac{1}{8} \times 4.728 \times 2.65^{2} = 4.150 \text{ tfm}$$

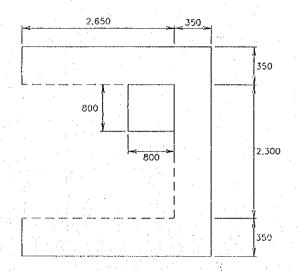
$$Ca = \frac{26}{\sqrt{\frac{15 \times 415000}{55 \times 1600}}} = 4.168$$

$$\delta = 0 \qquad \qquad \phi = 2.311$$

$$\delta = 0 \qquad \qquad \text{nw} = 0.06533$$

$$A = \frac{0.0653}{15} \times 100 \times 26 \qquad \qquad = 11.326 \text{ cm}^{2}$$

### Top Slab



Live load

Weight of slab = 
$$0.3 \times 2.5$$

$$= 0.30 t/m2$$

$$= 0.75 t/m2$$

$$= 1.05 t/m2$$

$$M = \frac{1}{8} \times 1.05 \times 2.65^{2}$$

Assume 
$$b = 60$$
 cm

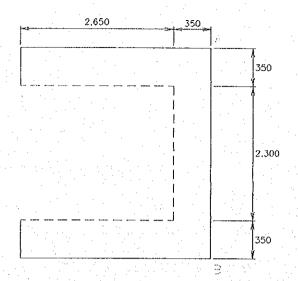
Ca = 
$$\frac{21}{\sqrt{\frac{15 \times 921700}{60 \times 1600}}}$$
 = 5.534

Ca = 5.534 
$$\delta$$
 = 0  $\delta$  = 3.292  $\delta$   $\delta$  = 0.03574

$$A = \frac{0.03574}{15} \times 100 \times 21$$

$$= 5.004 \text{ cm}^2$$

#### **Bottom Slab**



Weight of wall A B
 = 
$$0.35 \times 2.8 \times 3 \times 2.5$$
 =  $7.35$ 
 tf

 Total Weight
 =  $3 \times (3 \times 0.35 \times 2.8) \times 2.5$ 
 =  $22.05$ 
 tf/m

 - Weight of Slab
 =  $0.3 \times 3 \times 3 \times 2.5$ 
 =  $6.75$ 
 tf/m

 - Live load
 =  $3 \times 3 \times 0.3$ 
 =  $2.70$ 
 tf/m

= 31.50

tt/m

$$e = \frac{7.35 \times 1.325}{31.50} = 0.309$$

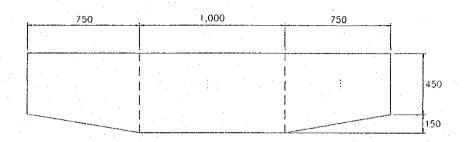
$$q_{\text{max}} = \frac{31.50}{3 \times 3} \left(1 + \frac{6 \times 0.3091}{3}\right) = 5.6637$$

$$M = \frac{1}{8} \times 5.664 \times 2.65^2 = 4.972$$

$$Ca = \frac{31}{\sqrt{\frac{15 \times 497200}{100 \times 1600}}} = 4.5406$$

$$A = \frac{0.04538}{15} \times 100 \times 31 = 9.3785 \text{ cm}^2$$

#### 6.1.4 Control Deck



Weight of concrete I = 
$$2 \times 0.75 \times (0.45 + 0.60)/2 \times 2.5 = 1.969$$
 tf/m

Weight of concrete II =  $1 \times 0.6 \times 2.5$  =  $1.500$  tf/m

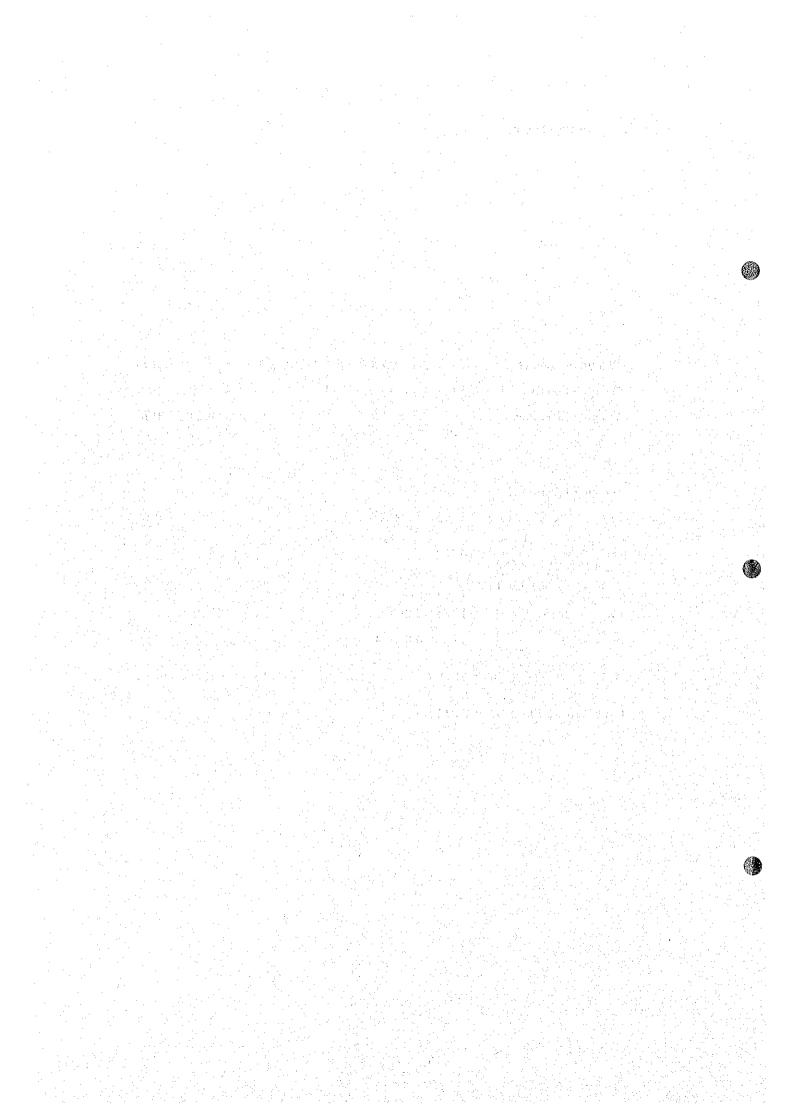
Weight of live load =  $0.3 \times 2.5$  =  $0.750$  tf/m =  $0.750$  tf/m

Weight of gate = 2 t

$$M = \frac{1}{8} \times 4.219 \times 2.2^{2} \times \frac{1}{4} \times 2 \times 2.2 = 3.652 \text{ tf m}$$

$$Ca = \frac{45}{\sqrt{\frac{15 \times 3.652}{60 \times 1800}}} = 8.157$$

$$A = \frac{0.0123}{15} \times 100 \times 51 = 4.182 \text{ cm}^2$$



### CHAPTER 7 RAISING OF RAILWAY BRIDGE

# 7.1 DESIGN CONCEPT

### 1 INTRODUCTION

We have the honor to submit Design of Railway Bridge Sub-structure Which are arranged based on the data of soil investigation and topographic survey and also The Memorandum of meeting for Design of Railway Bridge Raising on The West Flood Way in Semarang, dated October 2, 1998 in The Jrantunseluna Office and Perumka data's.

This report is consist of 4 bridges and track design:

J.	BH 10, Km. 01+577				
	BH 5, Km. 00+816				
	BH 6, Km. 00+177				
	BH 13, Km. 02+331				
	and track work between	en Km. 0+677 to	Km. 02+521	, Cirebon - S	emarang Line

Design of the bridges have considered many aspect such as financial, construction, maintenance aspect, local condition and also are based on The Perumka's Regulation and memorandum of meeting.

### 2 COMPREHENSION OF SITE CONDITION

#### A. General

We have carried out the site survey and acquainted deeply with the site condition and comprehends such principal matters for design as geographical or geological feature, existing track alignments, condition of existing bridge and circumference thereby. We have also acquainted with the data and informations which the client (PCI) possesses regarding the project.

The data and informations that have been received from the client is mentioned in the appendix A hereinafter.

Beside that, we have also discussed with Perumka's staff and have presented the data and information which related with this project.

The data that we have obtained from Perumka are as follows:

- Super-structure drawings.
- Longitudinal section of track on this bridge
- Sub-structure data.
- etc.

#### **B.** Description Situation of Project

#### 1. General

Location of Railway Bridge (BH 10 Km 1 + 577) are laid on the rather flat land in Semarang City arround the dense population and housing complex and also the location is near by The Java Sea (about 6.5 Km from this Bridge). Accesibility is very easy because the location of bridge is between two roads with flexible pavement (Madukoro street at Cirebon side and Kokrosono street at Semarang side). Train's frequency on this segment (between Cirebon - Semarang) are very high due to this Bridge is laid on the two Railway trunk lines: Jakarta - Surabaya Line through Semarang (The North Line) and Jakarta - Surabaya, high and the maximum speed is 100 km/hour.

#### 2. Present situation

a). Topographical condition

Landscape

Circumstance around bridge

: Flat area

: - Urban area/housing complex

- Bridge is laid between two roads

b). Geotechnical condition

Formation

: - Topsoil + embankment material

- Alluvial clays with locally some more sandy

and sillty pitches

c). Characteristic of river

1). Name

2) Characteristic of river

3) Type of river cross section4) Width of river bottom

5) Slope of river bank

6) Sedimentation

7) Scouring

8) Scouring protection

9) River bed material

10)Other information

Garang River

Relative straight; permanent river flow

: Trapeze

: 40.00 m

Relative regular

: Available

: to be accured around pier at Semarang Side

: Not available

: Mud sedimentation, sand and silty clay

Flood problems

d). Existing track

1). Track alignment

Horizontal alignment

Vertical alignment

: Straight

: Horizontal on bridge

2). Rail

a. Type

: R 42

b. Condition

: Good

3). Fastenings

: Rigid / elastic fastenings

#### 4). Sleepers

a. Type

: - Wooden sleeper on bridge

- Concrete sleeper on tracks

b. Condition

: Good (on track) : Fair (on bridge)

5). Ballast and subgrade

: Ballast and subgrade structure have been

rehabilited.

Beside of the track, ballast to be supported by

concrete panel that was retained by H-steel

piles.

#### e) Bridge

#### 1). Superstructure

span 1	span 2	span 3	
Steel	Steel	Steel	
Truss	Truss	Truss	
31.00 m	31.00 m	31.00 m	
31.20 m	31,20 m	31.20 m	
32.40 m	32.40 m	32.40 m	
1.67 m	1.67 m	1.67 m	
4.60 m	4.60 m	4.60 m	
0.30 m	0.30 m	0.30 m	
Steel	Steel	Steel	
- The erection of replacing of super structure are still carried out by the Contractor.  - There are many coconut/palm tree piles are constructed around this bridge for temporary structure of superstructure.			
	Steel Truss 31.00 m 31.20 m 32.40 m 1.67 m 4.60 m 0.30 m Steel The erection structure a Contractor There are no piles are cobridge for the contractor of the	Steel Steel Truss Truss 31.00 m 31.00 m 31.20 m 31.20 m 32.40 m 32.40 m 1.67 m 1.67 m 4.60 m 4.60 m 0.30 m 0.30 m Steel Steel The erection of replacing structure are still carried Contractor. There are many coconut/piles are constructed aro bridge for temporary stru	

#### 2). Substructure

DESCRIPTION	Abutment	Pier	Pier	Abutment
	1		Semarang Side	Semarang Side
a. Material	stone masonry	stone masonry	stone masonry	stone masonry
b. Type	gravity	gravity	gravity	gravity
c. Condition		3-41-43		
1). Visual Condition	good	good	good	good
2). Crack onstructure	nothing	nothing	nothing	nothing
3). Displacement	nothing	nothing	nothing	nothing
d. Foundation *)	concrete	concrete	concrete	concrete
	*). Reference	s data of Perum	nka	

#### 3. PROBLEMS

- a). With regard to The Planned Works concerning The West Floodway / Garang River Improvement and Urban Drainage System Improvement, now under study by JICA Study Team, the existing watted area of Garang River to be normalized and improved due to the Design of River Improvement, the railway Bridge that was through this river shall be increase by 0.70 m therefore the freeboard will become 1.00 m.
- b) JICA Team, PERUMKA and PROJECT have been discussed and aggreed about The Planned of Design of Railway Bridge Raising (BH 10) on this location. The result of meeting that is mentioned in the memorandum of meeting for design of railway bridge raising on the west flood way in Semarang that was performed in Jrantunseluna Office on dated October 2, 1998. (see appendix B)

The principle scope of Design of Railway Bridge (BH 10 Km 1+577) are as follows:

- 1) Increasing the existing superstructure up to 0.70 m
- 2). Design of substructures
- 3). Design Improvement of existing track around this bridge
- 4). Design Improvement of existing road or level crossing beside this bridge
- 5) Design of other related structure due to the increasing level of bridge up to 0.70 m

#### 4. PRELIMINARY DESIGN PROPOSAL

#### a. Basic consideration

The basic consideration on the choosing of preliminary design proposal are as follows:

- 1). Financial Aspect
- 2). Construction Aspect
- 3). Maintenance Aspect
- 4). Topographical and Geological local condition
- 5). Based on the Memorandum of Meeting between Project's Staff, JICA Team and Perumka's Staff. (see appendix B)

#### b. Preliminary Design

#### 1). Superstructure

- a). Existing superstructure shall be reutilized. (no design of superstructure)
- b). Bottom soffit of truss girder shall be up to 0.70 m (elevation + 4.07 m), therefore the free board is 1.00 m above the highest water level.

#### 2). Substructures

#### a) Material

Type of Material

: Reinforced concrete

Quality

K-225

Rebar

BJTD-40

Foundation

: Concrete Prestressed Pile K-500

#### b). Type of substructures

#### - Abutment

In this case, we propose 3 (three) alternatives Design of Abutments are as follows:

- Alternative 1 : Concrete Beam above the pile caps to support the super-structure.
- 2. Alternative 2 Abutment on Concrete Slab for Supporting the super-structure.
- 3. Alternative 3: Ditto with alt.2, but the location of abutments are moved to Cirebon Side about 5.00 meter

#### - Pier

In this case, we propose 2 (two) alternatives Design of Pier, are as follows:

- 1. Alternative 1: Pier on Concrete Slab for support the super-structure.
- 2. Alternative 2: Ditto with alternative 1, the difference on the type dimension of concrete slab and formation of piles only.

The combination of substructure that will be proposed for this bridge is mentioned in table 1.

Table 1. Alternatives of Bridge Sub-structures Proposal

No.	Alternative		Type of Sub-	Structure	
		Abutment	Pier	Pier	Abutment
		Cirebon	Cirebon	Semarang	Semarang
1. 2.	A B	alt.1. alt.2.	alt. 1. alt. 1.	alt. 1. alt. 1.	alt. 1. alt. 2.
3.	С	alt.3.	alt. 1.	alt. 1.	alt. 3.
4.	D	alt.1.	alt. 2.	alt. 2.	alt. 1.
5.	E	alt.2.	alt. 2.	alt. 2.	alt. 2.
6.	F	alt.3.	ait, 2.	alt. 2.	alt. 3.
7.	G	alt.3	alt.1	alt. 1	alt.3

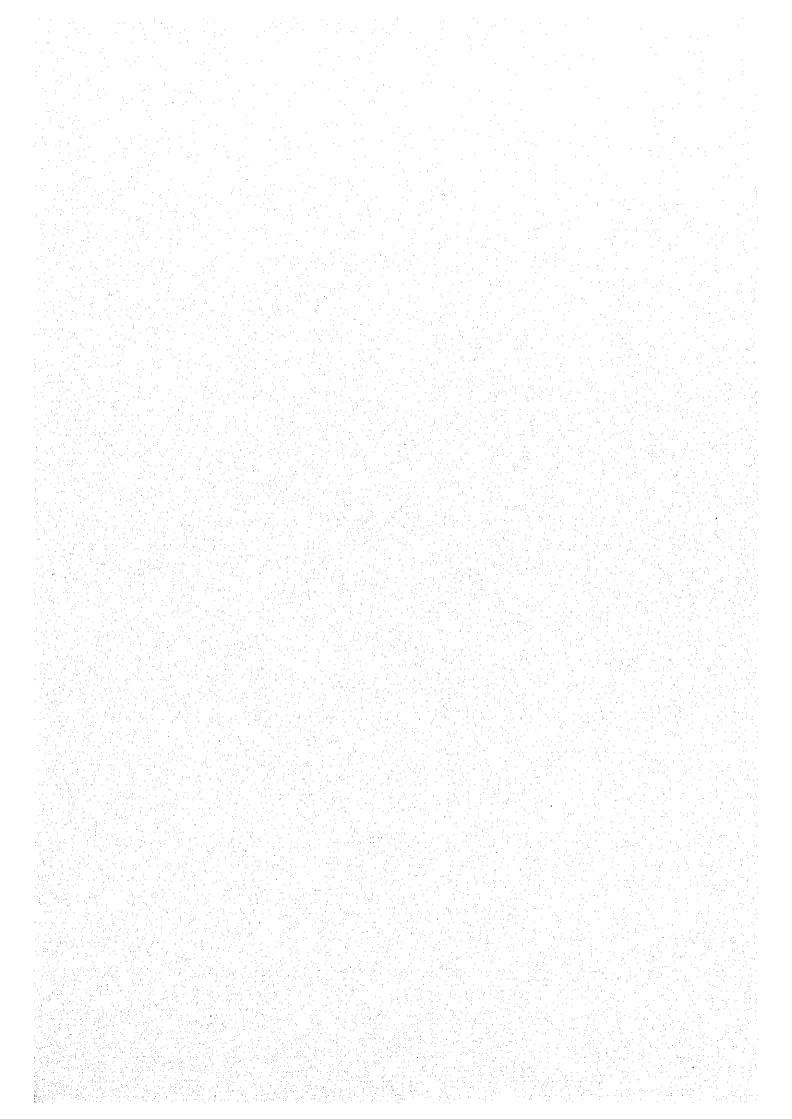
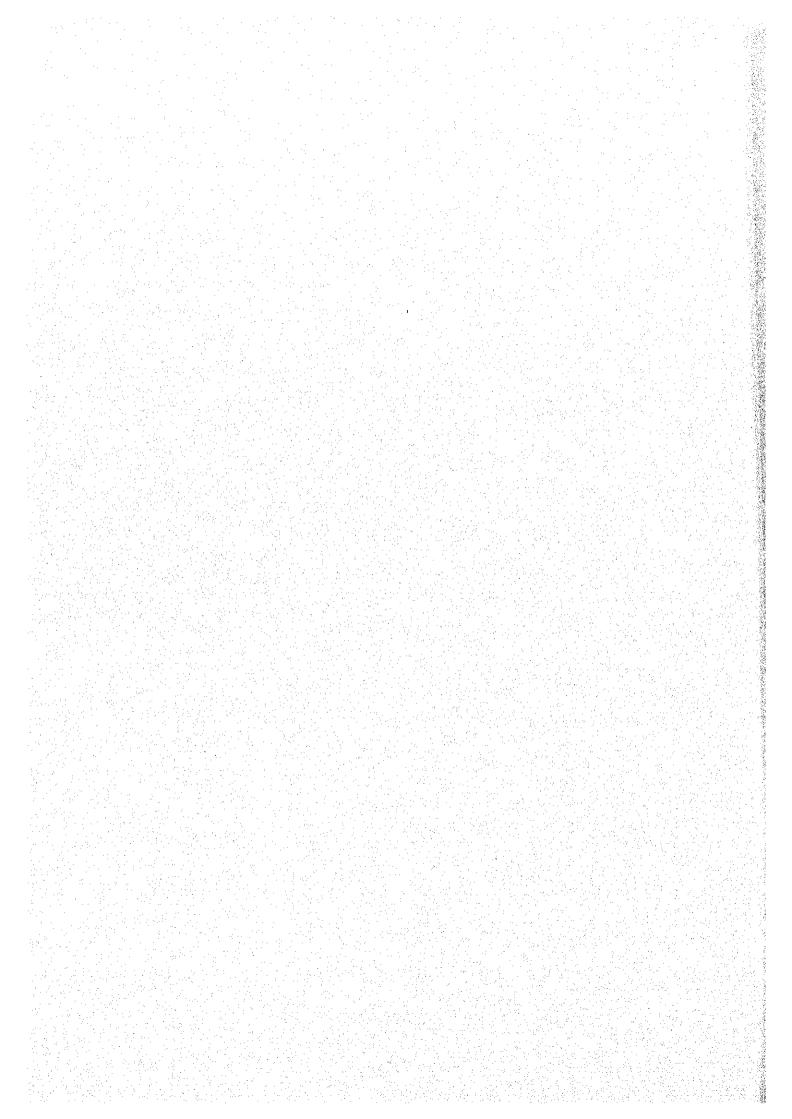


table 2. The Advantage and Disavantage of Alternative.

٥.	items.	Alternative A.	Alternative B.	Alternative C.	Alternative D.	Alternative E.	Alternative F.	Alternative G.
	Super-structure (to be reutil	lzed )			The state of the s			
	a. Type	Through Truss Girder Type 446 / JIS A	Through Truss Girder	Through Truss Girder	Through Truss Girder	Through Truss Girder	Through Truss Girder	Through Truss Girder
.	b. C.T.C. of Shoes	31.20 m	Type 446 / JIS A 31.20 m	Type 446 / JIS A 31.20 m	Type 446 / JIS A 31.20 m	Type 446 / JIS A	Type 446 / JIS A	Type 446 / JIS A
١	c. C.T.C. of Girders	4.60 m	4.60 m	4.60 m	4.60 m	31.20 m 4.60 m	31.20 m	31.20 m
	d. Construction Depth	1.67 m	1.67 m	1.67 m	1.67 m	1.67 m	4.60 m 1.67 m	4.60 m 1.67 m
	Sub-structure							
	a. Material - Type of Material	Reinforced concrete.						
j	- Quality.	K- 225	Reinforced concrete. K - 225	Reinforced concrete, K - 225	Reinforced concrete.	Reinforced concrete.	Reinforced concrete.	Reinforced concrete.
1	- Rebar.	BJTD - 40	BJTD - 40	BJTD - 40	K - 225 BJTD - 40	K - 225 BJTD - 40	K - 225 BJTD - 40	K - 225 BJTD - 40
١	- Foundation Concrete prestress pile	K - 500	K - 500	K - 500	K - 500	K - 500	K - 500	
						K-000	<b>₹-500</b>	K - 500
	b. Type of Sub-structure							
	- Abutment	- Concrete Beam above piles	- Abutment on concrete slab for	ditta tidik abanasan o				
		cap to support the super-structure ( alternative 1 )	supporting the super-structure, ( alternative 2 )	- ditto, with alternative 2; but the position of new abutment to be moved to Cirebon side about 3.45 m ( alternative 3 )	- Concrete Beam above piles cap to support the super-structure ( alternative 1 )	Abutment on concrete slab for supporting the super-structure.  ( alternative 2 )	<ul> <li>ditto, with alternative 2; but the position of new abutment to be moved to Cirebon Side about</li> </ul>	<ul> <li>ditto, with alternative 2; but the position of new abutment to the moved to Cirebon side about</li> </ul>
١		- Existing abutment to be used	- Top part of existing abutment	- Top part of existing abutment	- Existing abutment to be used	- Top part of existing abutment	3.45 m ( alternative 3 )	5.00 m ( alternative 3 )
		as retaining wall and the top part of abutment will be impro-	to be demolished up to 10 cm	to be demolished up to 10 cm	as retaining wall and the top	to be demolished up to 10 cm	<ul> <li>Top part of existing abutment to be demolished up to 10 cm</li> </ul>	
		ved for ballast.	below the concrete slab.	below the concrete slab.	part of abutment will be impro- ved for ballast.	below the concrete slab.	below the concrete slab.	
		- Foundation: Concrete Prestress Pile	- Foundation : Concrete Prestress Pile	- Foundation : Concrete Prestress Pile	- Foundatio: Concrete Prestress Pile	- Foundation : Concrete Prestress Pile	- Foundation: Concrete Prestress Pile	- Foundation : Concrete Prestres
	- Pler	- Pier on Concrete Slab for sup -	- Pier on Concrete Slab for sup-	- Pier on Concrete Slab for sup -	- Pier on Concrete Slab for sup-	- Pier on Concrete Slab for sup-	- Pier on Concrete Slab for sup-	- Pier on Concrete Slab for si
		porting the super-structure. ( alternative 1 )	porting the super-structure.  ( alternative 1 )	porting the super-structure. ( alternative 1 )	porting the super-structure.  ( alternative 2 )	porting the super-structure. ( alternative 2 )	porting the super-structure. ( alternative 2 )	porting the super-structure. ( alternative 1 )
		- Foundation: Concrete Prestress Pile	- Foundation : Concrete Prestress Pile	- Foundation : Concrete Prestress Pile	- Foundatio: Concrete Prestress Pile	- Foundation : Concrete Prestress	- Foundation : Concrete Prestress Pile	- Foundation : Concrete Prestre
.	Financial.	92 %	95 %	89.5 %	93 %	100 %	91 %	71 %
	Advantage and Disavantage.						•	1 7 7 1 7 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
•	a. Advantage.	- Construction Cost is cheeper	- Shape of piers are better than	C.				
		- Shape of piers are better than	alternative D E and F.	Shape of piers are better than alternative D E and F.			- Not neccessary to demolish	- Shape of piers are better the
		alternative D, E and F.	- Scouring arround piers are less	- Scouring arround plers are			the existing abutment Cirebon side	alternative D E and F Scouring arround piers are
. }		- Scouring arround piers are	than alternative D, E and F.	less than alternative D, E & F.			side	less than alternative D.E.&
. 1		less than alternative D, E & F.		- Not neccessary to demolish			[集资 医动物性 医乳腺性炎	- Not neccessary to demolish
				the existing abutment Cirebon				the existing sub structure
			하는 말이 되었습니다. 1987년 1일 : 1987년 1일 : 1	side.				Temporary support cost is ver     cheap
	b. Disadvantage.	- Top part of existing abutment	- Construction Cost is higher	- Construction Cost is higher	- Construction Cost is higher	- Construction Cost is higher	- Construction Cost is higher	- Construction Cost is high
		to be improved.	than alternative A.	than alternative A, B, D and E.	than alternative A.	than alternative A, B, C & D	than alternative A,B,C,D&E	than alternative A B
1		<ul> <li>In the construction stage of new abutments aren't disturbed</li> </ul>	- In the construction stage of new abutments are disturbed the	- Watted Area are become small	- Top part of existing abutment	- In the construction stage of new	- Watted Area are become small	- Watted Area are become sr
		the existing road	existing road	- Scouring will be occurred around	to be improved.	abutments are disturbed the	- Scouring will be occured around	- Width of flexible pavement
-				abutment Semarang side Width or flexible pavement at	- The shape of pile caps are not smooth	existing road	abutment Semarang side.	will become small at Cirebon
				Cirebon Side will become	Scouring Problems will be	The shape of pile caps are not smooth	Width of flexible pavement will become small on Cirebon side	<ul> <li>In the construction stage of abutment on Cirebon side is</li> </ul>
				small	occured around both of piers	- Scouring Problems will be	- In the construction stage of new	disturbed the existing road
			[조선들의 중요와 원임회	- In the construction stage of new	- In the construction stage of	occured around both of piers	abutment on Cirebon side is	- Shall be request agreement fr
				abutment on Cirebon side is	new abument aren't disturbed the	[문화학자 미토화 회사 지역 기	disturbed the existing road	Government (Pemda or PU)
				disturbed the existing road	existing rod		- The shape of pile caps are	
							not smooth - Scouring Problems will be	
. 1				· · · · · · · · · · · · · · · · · · ·	<ul> <li>The second of the second of the</li></ul>		- SCOUDED PRODUCTAG WILL DO	<ul> <li>In the control of the c</li></ul>
				<ul><li>原門等別的支持。如果者等以外</li></ul>			occured around both of piers	



### 7.2 DESIGN CONDITION

#### 1.1. DESIGN CONDITION

#### 1.1. EXISTING SUPERSTRUCTURE

	span 1	span 2	span 3	
- Type	Truss	Truss	Truss	
- Total Weight	67,00	67.00	67.00	ton-f
- Effective Span (c.t.c.)	31.20	31.20	31.20	m
- Total Length of Stringer or truss girder	32.16	32.16	32.16	m
- Center to center of Main Girder	4.60	4.60	4.60	m
- Construction Depth	1.33	1.33	1.33	m
- Distance between top of rail up to top of				
concrete bearing	1.65	1.65	1.65	m :
- Distance between top of rall up to HVVL	2.33	2.33	2,33	m

#### 1.2. TRACK CONDITION

- Track Plan

- Track Elevation

: straight

: horizontal on Bridge.

#### 1.3. REGULATION REFERENCE.

- Specification of Perumka Railway Bridge Design (AVBP 1932).
- PD 10
- Indonesian Concrete Code (PBI 1971)
- Elastic Analysis of Reinforced Concrete Section (Departement PU)

#### 1.4. MATERIAL QUALITY

- Concrete K 225
- Plain / Lean Concrete K 125
- Reinforced Steel Bar U-39 (deform steel)

#### 1.5. LOADINGS

- Train Load

- impact

- Longitudinal Load due to Long Rails

- Brake Load

- Lateral Load

- Wind Load

- Earth Pressure

- Stream Flow

- Seismic Load

: based on 100 % Load Scheme 1921.

: { 0.2 + 26 /(L + 60) } x train Load

1.00 tf/m' (per one track) , but max. 200 tf.

: 1/6 Locomotive + 1/10 Wagon

: 1/10 Train Load

0.10 tf/m2.

: based on Coulomb's Theory

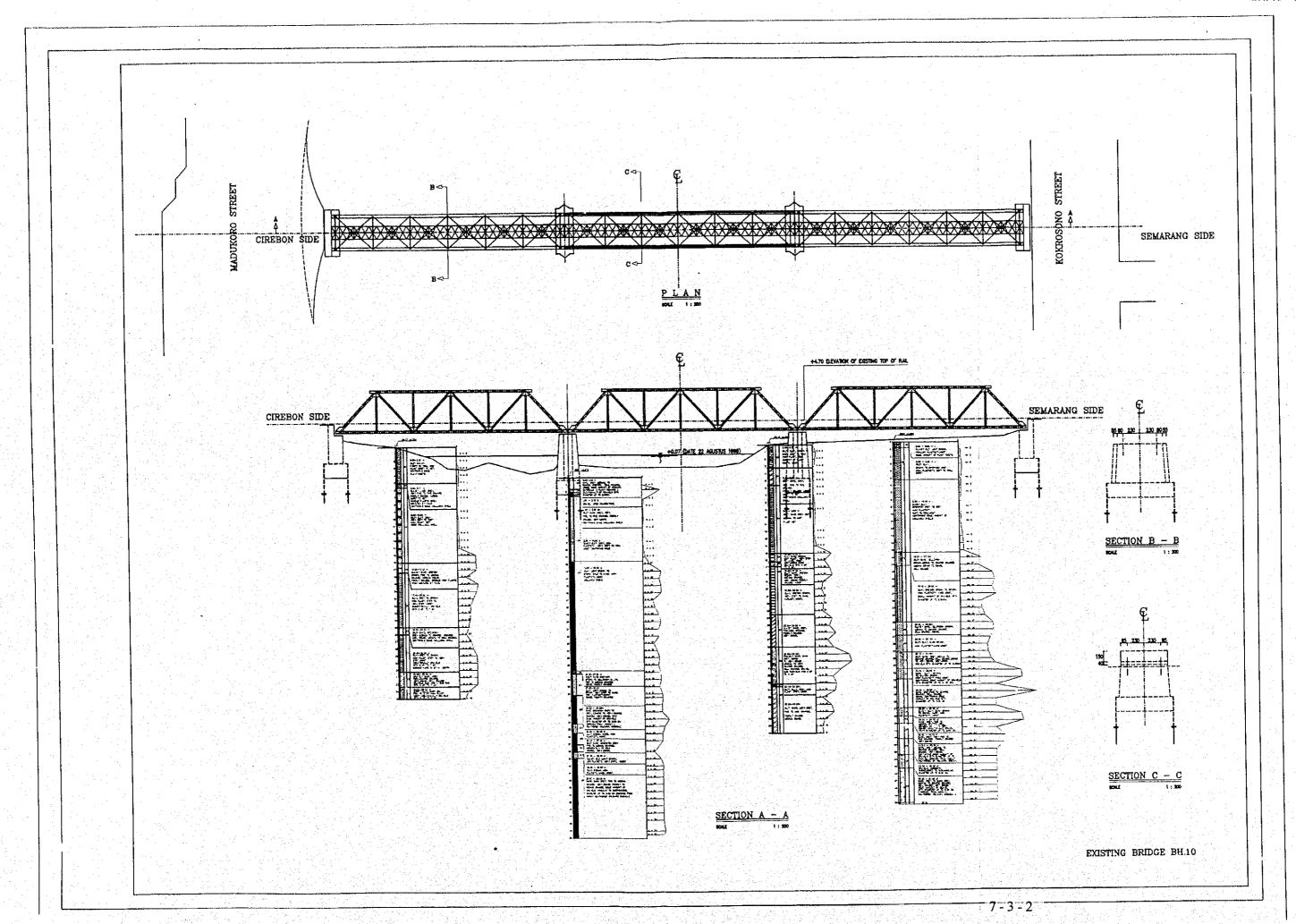
; based on the velocity of stream on HWL Condition

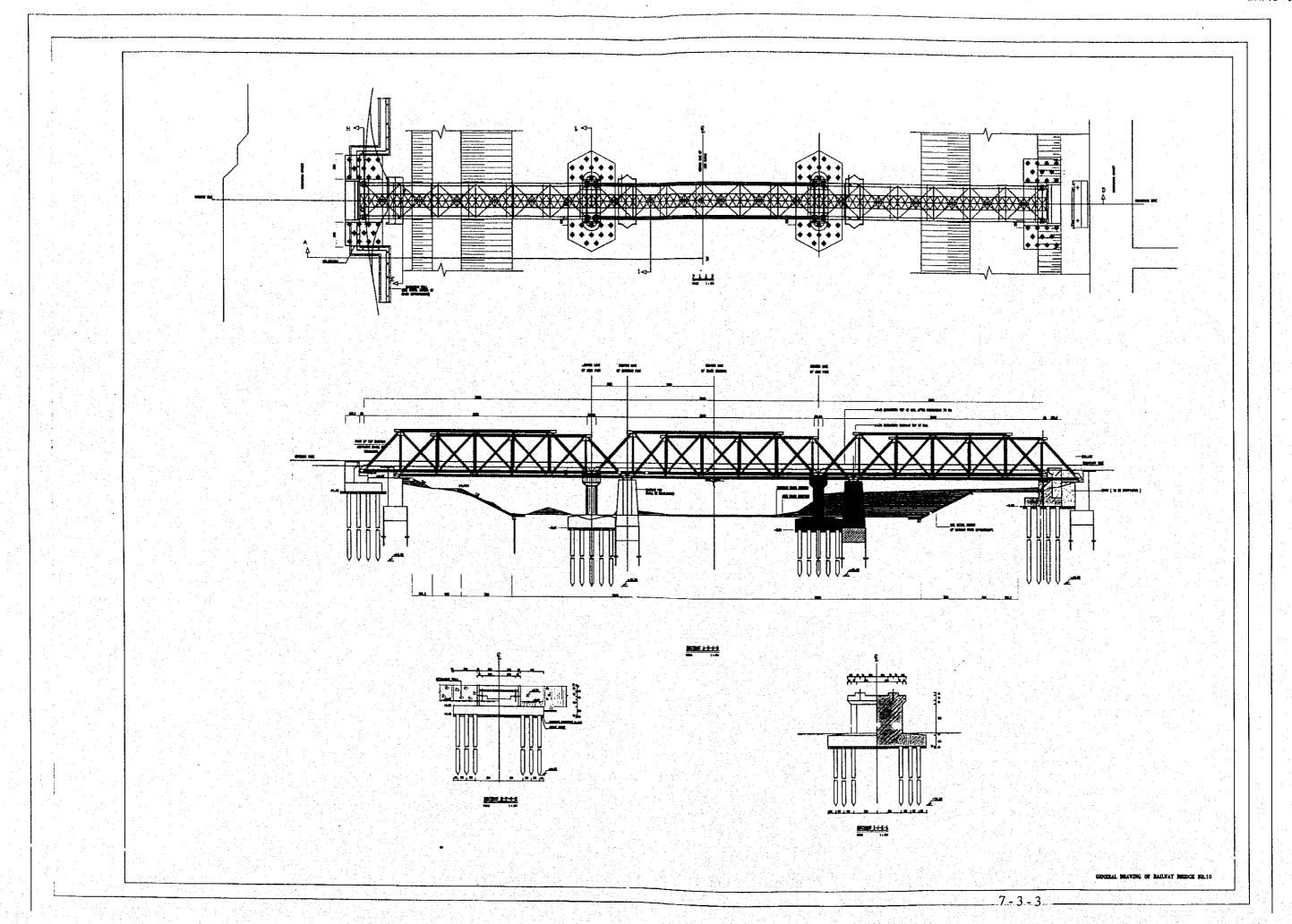
: based on the equivalent static force and design seismic intensity expressed as followings :

KH = 0.18

KV = 0.00

# 7.3 DESIGN DRAWING





en e	
	60% 60% 1138
그런 하는 한번 하는 사람들 학교 이 사람들은 사람들이 보고 있는 그릇을 다 살아 있다. 그런 경기를	
그렇게 많은 얼마 하나 되었다. 그리고 모르는 이 바라 보고 있는데 그리고 그리고 하다고 있는데 다른 사람들이다.	
그림에 하고 있는 오늘 잘 보았네요. 아이의 그를 살아보는 이번 그리는 어림은 아이를 받았다.	
그렇게 하고 살을 내고 있어? 어머니 아들이 하는 이는 보는 그는 이는 어때 아니라도 되어 먹었다.	
그를 잘했다. 전문에 보는 사람들은 그 에트를 보면한 때 하면 목 이번 등에 하는 것 하는 것 같다.	
그렇지만하다 이 그리는 사고를 하다고 되었어요? 그런 그리는 그리고 그리고 있는데 그리고 하고 있는데 없다.	
그러면 없는데 물통하다 이 동안 되면서 가장 살아왔다고 있다는 말이라는 말을 하셨다. 모양을 다 나갔던	
그림 그들은 경험에 모임하는 말리를 보고 하는 것은 것은 그들은 느낌을 되는 것이 되고 있다고 한다.	
그러나 살통하는 이렇게 했다면 하고 사람들이라고 하지 않는데 하고 하는데 하는데 다른데 다른데 다른데 다른데 다른데 다른데 다른데 다른데 다른데 다른	
는 마음을 가게 하는 자연 가능한 가는 이 것을 가는 사고를 가는 사고 있는 것이다. 그는 것이다. 그는 것이다. 그는 것이다는 것이 말하는 것이 말한 것이다. - 사회의 교육 사용 기업 등 전문이다. 그는 것이 되는 것이다. 그 것은 것이다. 그는 것이 되는 것이다. 그는 것이다. 그는 것이다. 그는 것이다.	
그 회 주의 전 보인 하다 마음이 있다. 요하다 그리고 생님 그리고 하는 것 하는 것이 하는 것이 모든데 하고 있다.	
- 함께 있는데, 그림은 사람들은 바로에 하는 그 그들은 것이다. 그리고 말을 만들는 때 없고 하고만 함께 되었다.	
그림도 사용들이 아니라 보고 있다면 하는데 하면 하면 하는데	
- 사이트 사용하는 경우 사용 경우 사용 사용 사용 사용이 가능하는 사용 경우 사용 경우 사용 사용 기업을 되었다. - 사용 사용 사용 기업을 가능하는 것을 하는 것	
그렇게 한 대통령에 화장 이 모임 아버지는 아버지의 아버지는 전환 경기 이 화를 가져왔는데 하는데 되었다.	
그냥 문화가 되었다는 얼마나 보는 아이들이 살아가 되었다. 그 아이들은 그리고 말을 보고 있다는 것이라는 것이라고 있다.	
그는 10 원내의 그림, 집에 가게 되는 것은 하는 것들을 모르는 것이 되는 것이 되었다.	
그렇게 한 소스트를 끊겨울 하는데 하는데 하는데 하는데 된 아니다. 그 아내는 생각 그림이	
그렇는데요 그는 이번에 하는 그리는 전 얼마들도 얼굴이 한 사내는 것이다. 이 너무 하지 않는데요?	
그렇게 되었으면 그렇게 되었으면 그 그런 생님이 그렇게 되는 것 같아. 그렇게 되었다면 하다 나를 다 나왔다.	
그는 마음을 전하는 하셨다. 하지만 하는 모양이라는 말을 하는 다음이다. 그는 사람들은 말을 하는 것이다.	
그 있다는 불문이 경찰되었다. 이 경험 그림으로 그렇게 하다 살아가 되었다. 그림을 모르는	
그리다는 보면 살아 된 이번째 보다 보다면 얼마를 하고 있다면 하고 되었다면 한 점점 점점을 된다.	
그 없는 어느 문화 그렇게 되어 그림 남을 하고 말을 통과하다면 하고 못하는 사람은 사람들이 함께	
그렇게 그렇게 되었는 것도 없다면 그 그래요 아들들만 그런데 통계하고 하고 있다고 있는 동안이 모든 것을 모든	
그 도로 마음을 이 하셨다. 상태가 하는 말았습니다. 하는 그는 그는 그는 그는 그는 사람들이 모습을 하는 것이다.	
그 전에 보고 하늘이는 내려오고 하면 되었다. 그는 그는 말을 하는 것이 모으면 먹고 있다.	
그렇게 그는 그리지 않아 그 그러들이 그릇 비교 아버트의 그리고 있다면 하는데 이글 목록했다면 없다.	
그렇게 하다 하는데, 얼마를 되는데 말을 하는데	
그 프로그 보는 사람이 그 그림을 가는 말이 그는 물을 하면, 맛있다는 말이를 달리다는 그림에 함께 함께 흔들었다.	
그들이 한 경험된다면 하는 그리다고 있어요? 그리고 불고통되었다고 생각하다.	
그 보았다면 한 생각 생각 보고 보는 다른 사람들의 학회 경험으로서 가고 있는데 한 번째 모양을 되었다.	
그는 병원 보고 있다면 하는 물건으로 하고 있다. 사람들은 그는 사람들은 사람들은 사람들은 그들은 사람들이 되었다.	
그들은 이 등을 내려 있을 한 내가 나는 하는 것이 중요 하는데, 그들만 하는데 모를 사용하는데 하다.	
그는 집 이 동네 시간 동요 집으로 있었다. 나는 살은 사람이 얼마를 모르는 바람이 얼마 되었다.	
그리고 있으면 있다. 이용이 어떤 어린 일반 일반 경험 가는 사람들은 사람들은 사람이 되었다.	
그 마음 등 하는 사람들은 속 보다는 살이 있다. 그는 사람들은 하는 사람들은 사람들이 함께 살아 없었다.	
그들이 되어 그림을 나타지 않는데, 눈이 잘 살아 되어 하고 있는 눈과 나를 만했다고 말을 보여 하지 않다.	
	(A)