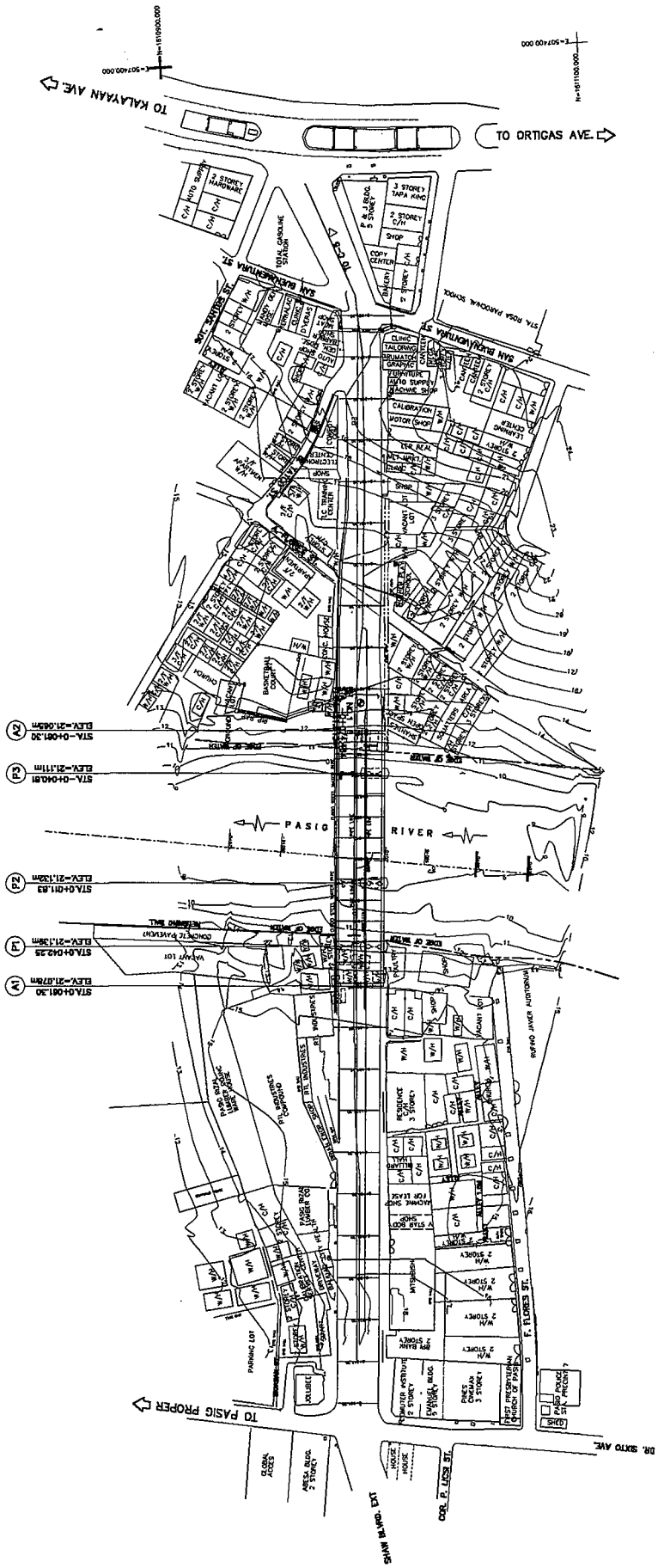
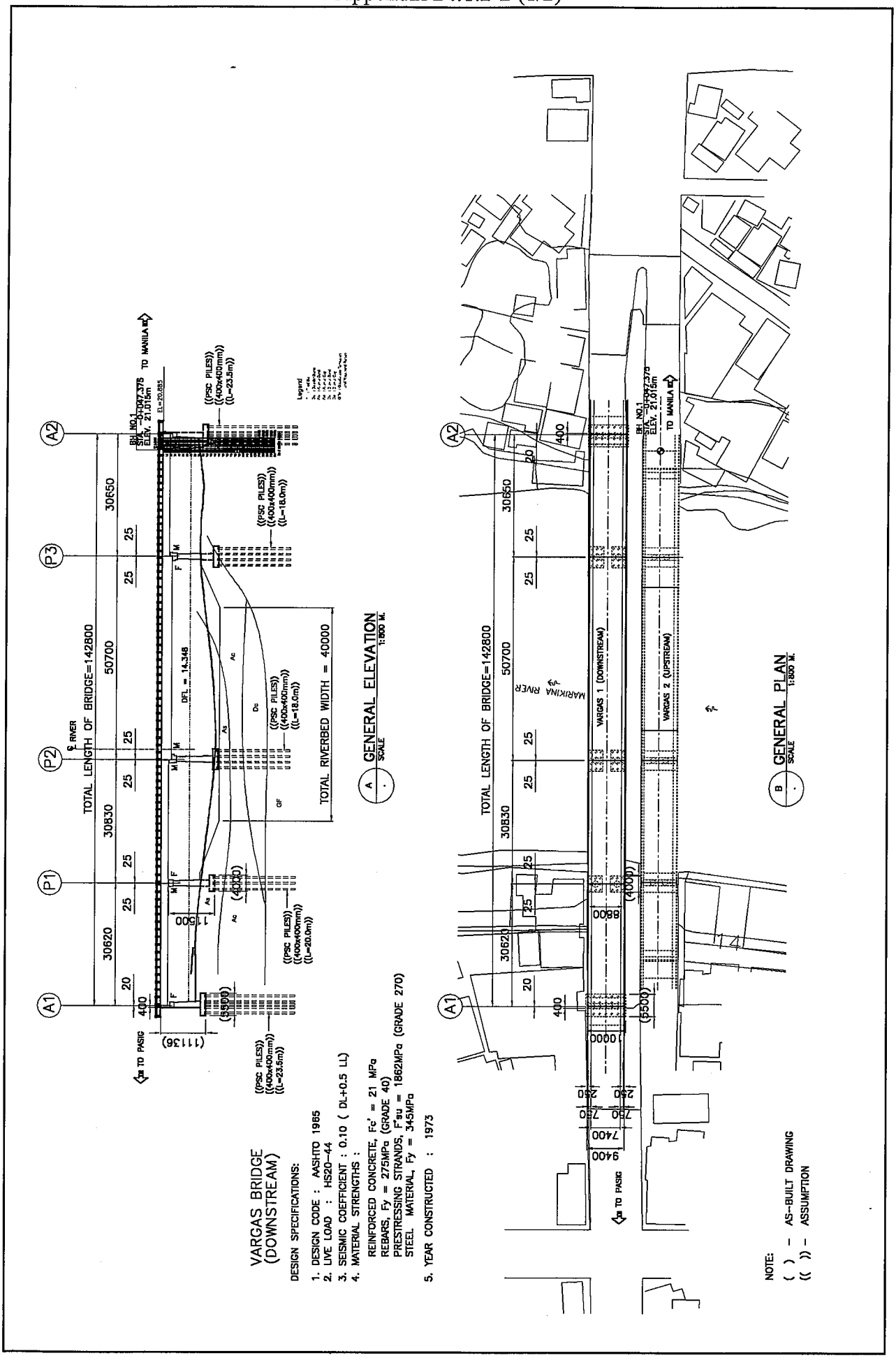
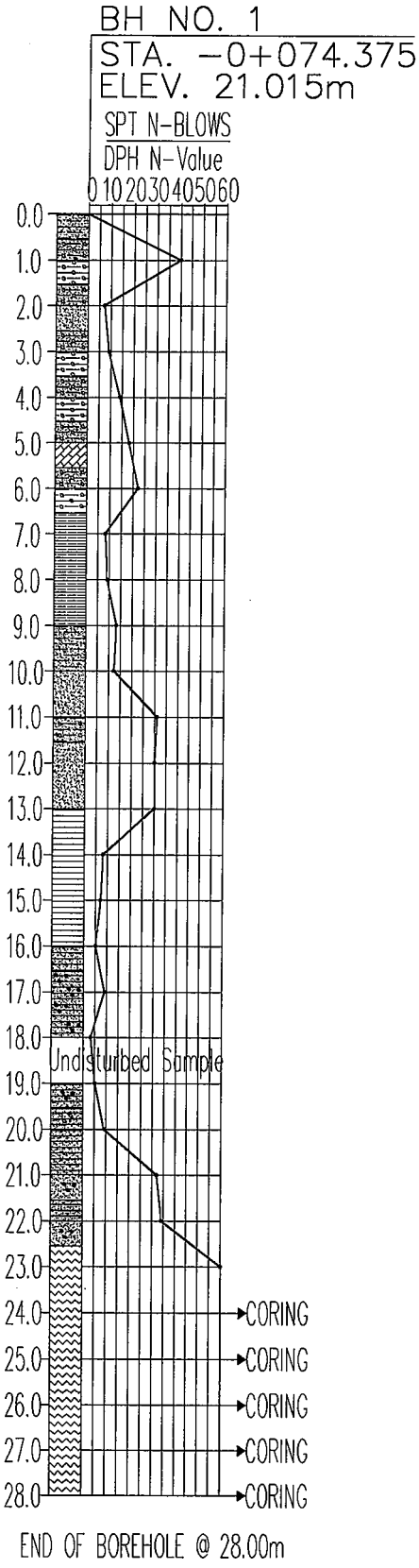
CHAPTER 24

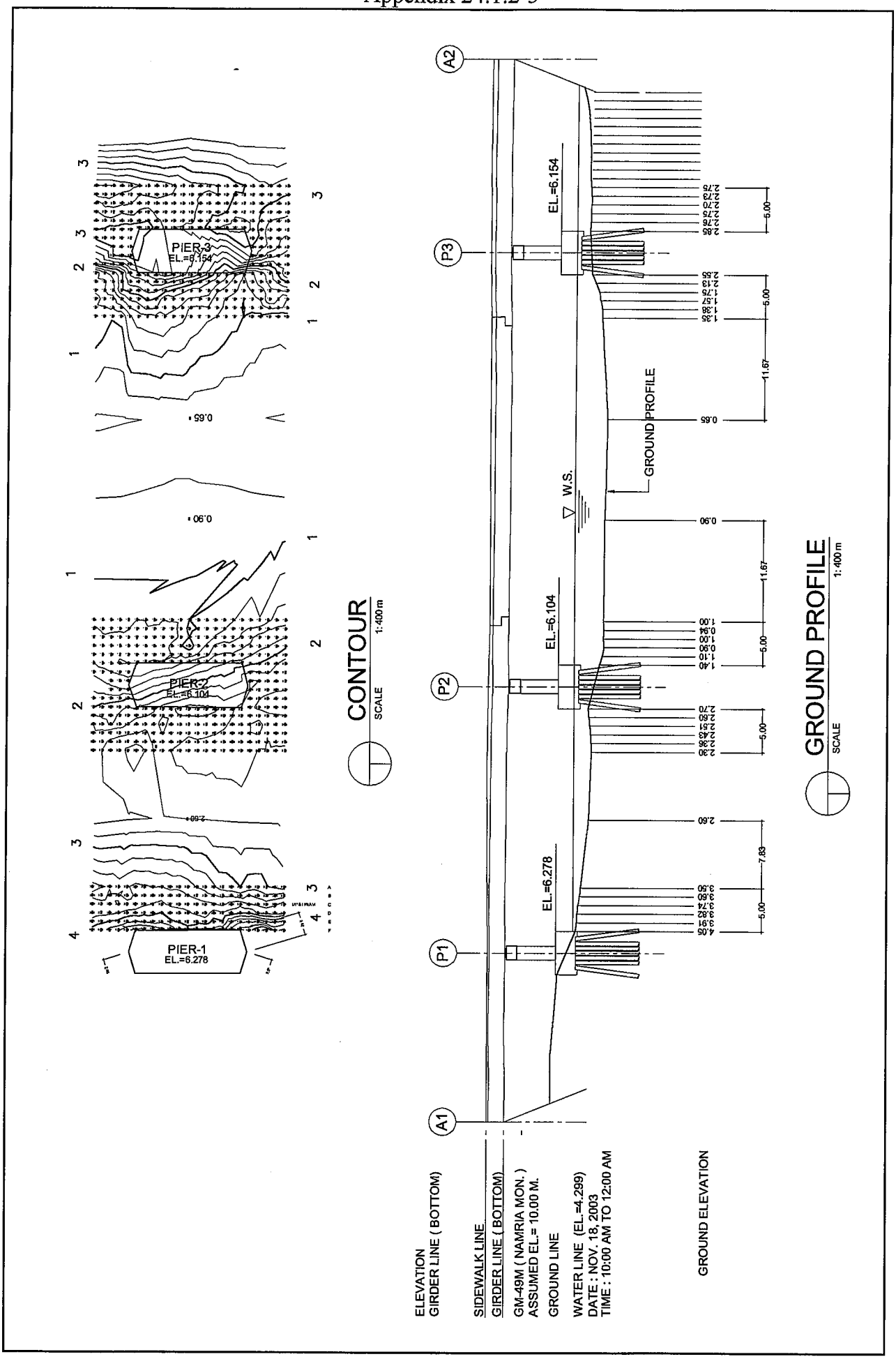
FEASIBILITY STUDY OF VARGAS BRIDGE REHABILITATION PLAN



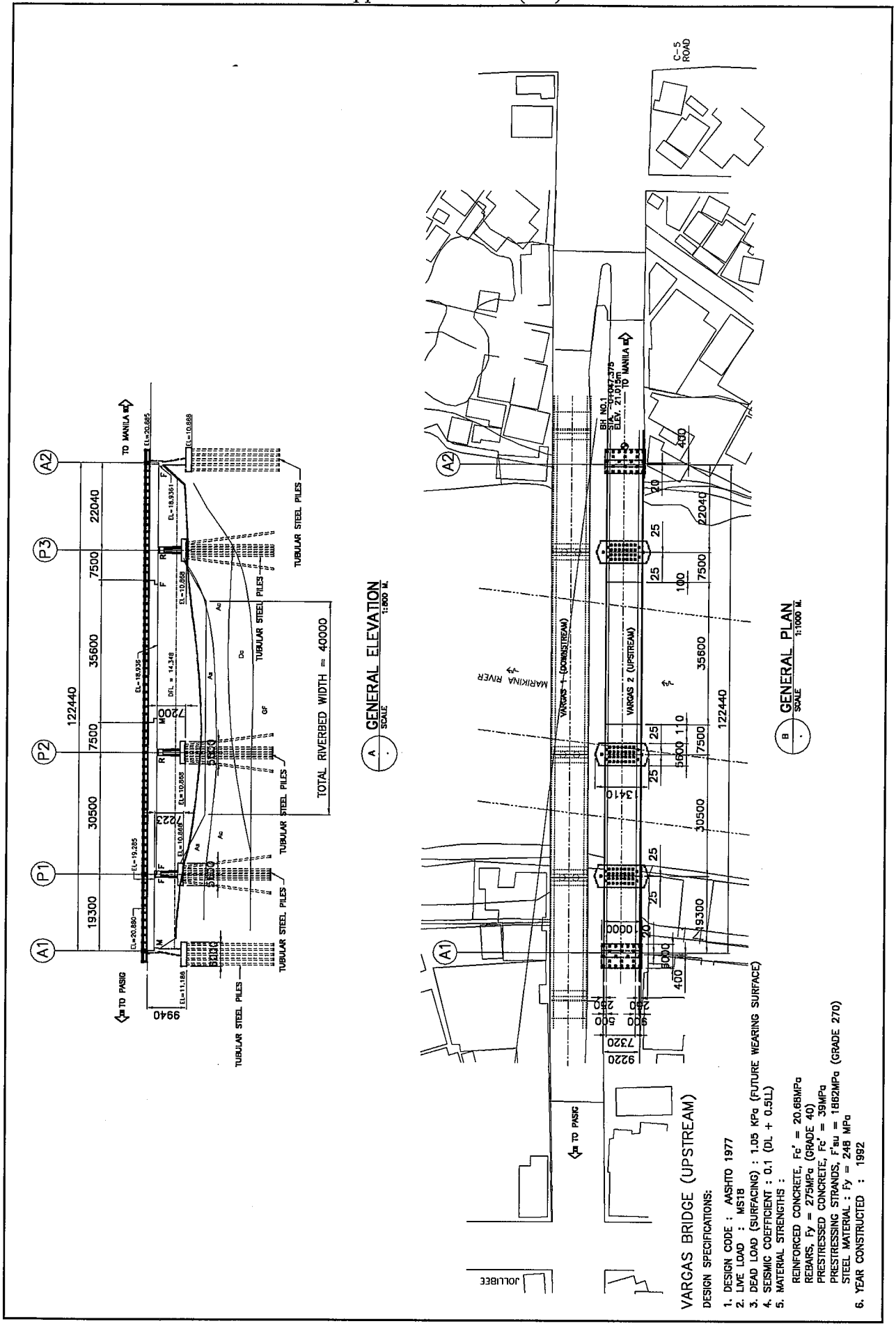
TOPOGRAPHIC SURVEY OF VARGAS BRIDGE


VARGAS BRIDGE
(DOWNSTREAM)
DESIGN SPECIFICATIONS:
1. DESIGN CODE : AASHTO 1965
2. LIVE LOAD : HS20-44
3. SEISMIC COEFFICIENT : 0.10 (DL+0.5 LL)
4. MATERIAL STRENGTHS :
REINFORCED CONCRETE, Fc' = 21 MPa
REBARS, Fy = 275MPa (GRADE 40)
PRESTRESSING STRANDS, F'su = 1862MPa (GRADE 270)
STEEL MATERIAL, Fy = 345MPa
5. YEAR CONSTRUCTED : 1973
A GENERAL ELEVATION SCALE 1:800 M.
B GENERAL PLAN SCALE 1:800 M.
TOTAL LENGTH OF BRIDGE=142800
TOTAL RIVERBED WIDTH = 40000
TO MANILA
TO PASIG
MARIKINA RIVER
VARGAS 1 (DOWNSTREAM)
VARGAS 2 (UPSTREAM)
NOTE:
( ) - AS-BUILT DRAWING
(( )) - ASSUMPTION

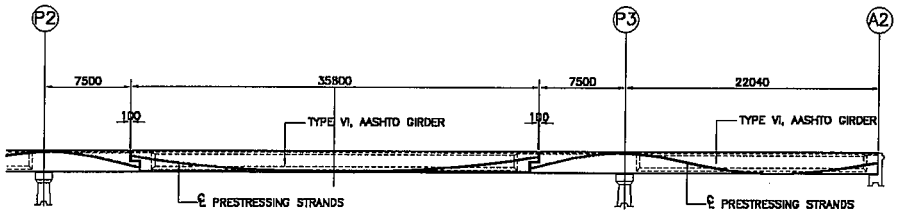

BH NO. 1
STA. −0+074.375
ELEV. 21.015m
SPT N-BLOWS
DPH N-Value
0 10 20 30 40 50 60
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
15.0
16.0
17.0
18.0
19.0
20.0
21.0
22.0
23.0
24.0
25.0
26.0
27.0
28.0
Undisturbed Sample
CORING
CORING
CORING
CORING
CORING
END OF BOREHOLE @ 28.00m



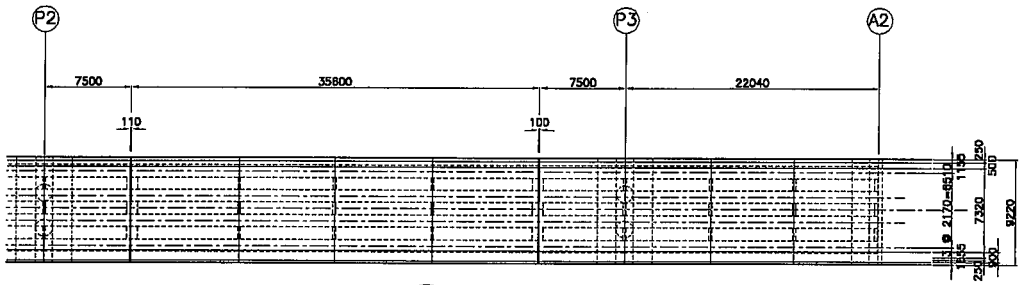
SCOUR SURVEY



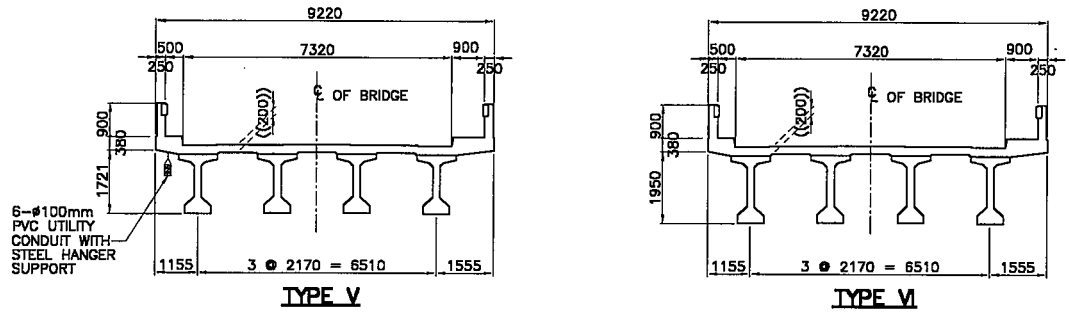
VERIFICATION OF SHAPES AND DIMENSIONS
GENERAL PLAN, ELEVATION AND SECTION



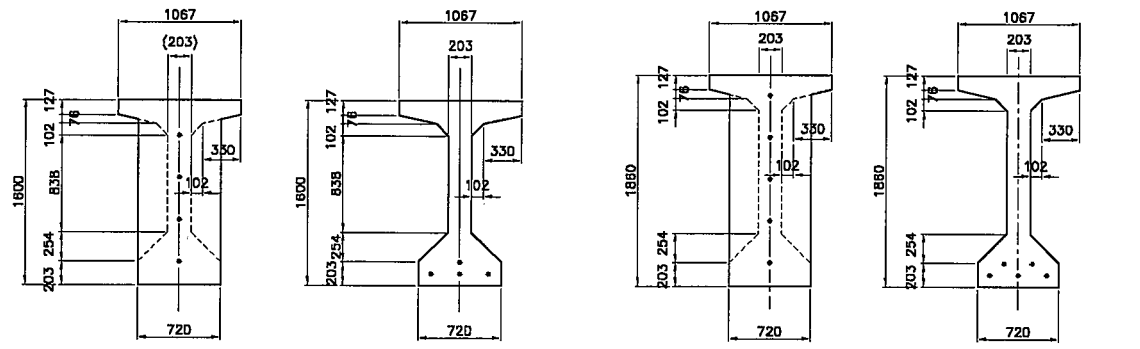
A GIRDER ELEVATION
SCALE 1:400 M.



B FRAMING PLAN
SCALE 1:400 M.

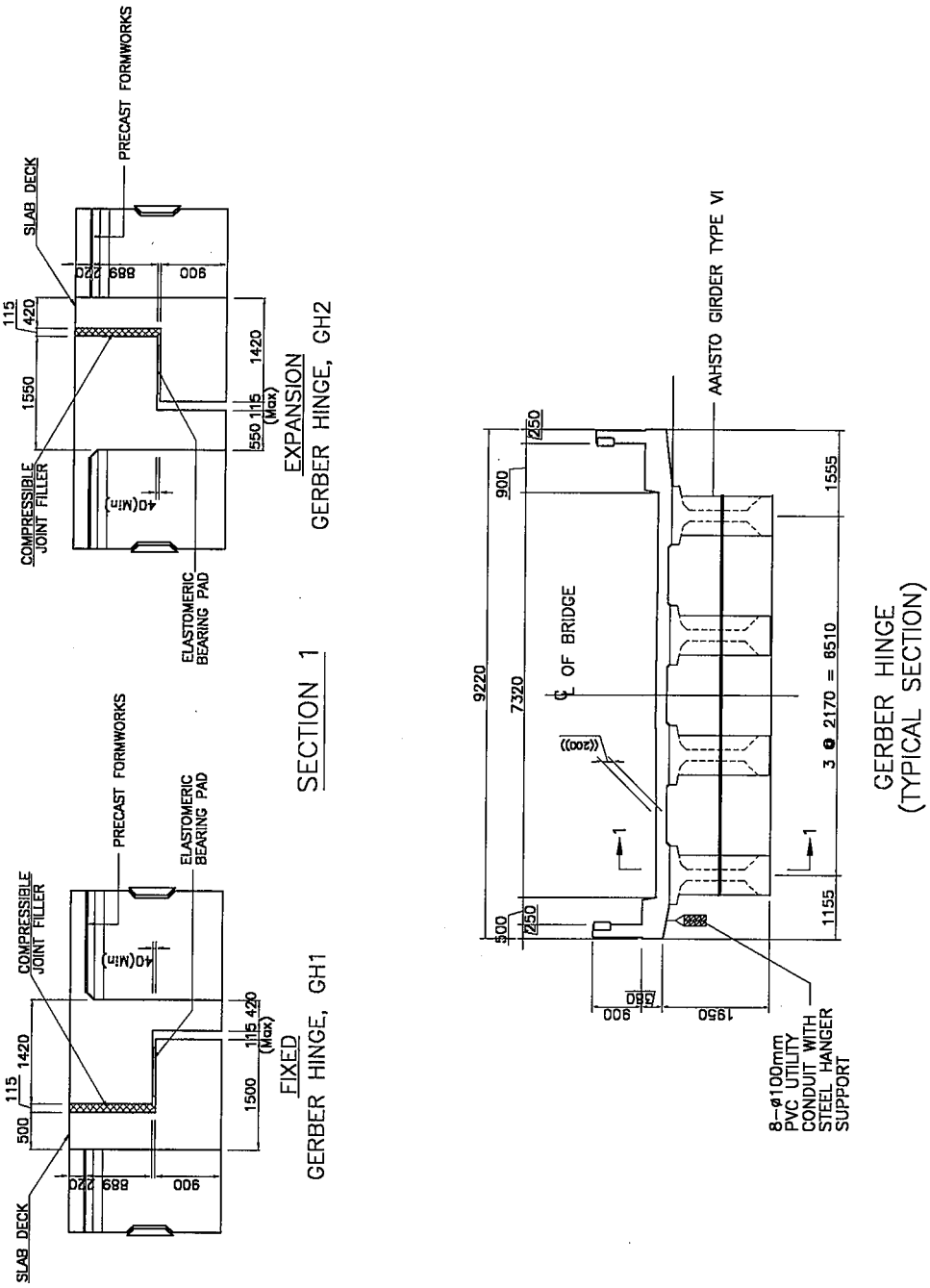


A BRIDGE CROSS SECTION
SCALE 1:125 M.

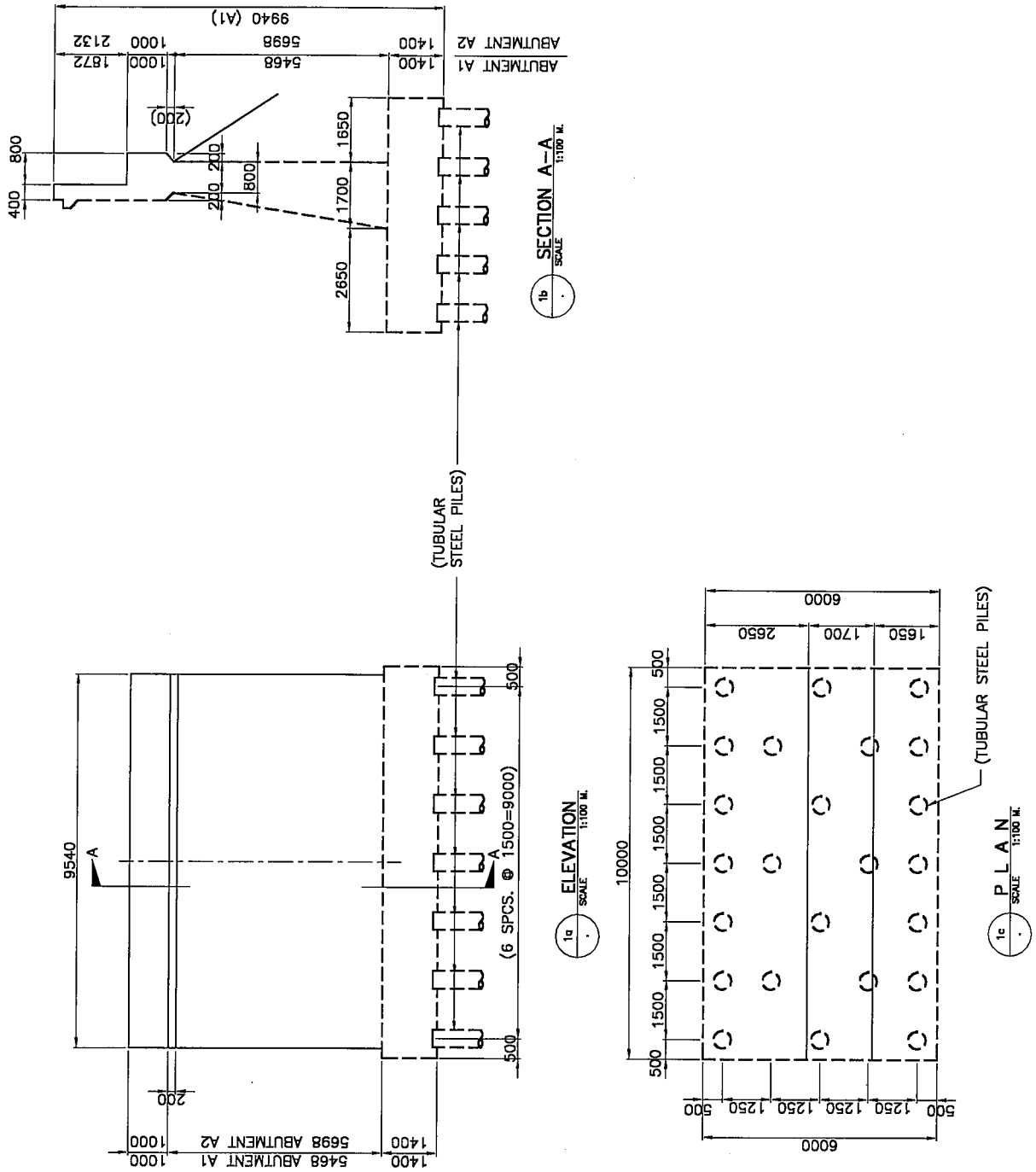


B GIRDER SECTION (TYPE V)
SCALE 1:40 M.

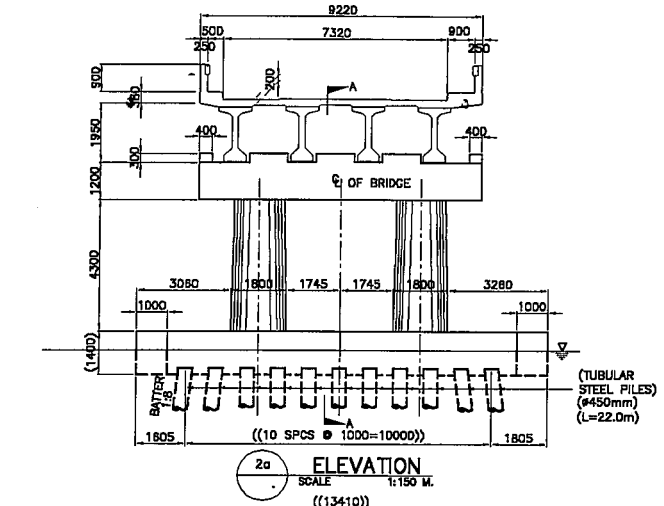
C GIRDER SECTION (TYPE VI)
SCALE 1:40 M.



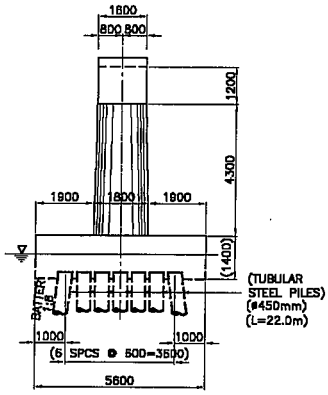
VERIFICATION OF SHAPES AND DIMENSIONS
GERBER HINGE DETAILS



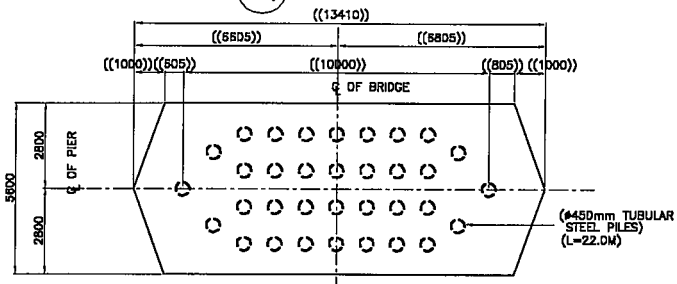
VERIFICATION OF SHAPES AND DIMENSIONS
ABUTMENT A1 AND A2 DETAILS



2a ELEVATION SCALE 1:150 M.

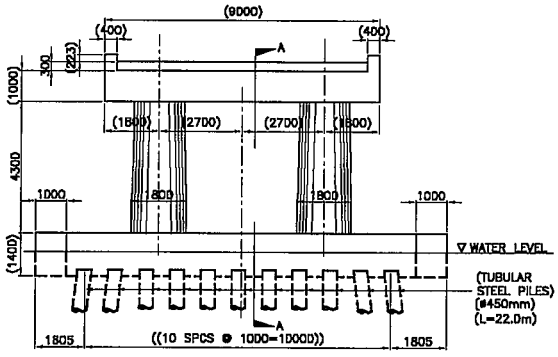


2b SECTION A–A SCALE 1:150 M.

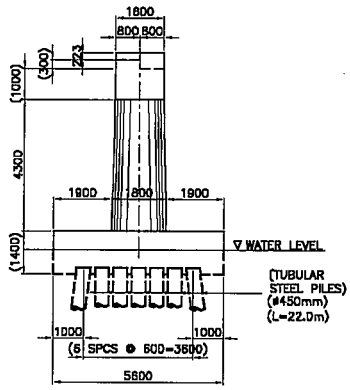


2c PLAN SCALE 1:150 M.

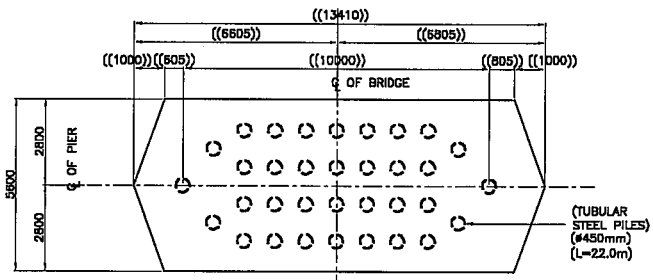
2 PIER 2 & PIER 3 SCALE AS SHOWN



1a ELEVATION SCALE 1:150 M.



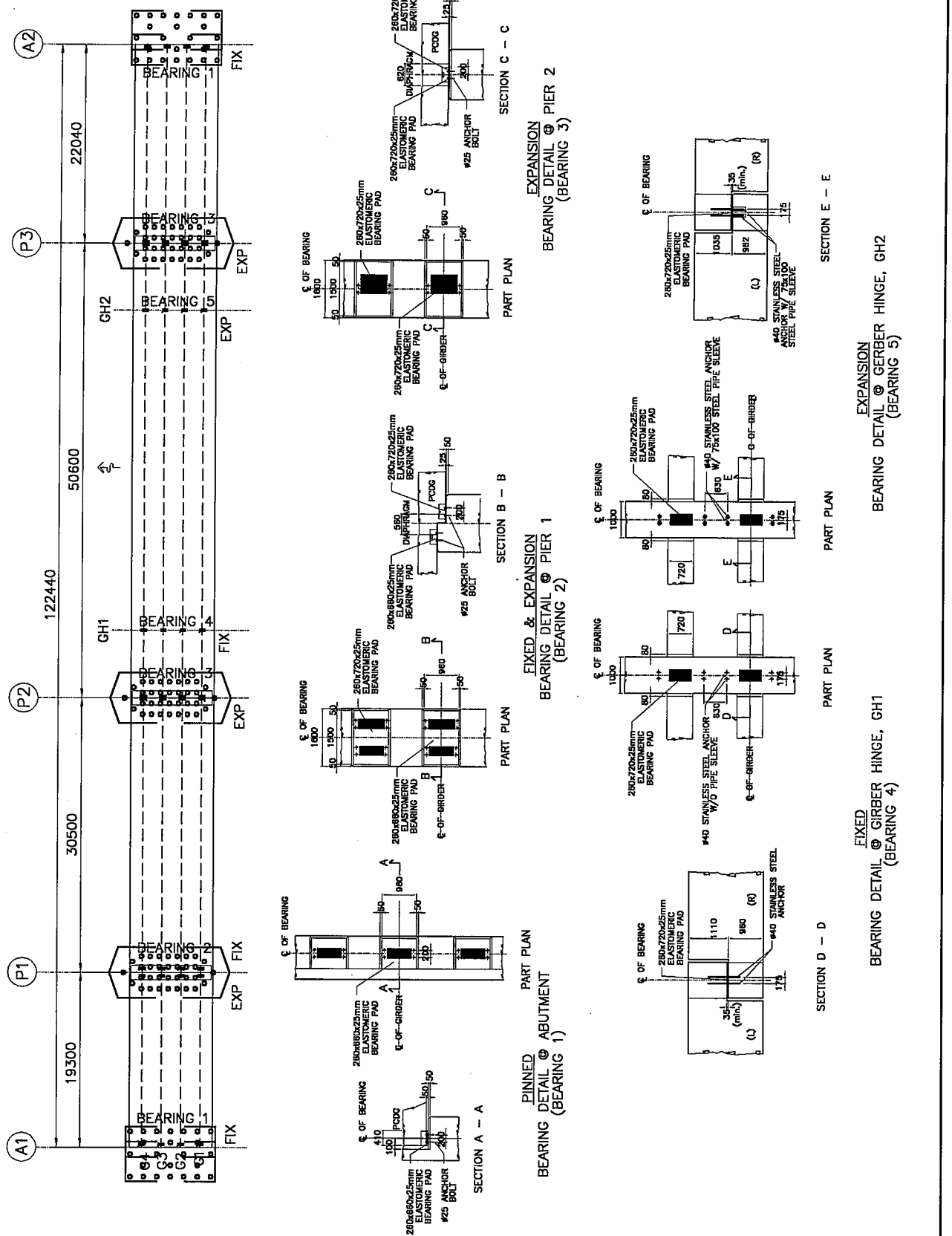
1b SECTION A–A SCALE 1:150 M.

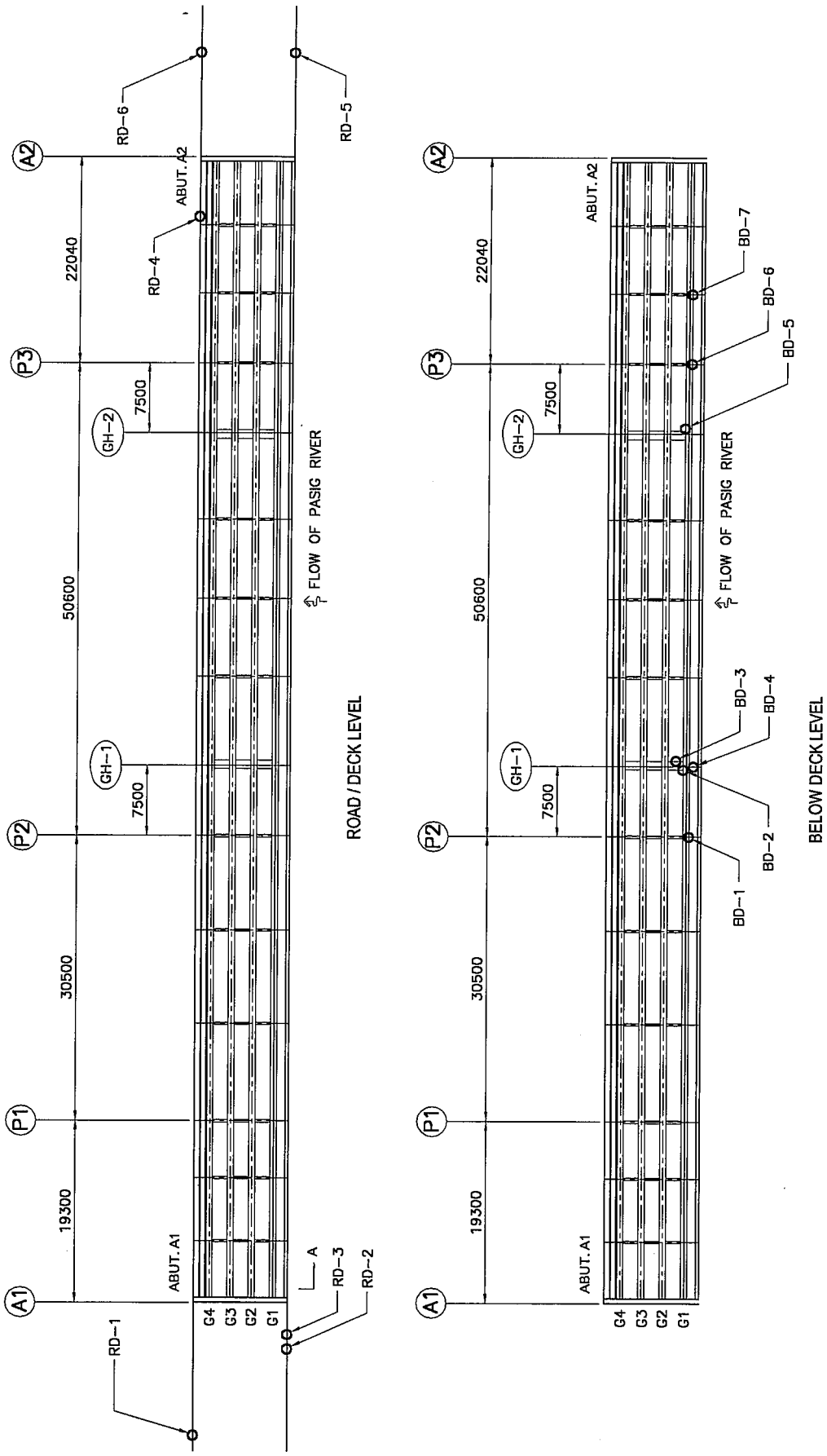


1c PLAN SCALE 1:150 M.

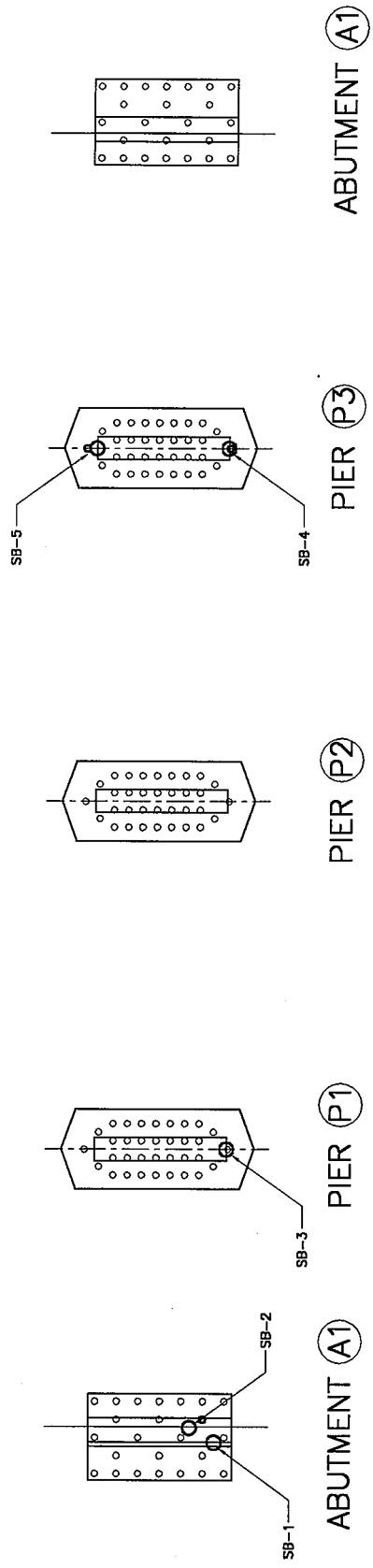
1 PIER 1 SCALE AS SHOWN

VERIFICATION OF SHAPES AND DIMENSIONS - PIER 1, PIER 2 & PIER 3


A1
A2
P1
P2
P3
BEARING 1
BEARING 2
BEARING 3
BEARING 4
BEARING 5
FIX
EXP
GH1
GH2
122440
50600
30500
19300
22040
PINNED
BEARING DETAIL @ ABUTMENT
(BEARING 1)
FIXED & EXPANSION
BEARING DETAIL @ PIER 1
(BEARING 2)
EXPANSION
BEARING DETAIL @ PIER 2
(BEARING 3)
FIXED
BEARING DETAIL @ GIRBER HINGE, GH1
(BEARING 4)
EXPANSION
BEARING DETAIL @ GERBER HINGE, GH2
(BEARING 5)
SECTION A - A
SECTION B - B
SECTION C - C
SECTION D - D
SECTION E - E
PART PLAN
℄ OF BEARING
℄ OF GIRDER
280x720x25mm ELASTOMERIC BEARING PAD
280x680x25mm ELASTOMERIC BEARING PAD
#25 ANCHOR BOLT
#40 STAINLESS STEEL ANCHOR W/ 75x100 STEEL PIPE SLEEVE
#40 STAINLESS STEEL ANCHOR W/O PIPE SLEEVE
#40 STAINLESS STEEL ANCHOR
PCDG
DIAPHRAGM

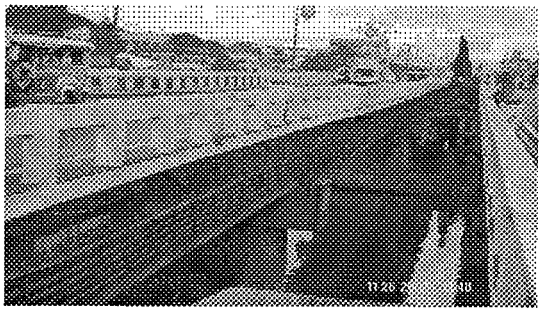


MAPPING OF DAMAGE ON ROAD / DECK LEVEL AND BELOW DECK LEVEL

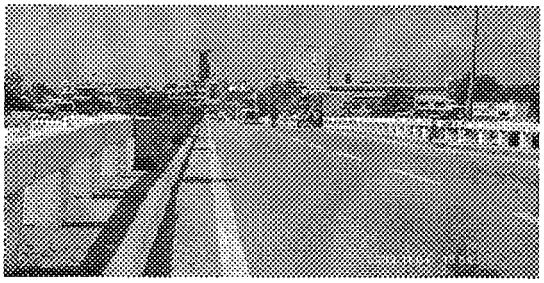


PLAN SHOWING SUBSTRUCTURES

MAPPING OF DAMAGE ON SUBSTRUCTURE AND BEARING

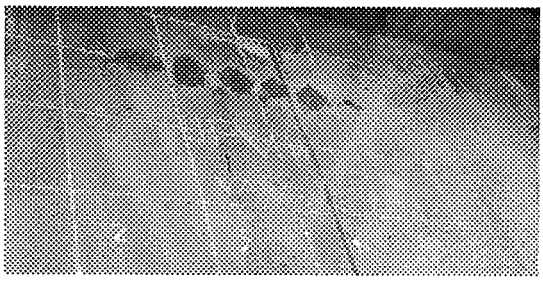


DAMAGE	TYPE	ABNORMAL DEFLECTION	
	EVALUATION	X	-
		Y	HIGH
		Z	-
	RATING	II	
	DAMAGE CONDITION		
DEFLECTION	VIEW	PHOTO FILENAME	
SUPERSTRUCTURE	EAST	DCP-0284.JPG	

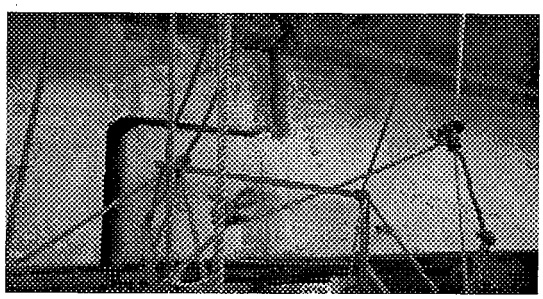


DAMAGE	TYPE		
	EVALUATION	X	
		Y	
		Z	
	RATING		
	DAMAGE CONDITION		
DEFLECTION	VIEW	PHOTO FILENAME	
SUPERSTRUTURE	WEST	DCP-8145.JPG	

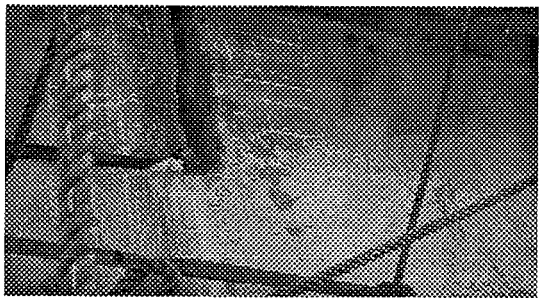
DAMAGE	TYPE	CRACKS	
	EVALUATION	X	HIGH
		Y	HIGH
		Z	LOW
	RATING	II	
	DAMAGE CONDITION	ONE(1) CRACK ONLY,w=2mm,(DEPTH OF CRACK d=17mm)(UPV 1)	
GIRDER	VIEW	PHOTO FILENAME	
G-1/PIER 2	DOWNSTREAM	DCP-8117.JPG	



DAMAGE	TYPE		
	EVALUATION	X	
		Y	
		Z	
	RATING		
	DAMAGE CONDITION		
GIRDER	VIEW	PHOTO FILENAME	
G-1/PIER 2	DOWNSTREAM	DCP-8116.JPG	



DAMAGE	TYPE	CRACKS	
	EVALUATION	X	HIGH
		Y	HIGH
		Z	HIGH
	RATING	II	
	DAMAGE CONDITION	w=2mm,spacing<50cm(DEPTH OF CRACK d=43mm)(UPV 3)	
GIRDER	VIEW	PHOTO FILENAME	
G-1/GH 2	DOWNSTREAM	DCP-8136.JPG	

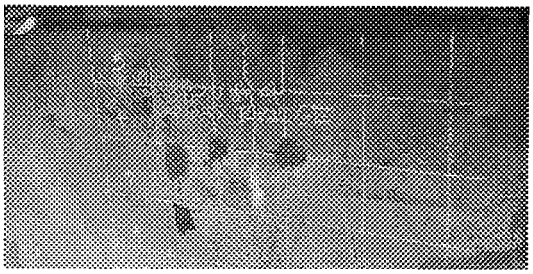


DAMAGE	TYPE	CRACKS	
	EVALUATION	X	HIGH
		Y	HIGH
		Z	HIGH
	RATING	II	
	DAMAGE CONDITION	w=1mm,spacing<50cm.	
GIRDER	VIEW	PHOTO FILENAME	
G-1/GH 2R	DOWNSTREAM	DCP-8138.JPG	

CLOSE-UP VISUAL INSPECTION OF DAMAGE BELOW/DECK LEVEL

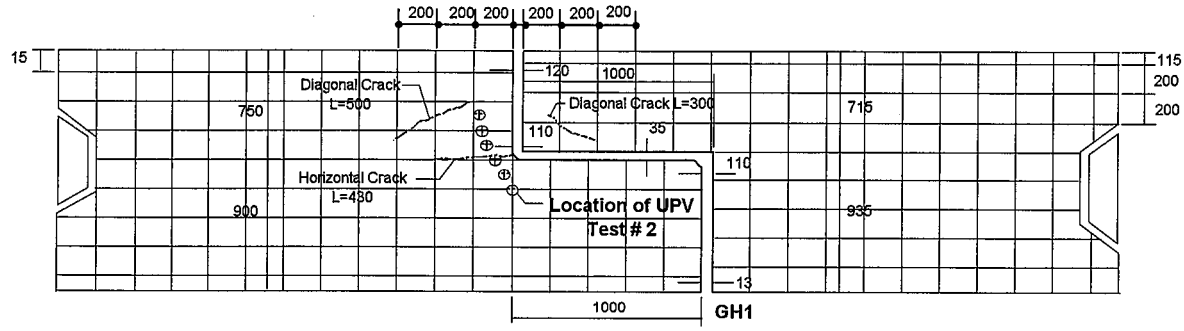
(VARGAS BRIDGE)

DAMAGE	TYPE	CRACKS	
	EVALUATION	X	HIGH
		Y	HIGH
		Z	HIGH
	RATING	II	
	DAMAGE CONDITION	ONE(1) CRACK ,w=2mm, spacing < 50cm.(DEPTH OF CRACK d=217mm)(UPV 4)	
GIRDER	VIEW	PHOTO FILENAME	
G-1/PIER 3	DOWNSTREAM	DCP-8124.JPG	



DAMAGE	TYPE		
	EVALUATION	X	
		Y	
		Z	
	RATING		
	DAMAGE CONDITION		
GIRDER	VIEW	PHOTO FILENAME	
G-1/PIER 3	DOWNSTREAM	DCP-8125.JPG	

BRIDGE NAME : Vargas Bridge Upstream
GIRDER : Interior [ ] Exterior [X]
GERBER HINGE NO : GH1
GIRDER NO : 1

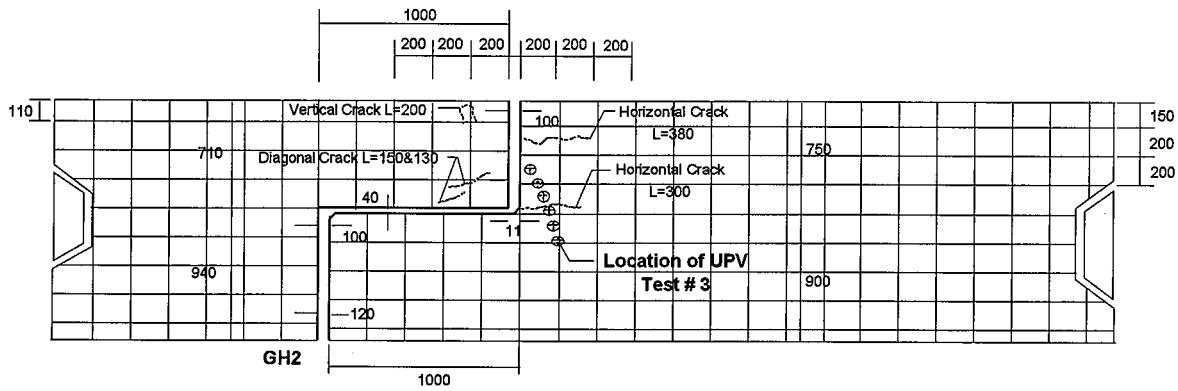


Elevation of Girder

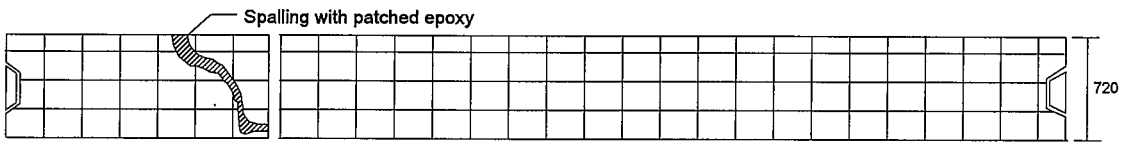
Bottom of Girder

Note : All Dimensions are in mm.

BRIDGE NAME : Vargas Bridge Upstream
GIRDER : Interior [ ] Exterior [X]
GERBER HINGE NO. : GH2
GIRDER NO. : 1



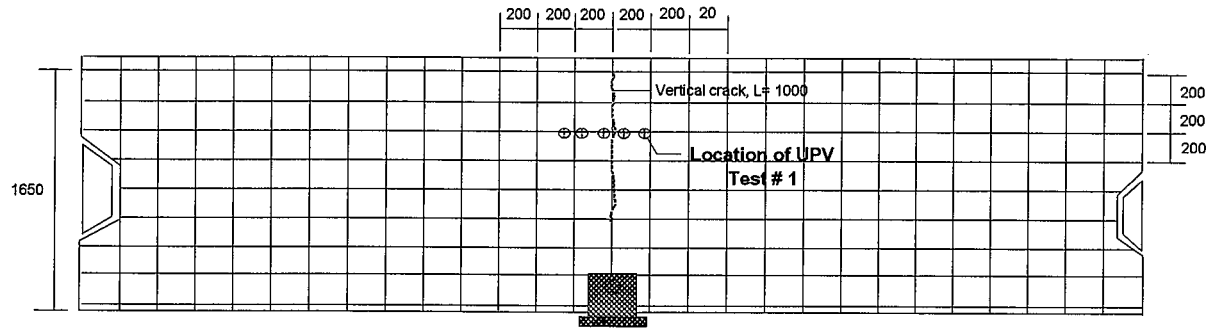
Elevation of Girder



Bottom of Girder

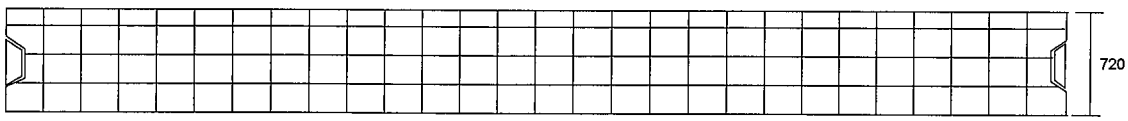
Note : All Dimensions are in mm.

BRIDGE NAME : Vargas Bridge Upstream
GIRDER : Interior [ ] Exterior [X]
PIER NO : 2
GIRDER NO : 1



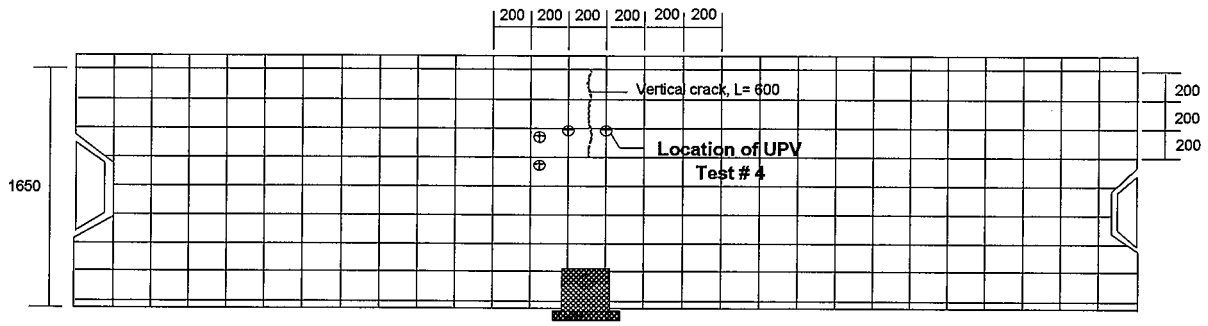
PIER # 2

Elevation of Girder



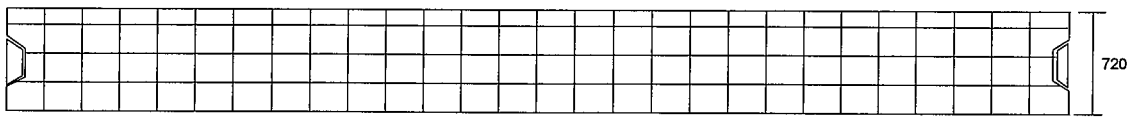
Bottom of Girder

BRIDGE NAME : Vargas Bridge Upstream
GIRDER : Interior [ ] Exterior [X]
PIER NO : 3
GIRDER NO : 1



PIER # 3

Elevation of Girder

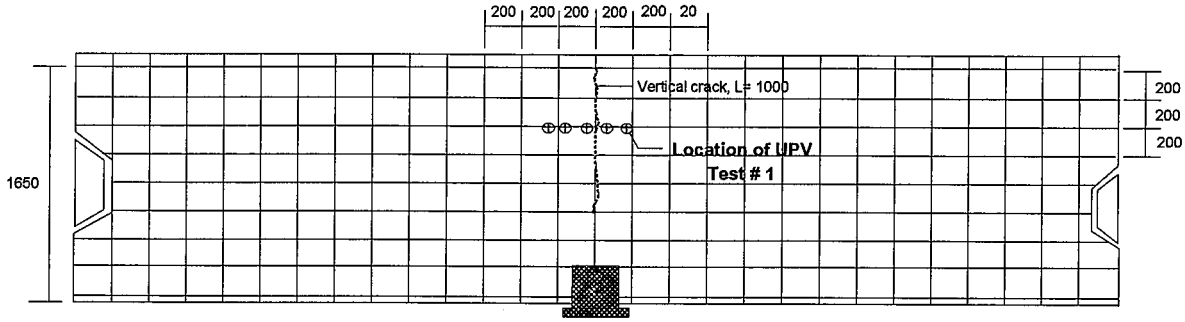


Bottom of Girder

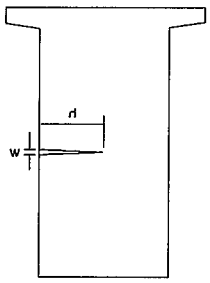
Note : All Dimensions are in mm.

ULTRASONIC PULSE VELOCITY TEST - ABOVE PIER 2 & 3

BRIDGE NAME : Vargas Bridge Upstream
GIRDER : Interior [ ] Exterior [X]
PIER NO : 2
GIRDER NO : 1

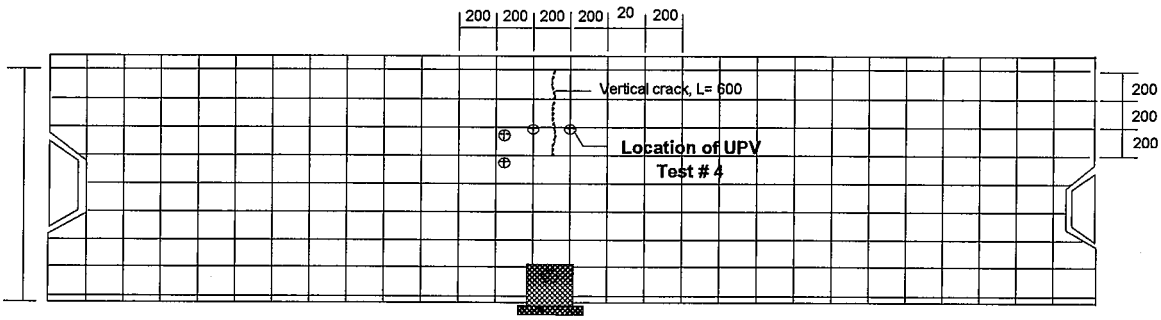


PIER # 2
Elevation of Girder

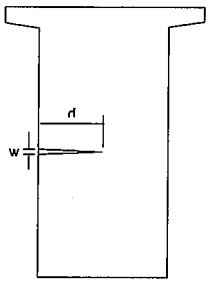


Test Reference	Element	Face	Crack Orientation	Estimated Apparent Depth, d (mm)	Width of Crack w (mm)	Length of Crack L (mm)
UPV 1	PIER 2	UPSTREAM	VERTICAL	43	1.5	1000

BRIDGE NAME : Vargas Bridge Upstream
GIRDER : Interior [ ] Exterior [X]
PIER NO : 3
GIRDER NO : 1

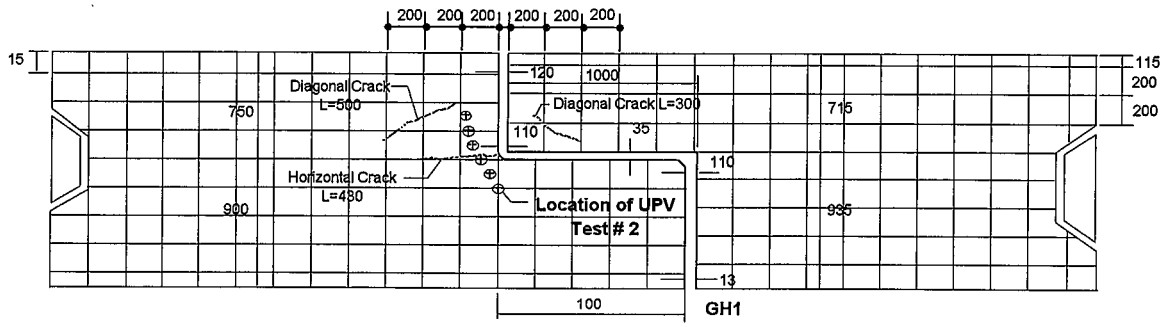


PIER # 3
Elevation of Girder

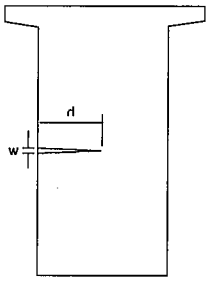


Test Reference	Element	Face	Crack Orientation	Estimated Apparent Depth, d (mm)	Width of Crack w (mm)	Length of Crack L (mm)
UPV 4	PIER 3	UPSTREAM	VERTICAL	217	1.0	600

BRIDGE NAME : Vargas Bridge Upstream
GIRDER : Interior [ ] Exterior [X]
GERBER HINGE NO. : GH1
GIRDER NO. : 1

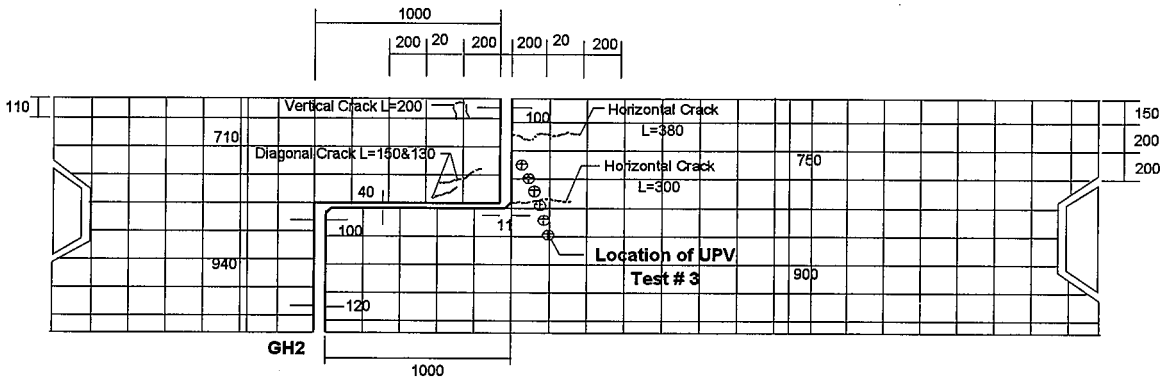


Elevation of Girder

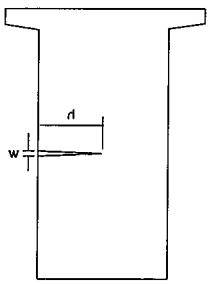


Test Reference	Element	Face	Crack Orientation	Estimated Apparent Depth, d (mm)	Width of Crack w (mm)	Length of Crack L (mm)
UPV 2	GH1, G1	UPSTREAM	HORIZONTAL	44	2.0	430

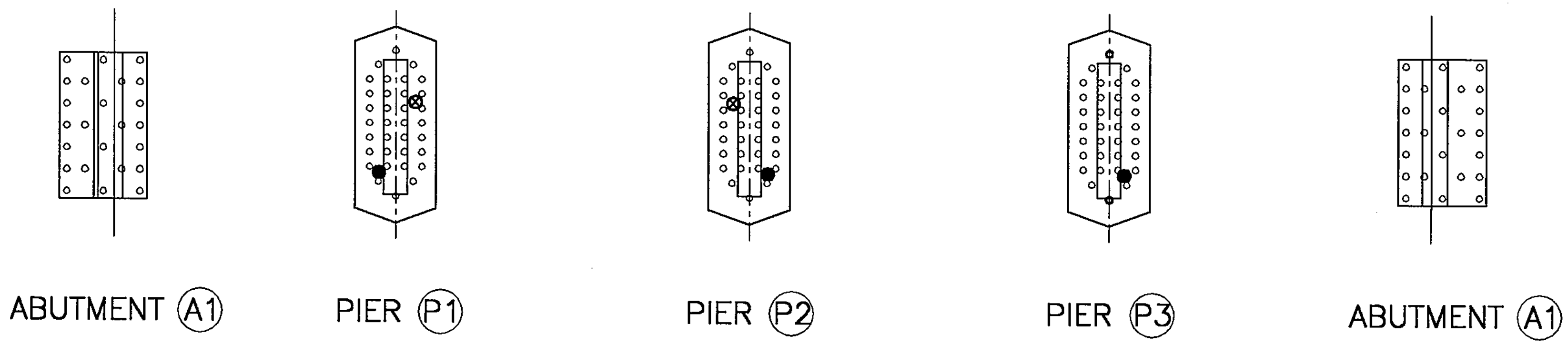
BRIDGE NAME : Vargas Bridge Upstream
GIRDER : Interior [ ] Exterior [X]
GERBER HINGE NO. : GH2
GIRDER NO : 1



Elevation of Girder



Test Reference	Element	Face	Crack Orientation	Estimated Apparent Depth, d (mm)	Width of Crack w (mm)	Length of Crack L (mm)
UPV 3	GH2, G1	UPSTREAM	HORIZONTAL	17	1.0	300



PLAN

LEGEND :

- ⊗ CONCRETE CORE SAMPLE LOCATION
- ● SCHMIDT HAMMER TEST LOCATION
- N/D NON DETECTED
- H HORIZONTAL
- P PRESSURE OF ALKALI-SILICA REACTION

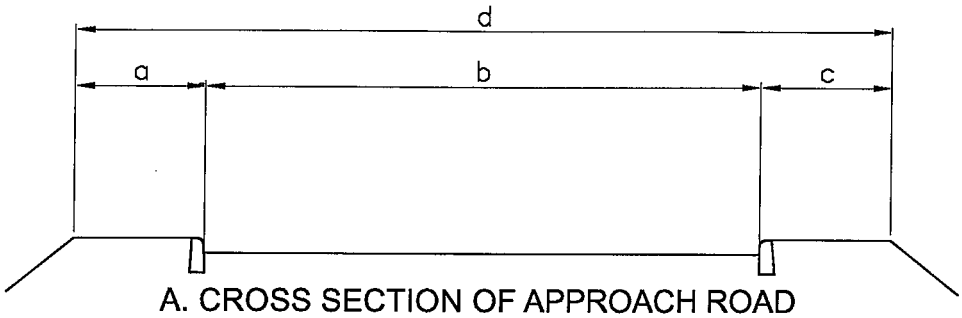
IN-SITU NON-DESTRUCTIVE TEST OF CONCRETE

	TEST LOCATION						
	SPAN2	SPAN 3	SPAN 4	A2	P1	P2	P3
HAMMER ORIENTATION	H	H	H	H	H	H	H
REBOUND NUMBER, R	49	47	45	33	44	47	45
CALIBRATED COMPRESSIVE STRENGTH (MPa) 2	59	54	52	29	49	54	52
CORE LENGTH (mm)	-	-	-	-	350	380	-
ORIENTATION 3	-	-	-	-	H	H	-
CARBONATION DEPTH (mm) (PHENOLPHTHALEIN TEST)	-	-	-	-	25	35	-

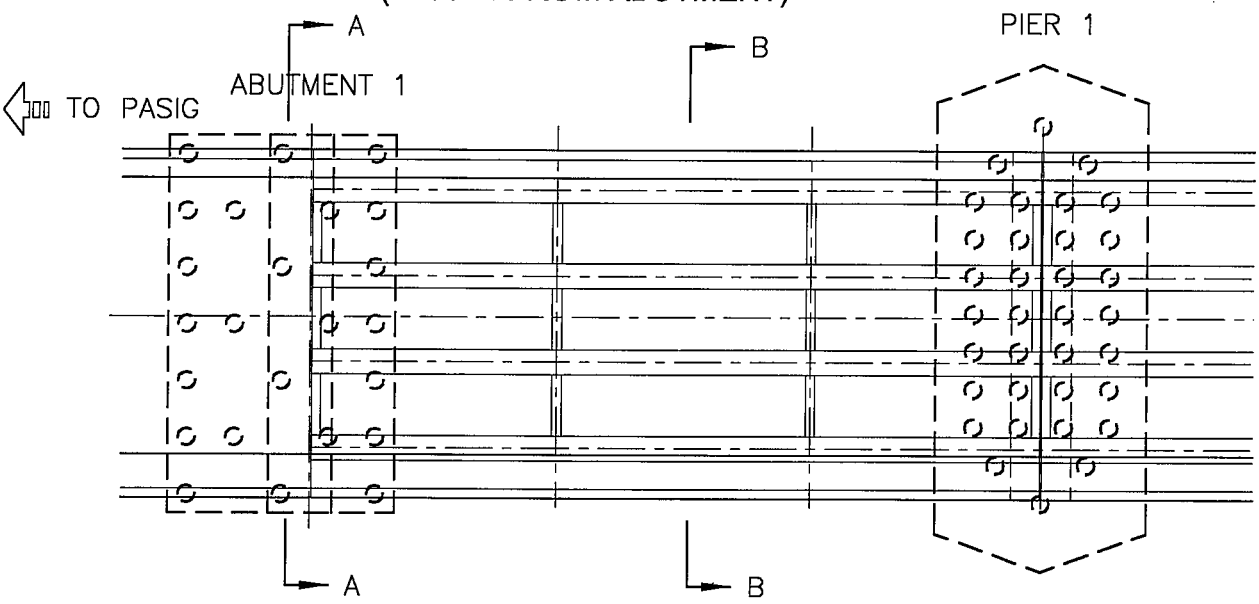
LABORATORY TEST ON CONCRETE SAMPLE

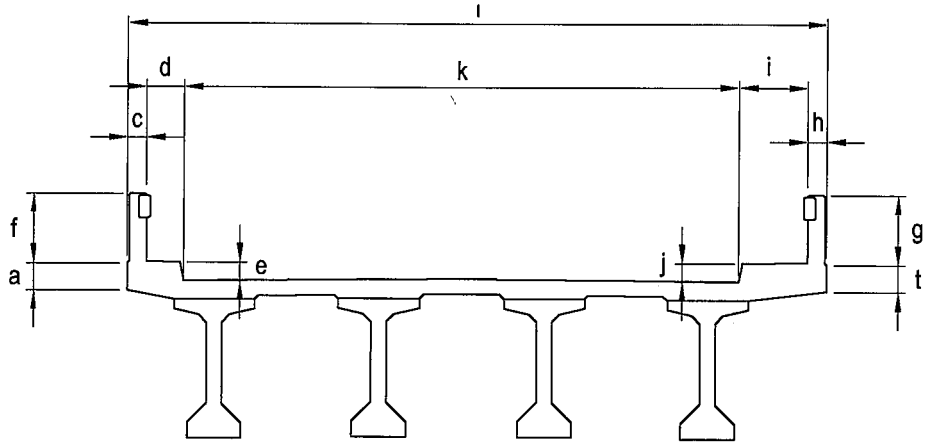
	TEST LOCATION						
	SPAN2	SPAN 3	SPAN 4	A2	P1	P2	P3
COMPRESSIVE STRENGTH (MPa)	-	-	-	-	-	35.5	-
ALKALI-SILICA REACTION (PETROGRAPHIC ANALYSIS)	-	-	-	-	-	P	-
CHLORIDE CONTENT (CHLORIDE TEST)	-	-	-	-	-	N/D	-

SCHMIDT HAMMER TEST, COMPRESSION TEST, PHENOLPTHALEIN TEST AND CHLORIDE TEST



A. CROSS SECTION OF APPROACH ROAD
(1.00m. FROM ABUTMENT)





B. SECTION OF DECK

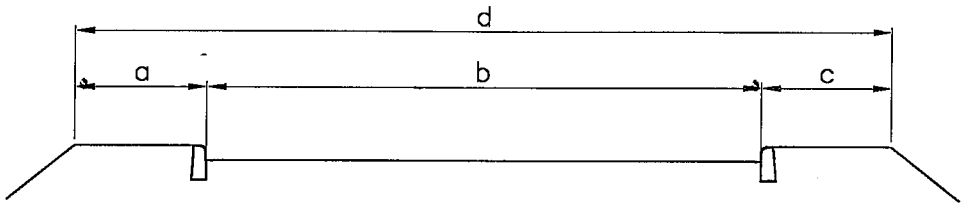
Table 1-1. Approach Road Dimensions

	A-A
a	380
b	7340
c	1060
d	9465

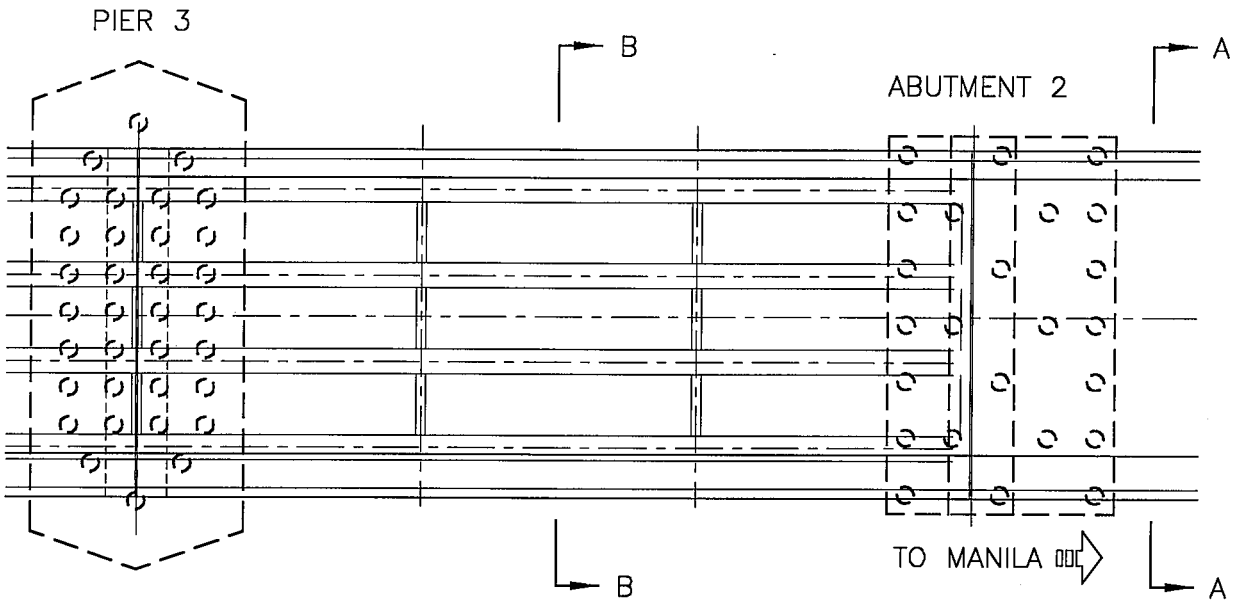
Table 1-2. Deck Dimensions

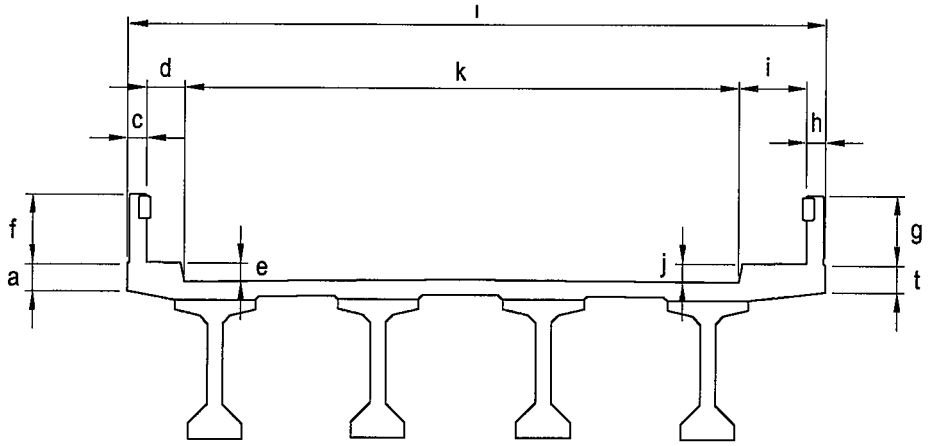
	B-B
a	380
b	900
c	310
d	560
e	170
f	380

	B-B
g	890
h	320
i	990
j	200
k	7320
l	9500



A. CROSS SECTION OF APPROACH ROAD
(1.00m. FROM ABUTMENT)





B. SECTION OF DECK

Table 1-1. Approach Road Dimensions

	A-A
a	380
b	7340
c	1060
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Table 1-2. Deck Dimensions

	B-B
a	380
b	900
c	310
d	560
e	170
f	380

	B-B
g	890
h	320
i	990
j	200
k	7320
l	9500

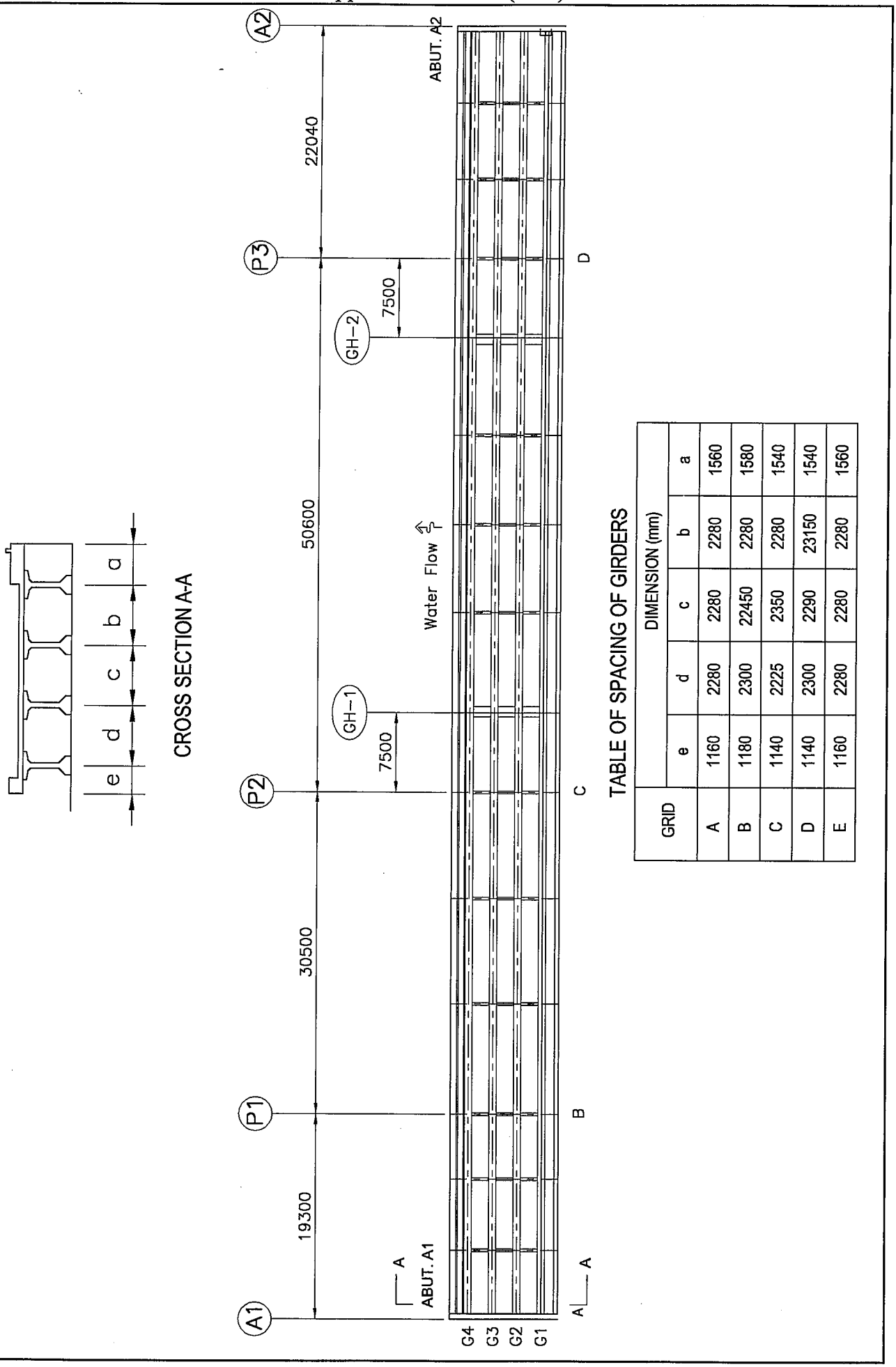
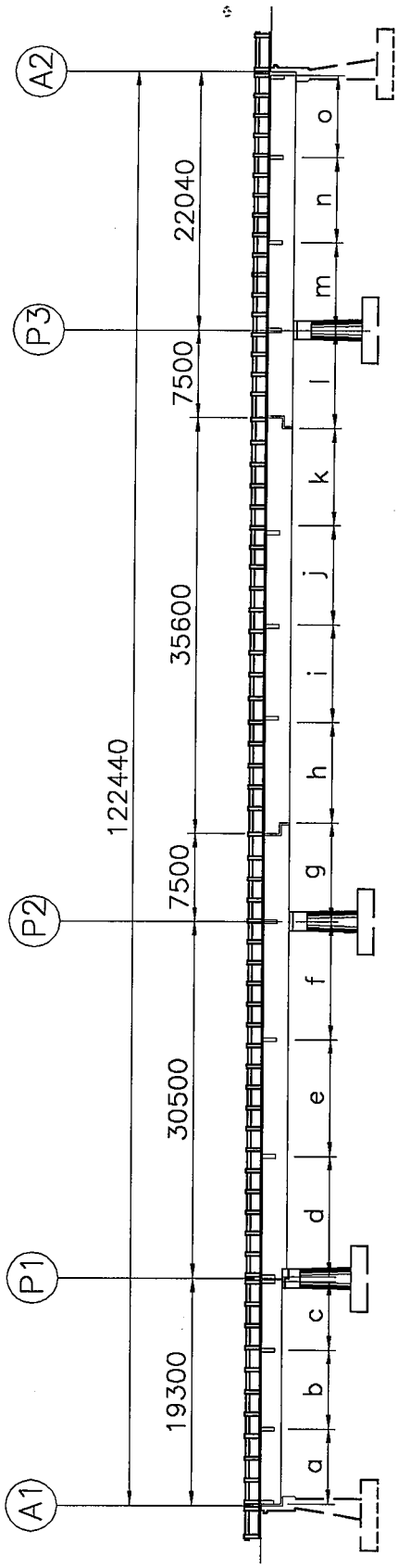


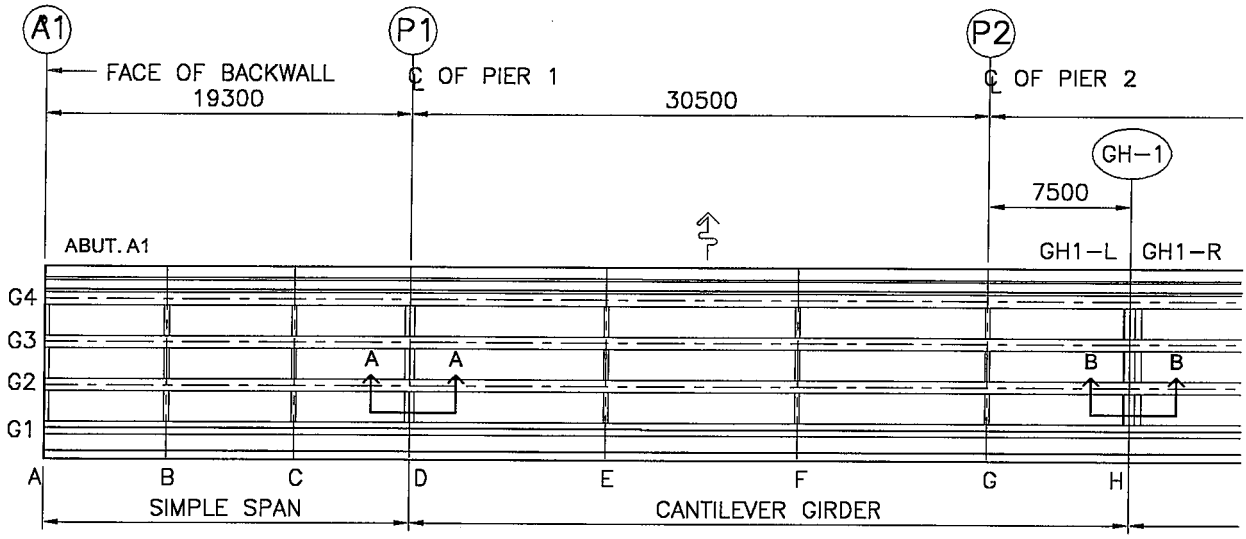
TABLE OF SPACING OF GIRDERS

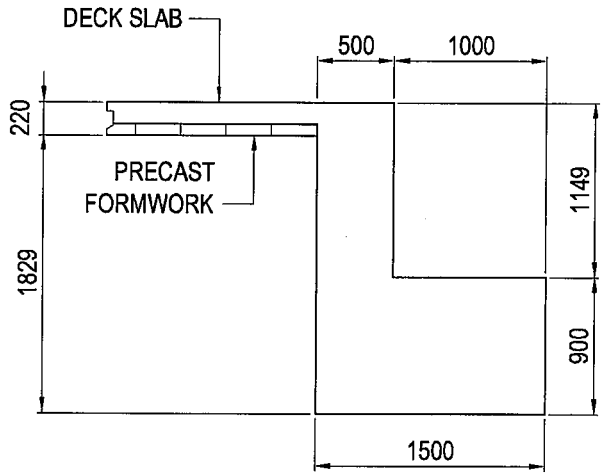
GRID	DIMENSION (mm)				
	e	d	c	b	a
A	1160	2280	2280	2280	1560
B	1180	2300	22450	2280	1580
C	1140	2225	2350	2280	1540
D	1140	2300	2290	23150	1540
E	1160	2280	2280	2280	1560



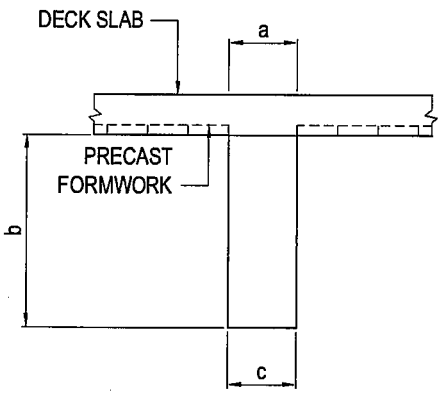
	DIMENSION (mm)
a	6510
b	6700
c	6090
d	10420
e	10000
f	10080
g	8450
h	8550
i	8350
j	8500
k	8350
l	8400
m	7480
n	7260
o	7300

SHAPES AND DIMENSIONS - SUPERSTRUCTURE



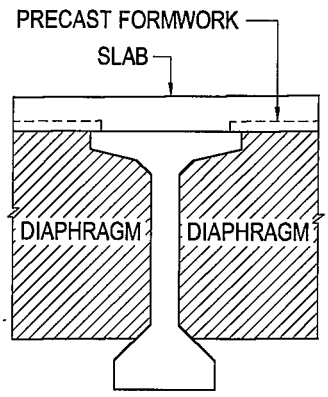


CROSS SECTION OF DIAPHRAGM AT GERBER HINGE (H)
(B-B)

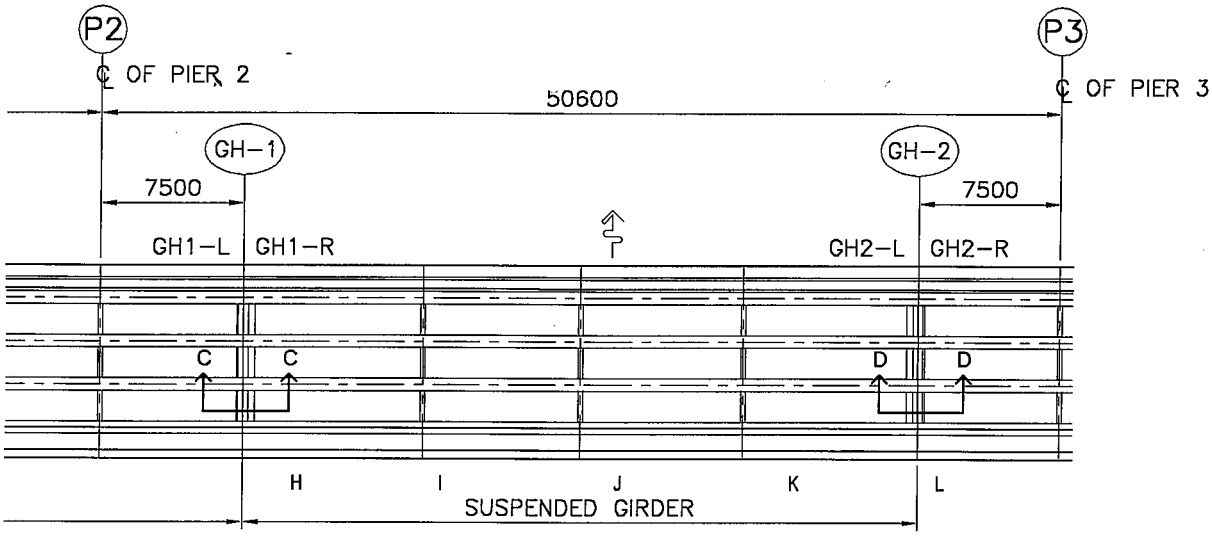


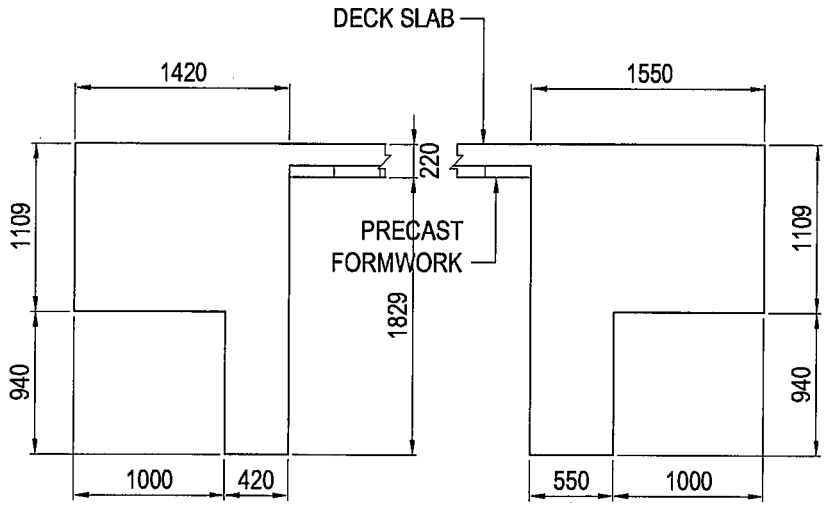
CROSS SECTION OF DIAPHRAGM
(A-A)

GRID	List of Diaphragm (mm)			
	a	b	c	d
A	250	975	250	-
B	250	1240	250	-
C	250	1240	250	-
D	250	975	250	-
	250	975	250	-
E	250	1472	-	-
F	250	1472	-	-
G	400	1472	-	-

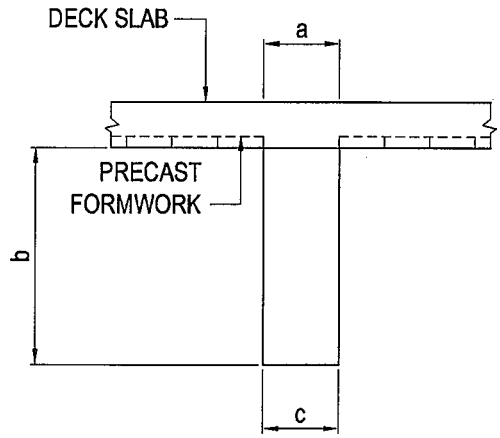


CROSS SECTION OF GIRDER



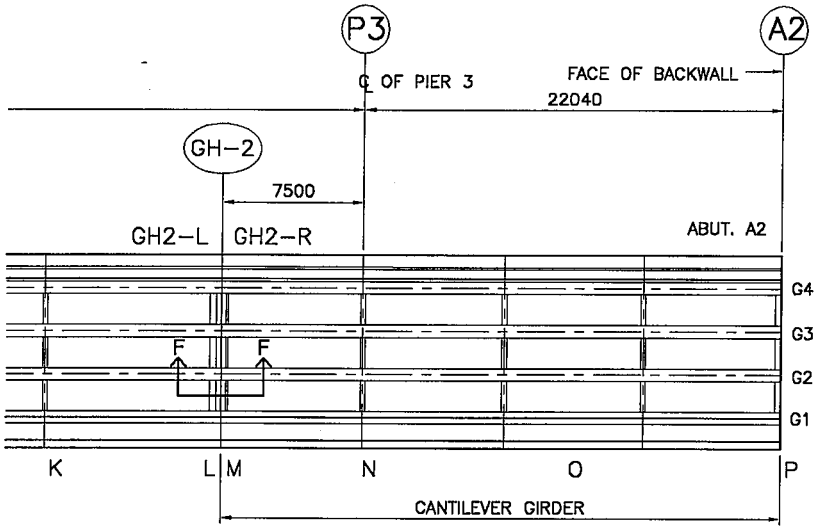


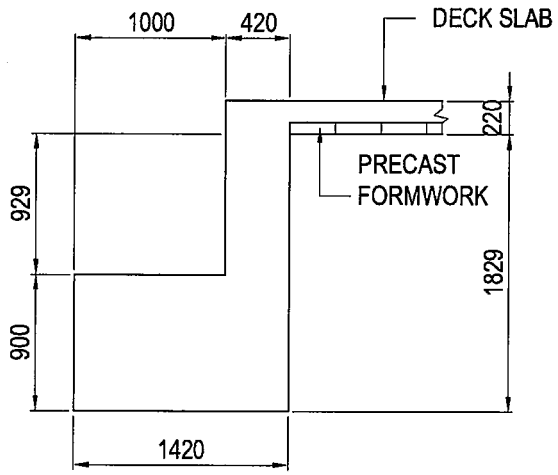
CROSS SECTION OF GERBER HINGE (GH1-R & GH2-L)
DIAPHRAGM AT GERBER HINGE (H & L)
C-C & D-D



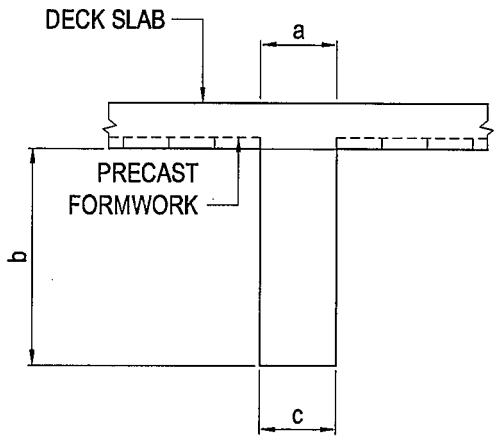
CROSS SECTION OF DIAPHRAGM

GRID	List of Diaphragm (mm)			
	a	b	c	d
I	250	1472	250	-
J	250	1472	250	-
K	250	1472	250	-





CROSS SECTION OF GERBER HINGE AT "M"
DIAPHRAGM AT GERBER HINGE (M)
E-E



GRID	List of Diaphragm (mm)			
	a	b	c	d
N	250	1472	250	-
O	250	1472	250	-
P	250	1472	250	-
Q	250	975	250	-

CROSS SECTION OF DIAPHRAGM
F-F

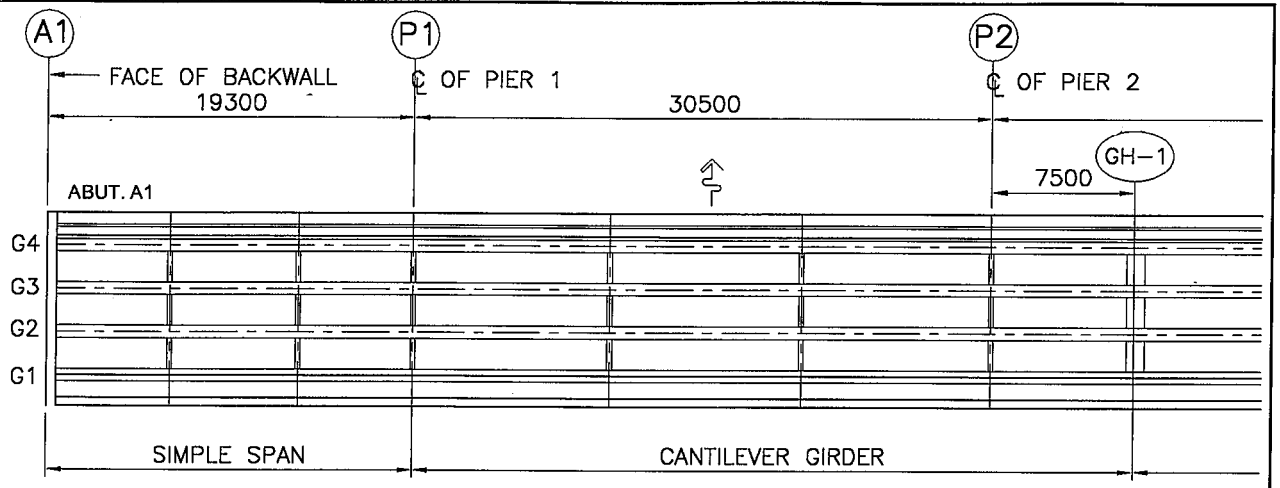


TABLE OF SIMPLE SPAN GIRDER (L=19.30M)

GIRDER	a	b	c	d	e	f	g	h	i	j	k	l
4	1040	130	70	100	840	250	220	720	180	100	330	270
3	1040	130	70	100	840	250	220	720	180	100	330	270
2	1040	130	70	100	840	250	220	720	180	100	330	270
1	1040	130	70	100	840	250	220	720	180	100	330	270

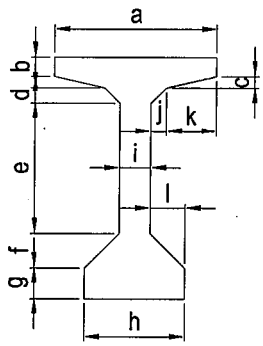
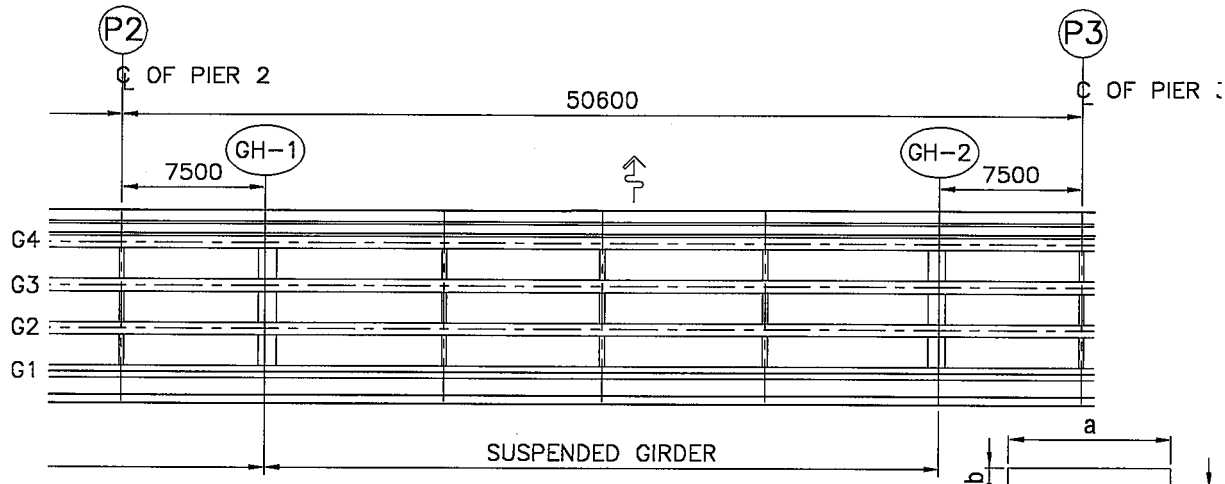


TABLE OF CANTILEVER GIRDER

GIRDER	a	b	c	d	e	f	g	h	i	j	k	l
4	1050	125	76	102	1070	265	220	720	180	102	330	270
3	1050	125	76	102	1070	265	220	720	180	102	330	270
2	1050	125	76	102	1070	265	220	720	180	102	330	270
1	1050	125	76	102	1070	265	220	720	180	102	330	270



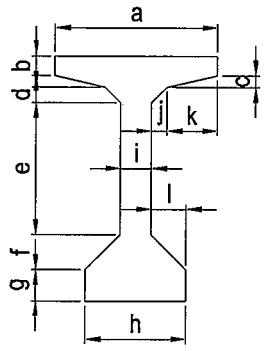
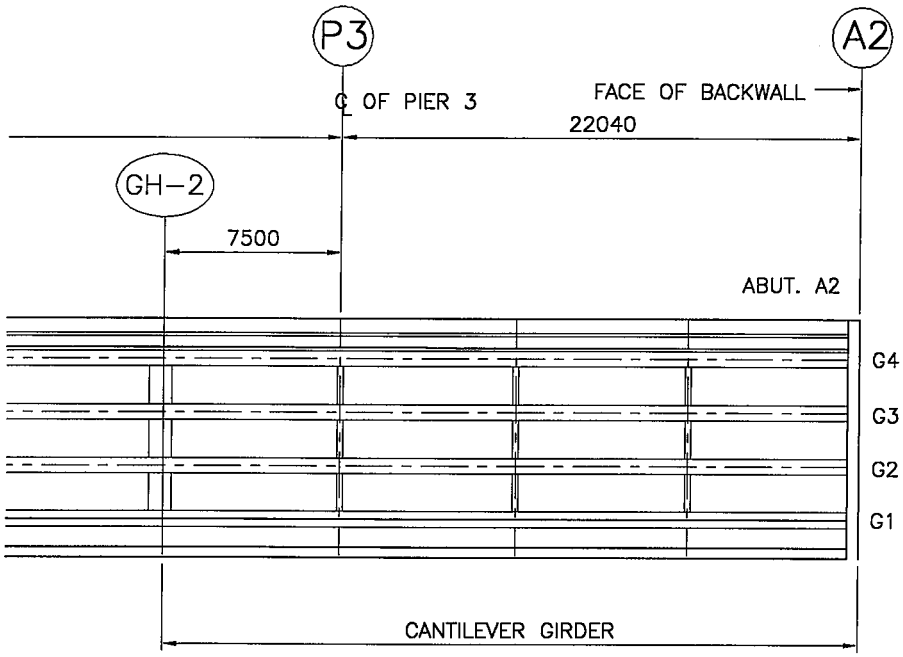


TABLE OF SUSPENDED GIRDER

GIRDER	a	b	c	d	e	f	g	h	i	j	k	l
4	1060	130	75	100	1075	270	210	720	190	100	330	260
3	1060	130	75	100	1075	270	210	720	190	100	330	260
2	1060	130	75	100	1075	270	210	720	190	100	330	260
1	1060	130	75	100	1075	270	210	720	190	100	330	260



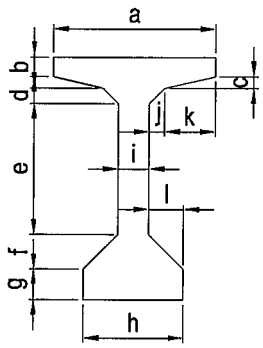


TABLE OF CANTILEVER GIRDER

GIRDER	a	b	c	d	e	f	g	h	i	j	k	l
4	1040	130	70	100	840	250	220	720	180	100	330	270
3	1040	130	70	100	840	250	220	720	180	100	330	270
2	1040	130	70	100	840	250	220	720	180	100	330	270
1	1040	130	70	100	840	250	220	720	180	100	330	270

SHAPES AND DIMENSIONS - GIRDER @ SPAN 4

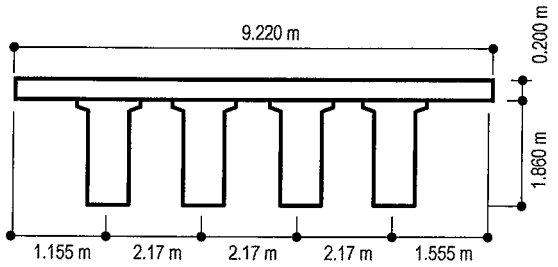
A. TYPE VI AASHTO GIRDERS

1.0 MATERIAL SPECIFICATIONS

Modulus of elasticity of prestressed concrete girder, E_c = 29538.84 Mpa
Modulus of elasticity of reinforced concrete slab, E_{cs} = 21520.20 Mpa
Modular ratio, $n = E_{cs} / E_c$ = 0.728539

2.0 WHOLE SUPERSTRUCTURE

2.1 END BLOCK / SOLID PORTION



2.1.1 Properties of Girder

Area of Girder = 1.390 m^2
Centroid of Girder = 0.961 m
Dimension of Haunch : 50 mm

2.1.2 For I_X

Girder : No. of girders x I_{X-X} = 4 × 0.007 = 0.030 m^4
Slab : $nbt^3 / 3$ = 0.729 × 9.220 × 0.200^3 ÷ 3 = 0.018 m^4
Total = **0.048 m^4**

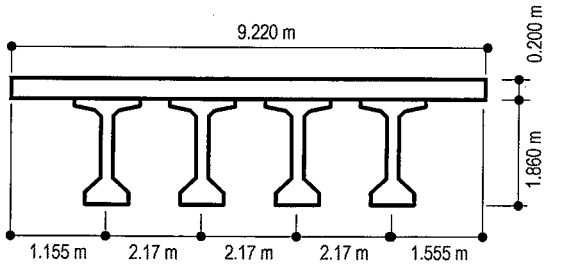
2.1.3 For I_Y

Item	Area, A (m^2)	y (m)	Ay (m^3)	d (m)	Ad^2 (m^4)	I_{Y-Y} (m^4)	$I_Y = I_{Y-Y} + Ad^2$ (m^4)
A	1.390	8.065	11.212	3.294	15.084	0.06798	15.152
B	1.390	5.895	8.195	1.124	1.756	0.06798	1.824
C	1.390	3.725	5.179	1.046	1.521	0.06798	1.589
D	1.390	1.555	2.162	3.216	14.379	0.06798	14.447
E	1.343	4.610	6.193	0.161	0.035	5.051	5.086
Total	6.904		32.941				**38.098**

2.1.4 For I_Z

Item	Area, A (m^2)	y (m)	Ay (m^3)	d (m)	Ad^2 (m^4)	I_{Z-Z} (m^4)	$I_Z = I_{Z-Z} + Ad^2$ (m^4)
A	1.390	0.961	1.336	0.194	0.053	0.422	0.475
B	1.390	0.961	1.336	0.194	0.053	0.422	0.475
C	1.390	0.961	1.336	0.194	0.053	0.422	0.475
D	1.390	0.961	1.336	0.194	0.053	0.422	0.475
E	1.343	1.960	2.633	0.805	0.870	0.004	0.874
Total	6.904		7.977				**2.773**

2.2 MID-SECTION (TYPICAL SECTION)



2.2.1 Properties of Girder

Area of Girder = 0.707 m^2
Centroid of Girder = 0.965 m
Dimension of Haunch : 50 mm

2.2.2 For I_X

Girder : No. of girders x I_{X-X} = 4 × 0.007 = 0.030 m^4

Slab : $nbt^3 / 3$ = 0.729 × 9.220 × 0.200^3 ÷ 3 = 0.018 m^4

Total = **0.048 m^4**

2.2.3 For I_Y

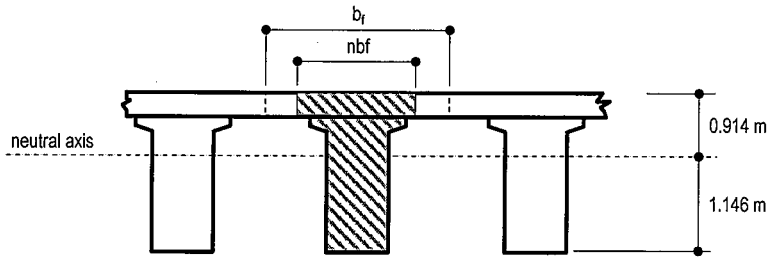
Item	Area, A (m^2)	y (m)	Ay (m^3)	d (m)	Ad^2 (m^4)	I_{Y-Y} (m^4)	$I_Y = I_{Y-Y} + Ad^2$ (m^4)
A	0.707	8.065	5.706	3.319	7.795	0.026	7.821
B	0.707	5.895	4.171	1.149	0.935	0.026	0.961
C	0.707	3.725	2.635	1.021	0.737	0.026	0.763
D	0.707	1.555	1.100	3.191	7.202	0.026	7.228
E	1.343	4.610	6.193	0.136	0.025	5.051	5.076
Total	4.173		19.805				**21.849**

2.2.4 For I_Z

Item	Area, A (m^2)	y (m)	Ay (m^3)	d (m)	Ad^2 (m^4)	I_{Z-Z} (m^4)	$I_Z = I_{Z-Z} + Ad^2$ (m^4)
A	0.707	0.965	0.683	0.320	0.073	0.322	0.394
B	0.707	0.965	0.683	0.320	0.073	0.322	0.394
C	0.707	0.965	0.683	0.320	0.073	0.322	0.394
D	0.707	0.965	0.683	0.320	0.073	0.322	0.394
E	1.343	1.960	2.633	0.675	0.612	0.004	0.616
Total	4.173		5.364				**2.193**

3.0 ONE GIRDER PROPERTY

3.1 INTERIOR GIRDER (END BLOCK)



Effective flange width, b_f : (minimum)

a) 1/4 span length = 35.600 ÷ 4 = 8.900 m

b) Center-to-center spacing of girder = 2.170 = 2.170 m

c) Web width + 12 times slab thickness = 1.067 + 12 × 0.200 = 3.467 m

Use b_f = 2.170 m

3.1.1 Properties of Girder

Girder : = 1.390 m^2

Slab : $b_f t$ = 2.170 × 0.200 = 0.434 m^2

Haunch : = 0.041 m^2

3.1.2 For I_X

Girder : = 0.007 m^4

Slab : $nb_f t^3 / 3$ = 0.729 × 2.170 × 0.200^3 ÷ 3 = 0.004 m^4

Total = 0.012 m^4

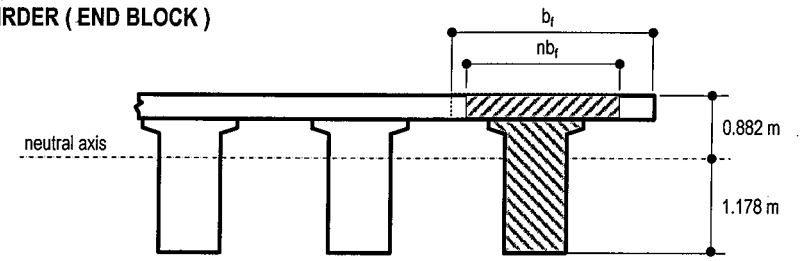
3.1.3 For I_Y

Item	Area, A (m^2)	y (m)	Ay (m^3)	d (m)	Ad^2 (m^4)	I_{Y-Y} (m^4)	$I_Y = I_{Y-Y} + Ad^2$ (m^4)
Girder	1.390	1.085	1.508	0.000	0.000	0.068	0.068
Slab	0.316	1.085	0.343	0.000	0.000	0.066	0.066
Total	1.706		1.851				**0.134**

3.1.4 For I_Z

Item	Area, A (m^2)	y (m)	Ay (m^3)	d (m)	Ad^2 (m^4)	I_{Z-Z} (m^4)	$I_Z = I_{Z-Z} + Ad^2$ (m^4)
Girder	1.390	0.961	1.336	0.185	0.048	0.422	0.470
Slab	0.316	1.960	0.620	0.814	0.209	0.001	0.211
Total	1.706		1.956				**0.680**

3.2 EXTERIOR GIRDER (END BLOCK)



Effective flange width, b_f : (minimum)

a) 1/4 span length	=	35.600	÷	4			=	8.900 m
b) 1/2 girder spacing + length of cantilever	=	1.085	+	1.555			=	2.640 m
c) Web width + 12 times slab thickness	=	1.067	+	12	×	0.200	=	3.467 m
						Use b_f	=	**2.640 m**

3.2.1 Properties of Girder

Girder	:						=	1.390 m^2
Slab	:	$b_f t$ =	2.640	×	0.200		=	0.528 m^2
Haunch	:						=	0.041 m^2

3.2.2 For I_X

Girder	:								=	0.007 m^4
Slab	:	$nb_f t^3 / 3$ =	0.729	×	2.640	×	0.200^3	÷ 3	=	0.005 m^4
								Total	=	**0.013 m^4**

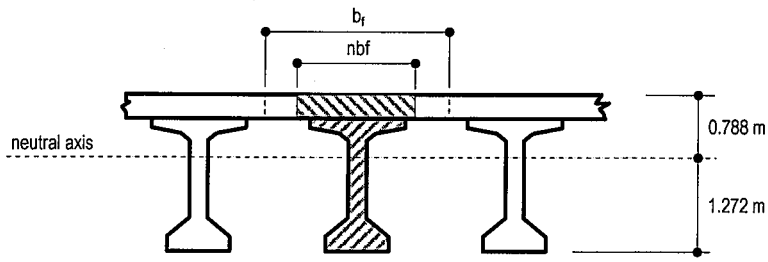
3.2.3 For I_Y

Item	Area, A (m^2)	y (m)	Ay (m^3)	d (m)	Ad^2 (m^4)	I_{Y-Y} (m^4)	$I_Y = I_{Y-Y} + Ad^2$ (m^4)
Girder	1.390	1.555	2.162	0.051	0.004	0.068	0.072
Slab	0.385	1.320	0.508	0.184	0.013	0.119	0.132
Total	1.775		2.670				**0.203**

3.2.4 For I_Z

Item	Area, A (m^2)	y (m)	Ay (m^3)	d (m)	Ad^2 (m^4)	I_{Z-Z} (m^4)	$I_Z = I_{Z-Z} + Ad^2$ (m^4)
Girder	1.390	0.961	1.336	0.217	0.065	0.422	0.487
Slab	0.385	1.960	0.754	0.782	0.236	0.001	0.237
Total	1.775		2.090				**0.724**

3.3 INTERIOR GIRDER (MIDSPAN SECTION)



Effective flange width, b_f : (minimum)

a) 1/4 span length	=	35.600	÷	4			=	8.900 m
b) Center-to-center spacing of girder	=	2.170					=	2.170 m
c) Web width + 12 times slab thickness	=	1.067	+	12	×	0.200	=	3.467 m
						Use b_f	=	**2.170 m**

3.3.1 Properties of Girder

Girder	:						=	0.707 m^2
Slab	:	$b_f t$ =	2.170	×	0.200		=	0.434 m^2
Haunch	:						=	0.041 m^2

3.3.2 For I_X

Girder	:								=	0.007 m^4
Slab	:	$nb_f t^3 / 3$ =	0.729	×	2.170	×	0.200^3	÷ 3	=	0.004 m^4
								Total	=	**0.012 m^4**

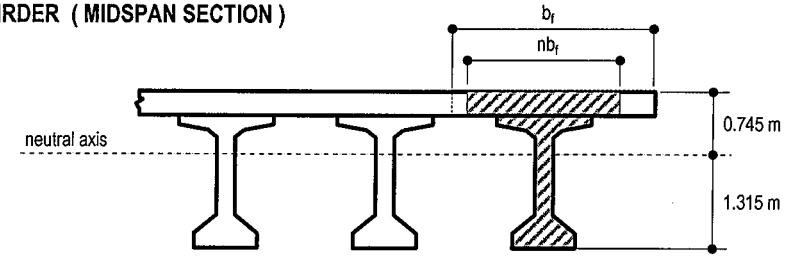
3.3.3 For I_Y

Item	Area, A (m^2)	y (m)	Ay (m^3)	d (m)	Ad^2 (m^4)	I_{Y-Y} (m^4)	$I_Y = I_{Y-Y} + Ad^2$ (m^4)
Girder	0.707	1.085	0.768	0.000	0.000	0.026	0.026
Slab	0.316	1.085	0.343	0.000	0.000	0.066	0.066
Total	1.024		1.111				**0.092**

3.3.4 For I_Z

Item	Area, A (m^2)	y (m)	Ay (m^3)	d (m)	Ad^2 (m^4)	I_{Z-Z} (m^4)	$I_Z = I_{Z-Z} + Ad^2$ (m^4)
Girder	0.707	0.965	0.683	0.307	0.067	0.322	0.388
Slab	0.316	1.960	0.620	0.688	0.150	0.001	0.151
Total	1.024		1.302				**0.539**

3.4 EXTERIOR GIRDER (MIDSPAN SECTION)



Effective flange width, b_f : (minimum)

a) 1/4 span length = 35.600 ÷ 4 = 8.900 m
b) 1/2 girder spacing + length of cantilever = 1.085 + 1.555 = 2.640 m
c) Web width + 12 times slab thickness = 1.067 + 12 × 0.200 = 3.467 m
Use b_f = 2.640 m

3.4.1 Properties of Girder

Girder : = 0.707 m^2
Slab : $b_f t$ = 2.640 × 0.200 = 0.528 m^2
Haunch : = 0.041 m^2

3.4.2 For I_X

Girder : = 0.007 m^4
Slab : $nb_f t^3 / 3$ = 0.729 × 2.640 × 0.200^3 ÷ 3 = 0.005 m^4
Total = **0.013 m^4**

3.4.3 For I_Y

Item	Area, A (m^2)	y (m)	Ay (m^3)	d (m)	Ad^2 (m^4)	I_{Y-Y} (m^4)	$I_Y = I_{Y-Y} + Ad^2$ (m^4)
Girder	0.707	1.555	1.100	0.083	0.005	0.026	0.031
Slab	0.385	1.320	0.508	0.152	0.009	0.119	0.127
Total	1.092		1.608				**0.158**

3.4.4 For I_Z

Item	Area, A (m^2)	y (m)	Ay (m^3)	d (m)	Ad^2 (m^4)	I_{Z-Z} (m^4)	$I_Z = I_{Z-Z} + Ad^2$ (m^4)
Girder	0.707	0.965	0.683	0.350	0.087	0.322	0.409
Slab	0.385	1.960	0.754	0.645	0.160	0.001	0.161
Total	1.092		1.437				**0.570**

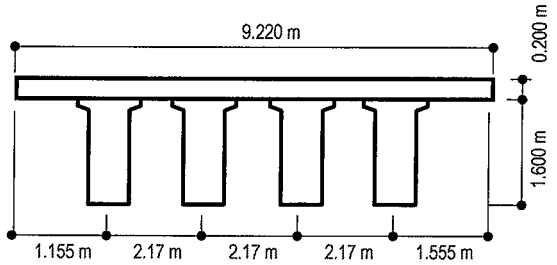
B. TYPE V AASHTO GIRDERS

1.0 MATERIAL SPECIFICATIONS

Modulus of elasticity of prestressed concrete girder, E_c = 29538.84 Mpa
Modulus of elasticity of reinforced concrete slab, E_{cs} = 21520.20 Mpa
Modular ratio, $n = E_{cs} / E_c$ = 0.728539

2.0 WHOLE SUPERSTRUCTURE

2.1 END BLOCK / SOLID PORTION



2.1.1 Properties of Girder

Area of Girder = 1.203 m^2
Centroid of Girder = 0.831 m
Dimension of Haunch : 50 mm

2.1.2 For I_X

Girder : No. of girders x I_{X-X} = 4 × 0.007 = 0.027 m^4
Slab : $nbt^3 / 3$ = 0.729 × 9.220 × 0.200^3 ÷ 3 = 0.018 m^4
Total = **0.045 m^4**

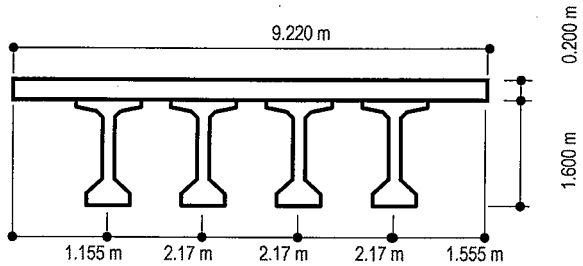
2.1.3 For I_Y

Item	Area, A (m^2)	y (m)	Ay (m^3)	d (m)	Ad^2 (m^4)	I_{Y-Y} (m^4)	$I_Y = I_{Y-Y} + Ad^2$ (m^4)
A	1.203	8.065	9.702	3.299	13.090	0.05989	13.150
B	1.203	5.895	7.092	1.129	1.532	0.05989	1.592
C	1.203	3.725	4.481	1.041	1.305	0.05989	1.364
D	1.203	1.555	1.871	3.211	12.406	0.05989	12.466
E	1.343	4.610	6.193	0.156	0.033	5.05126	5.084
Total	6.155		29.339				**33.657**

2.1.4 For I_Z

Item	Area, A (m^2)	y (m)	Ay (m^3)	d (m)	Ad^2 (m^4)	I_{Z-Z} (m^4)	$I_Z = I_{Z-Z} + Ad^2$ (m^4)
A	1.203	0.831	0.999	0.190	0.043	0.27160	0.315
B	1.203	0.831	0.999	0.190	0.043	0.27160	0.315
C	1.203	0.831	0.999	0.190	0.043	0.27160	0.315
D	1.203	0.831	0.999	0.190	0.043	0.27160	0.315
E	1.343	1.700	2.284	0.680	0.620	0.00448	0.625
Total	6.155		6.282				**1.884**

2.2 MID-SECTION (TYPICAL SECTION)



2.2.1 Properties of Girder

Area of Girder = 0.656 m^2
Centroid of Girder = 0.837 m
Dimension of Haunch : 50 mm

2.2.2 For I_X

Girder : No. of girders x I_{X-X} = 4 × 0.007 = 0.027 m^4

Slab : $nbt^3 / 3$ = 0.729 × 9.220 × 0.200^3 ÷ 3 = 0.018 m^4

Total = **0.045 m^4**

2.2.3 For I_Y

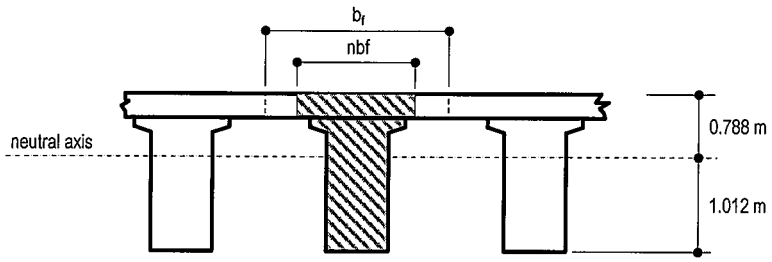
Item	Area, A (m^2)	y (m)	Ay (m^3)	d (m)	Ad^2 (m^4)	I_{Y-Y} (m^4)	$I_Y = I_{Y-Y} + Ad^2$ (m^4)
A	0.656	8.065	5.292	3.323	7.244	0.02580	7.270
B	0.656	5.895	3.868	1.153	0.872	0.02580	0.898
C	0.656	3.725	2.444	1.017	0.679	0.02580	0.705
D	0.656	1.555	1.020	3.187	6.665	0.02580	6.691
E	1.343	4.610	6.193	0.132	0.024	5.05126	5.075
Total	3.968		18.817				**20.638**

2.2.4 For I_Z

Item	Area, A (m^2)	y (m)	Ay (m^3)	d (m)	Ad^2 (m^4)	I_{Z-Z} (m^4)	$I_Z = I_{Z-Z} + Ad^2$ (m^4)
A	0.656	0.837	0.549	0.292	0.056	0.21859	0.275
B	0.656	0.837	0.549	0.292	0.056	0.21859	0.275
C	0.656	0.837	0.549	0.292	0.056	0.21859	0.275
D	0.656	0.837	0.549	0.292	0.056	0.21859	0.275
E	1.343	1.700	2.284	0.571	0.438	0.00448	0.442
Total	3.968		4.480				**1.541**

3.0 ONE GIRDER PROPERTY

3.1 INTERIOR GIRDER (END BLOCK)



Effective flange width, b_f : (minimum)

a) 1/4 span length = 19.300 ÷ 4 = 4.825 m

b) Center-to-center spacing of girder = 2.170 = 2.170 m

c) Web width + 12 times slab thickness = 1.067 + 12 × 0.200 = 3.467 m

Use b_f = 2.170 m

3.1.1 Properties of Girder

Girder : = 1.203 m^2

Slab : $b_f t$ = 2.170 × 0.200 = 0.434 m^2

Haunch : = 0.041 m^2

3.1.2 For I_X

Girder : = 0.007 m^4

Slab : $nb_f t^3 / 3$ = 0.729 × 2.170 × 0.200^3 ÷ 3 = 0.004 m^4

Total = **0.011 m^4**

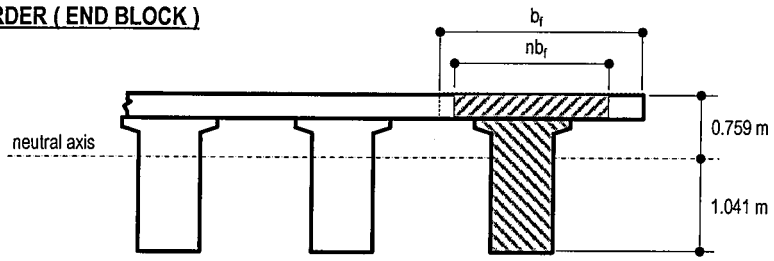
3.1.3 For I_Y

Item	Area, A (m^2)	y (m)	Ay (m^3)	d (m)	Ad^2 (m^4)	I_{Y-Y} (m^4)	$I_Y = I_{Y-Y} + Ad^2$ (m^4)
Girder	1.203	1.085	1.305	0.000	0.000	0.060	0.060
Slab	0.316	1.085	0.343	0.000	0.000	0.066	0.066
Total	1.519		1.648				**0.126**

3.1.4 For I_Z

Item	Area, A (m^2)	y (m)	Ay (m^3)	d (m)	Ad^2 (m^4)	I_{Z-Z} (m^4)	$I_Z = I_{Z-Z} + Ad^2$ (m^4)
Girder	1.203	0.831	0.999	0.181	0.039	0.272	0.311
Slab	0.316	1.700	0.538	0.688	0.150	0.001	0.151
Total	1.519		1.537				**0.462**

3.2 EXTERIOR GIRDER (END BLOCK)



Effective flange width, b_f : (minimum)

a) 1/4 span length	=	19.300	÷	4			=	4.825 m
b) 1/2 girder spacing + length of cantilever	=	1.085	+	1.555			=	2.640 m
c) Web width + 12 times slab thickness	=	1.067	+	12	×	0.200	=	3.467 m
						Use b_f	=	**2.640 m**

3.2.1 Properties of Girder

Girder	:					=	1.203 m^2
Slab	:	$b_f t$ =	2.640	×	0.200	=	0.528 m^2
Haunch	:					=	0.041 m^2
					Total	=	**1.772 m^2**

3.2.2 For I_X

Girder	:							=	0.007 m^4
Slab	:	$nb_f t^3 / 3$ =	0.729	×	2.640	×	0.200^3 ÷ 3	=	0.005 m^4
						Total	=		**0.012 m^4**

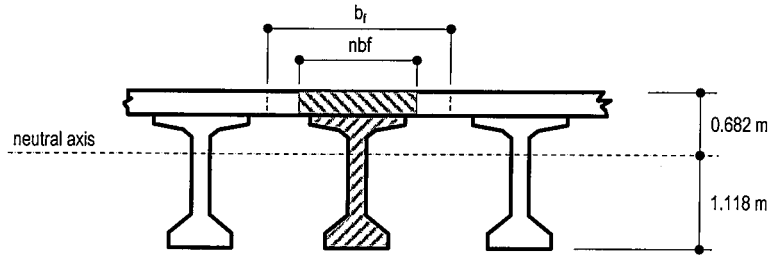
3.2.3 For I_Y

Item	Area, A (m^2)	y (m)	Ay (m^3)	d (m)	Ad^2 (m^4)	I_{Y-Y} (m^4)	$I_Y = I_{Y-Y} + Ad^2$ (m^4)
Girder	1.203	1.555	1.871	0.057	0.004	0.060	0.064
Slab	0.385	1.320	0.508	0.178	0.012	0.119	0.131
Total	1.588		2.378				**0.195**

3.2.4 For I_Z

Item	Area, A (m^2)	y (m)	Ay (m^3)	d (m)	Ad^2 (m^4)	I_{Z-Z} (m^4)	$I_Z = I_{Z-Z} + Ad^2$ (m^4)
Girder	1.203	0.831	0.999	0.211	0.053	0.272	0.325
Slab	0.385	1.700	0.654	0.659	0.167	0.001	0.168
Total	1.588		1.653				**0.493**

3.3 INTERIOR GIRDER (MIDSPAN SECTION)



Effective flange width, b_f : (minimum)

a) 1/4 span length	=	19.300	÷	4			=	4.825 m
b) Center-to-center spacing of girder	=	2.170					=	2.170 m
c) Web width + 12 times slab thickness	=	1.067	+	12	×	0.200	=	3.467 m
						Use b_f	=	**2.170 m**

3.3.1 Properties of Girder

Girder	:					=	0.656 m^2
Slab	:	$b_f t$ =	2.170	×	0.200	=	0.434 m^2
Haunch	:					=	0.041 m^2

3.3.2 For I_X

Girder	:							=	0.007 m^4
Slab	:	$nb_f t^3 / 3$ =	0.729	×	2.170	×	0.200^3 ÷ 3	=	0.004 m^4
						Total	=		**0.011 m^4**

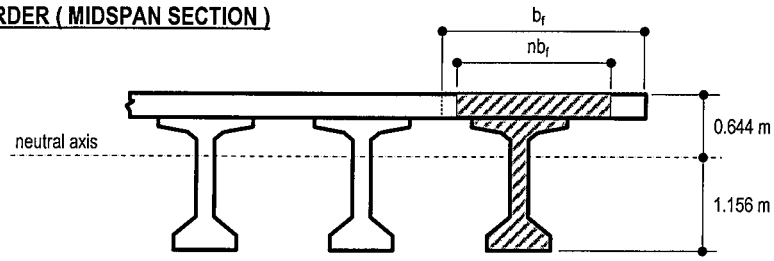
3.3.3 For I_Y

Item	Area, A (m^2)	y (m)	Ay (m^3)	d (m)	Ad^2 (m^4)	I_{Y-Y} (m^4)	$I_Y = I_{Y-Y} + Ad^2$ (m^4)
Girder	0.656	1.085	0.712	0.000	0.000	0.026	0.026
Slab	0.316	1.085	0.343	0.000	0.000	0.066	0.066
Total	0.972		1.055				**0.092**

3.3.4 For I_Z

Item	Area, A (m^2)	y (m)	Ay (m^3)	d (m)	Ad^2 (m^4)	I_{Z-Z} (m^4)	$I_Z = I_{Z-Z} + Ad^2$ (m^4)
Girder	0.656	0.837	0.549	0.281	0.052	0.219	0.270
Slab	0.316	1.700	0.538	0.582	0.107	0.001	0.108
Total	0.972		1.087				**0.379**

3.4 EXTERIOR GIRDER (MIDSPAN SECTION)



Effective flange width, b_f : (minimum)

a) 1/4 span length = 19.300 ÷ 4 = 4.825 m
b) 1/2 girder spacing + length of cantilever = 1.085 + 1.555 = 2.640 m
c) Web width + 12 times slab thickness = 1.067 + 12 × 0.200 = 3.467 m
Use b_f = 2.640 m

3.4.1 Properties of Girder

Girder : = 0.656 m^2
Slab : $b_f t$ = 2.640 × 0.200 = 0.528 m^2
Haunch : = 0.041 m^2

3.4.2 For I_X

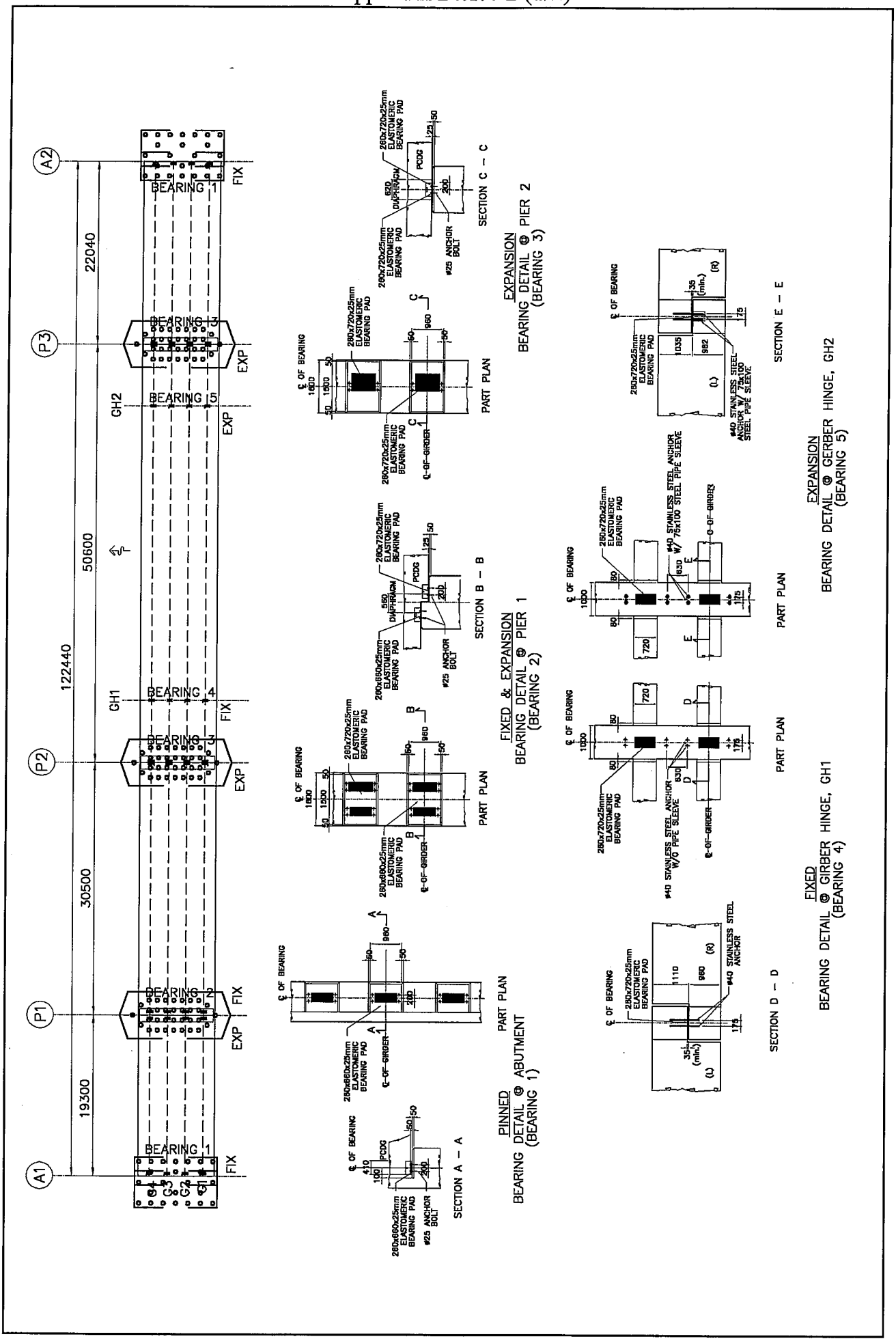
Girder : = 0.007 m^4
Slab : $nb_f t^3 / 3$ = 0.729 × 2.640 × 0.200^3 ÷ 3 = 0.005 m^4
Total = **0.012 m^4**

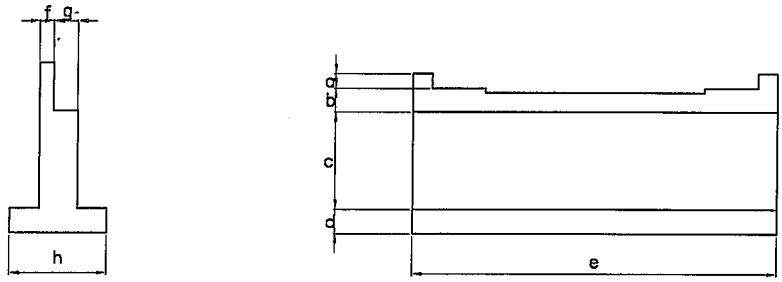
3.4.3 For I_Y

Item	Area, A (m^2)	y (m)	Ay (m^3)	d (m)	Ad^2 (m^4)	I_{Y-Y} (m^4)	$I_Y = I_{Y-Y} + Ad^2$ (m^4)
Girder	0.656	1.555	1.020	0.087	0.005	0.026	0.031
Slab	0.385	1.320	0.508	0.148	0.008	0.119	0.127
Total	1.041		1.528				**0.158**

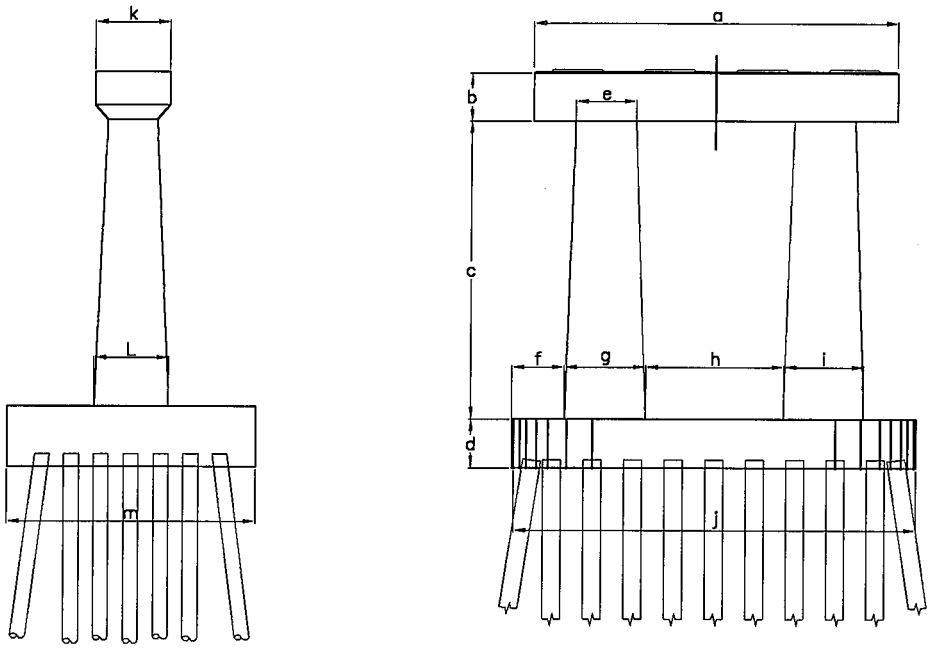
3.4.4 For I_Z

Item	Area, A (m^2)	y (m)	Ay (m^3)	d (m)	Ad^2 (m^4)	I_{Z-Z} (m^4)	$I_Z = I_{Z-Z} + Ad^2$ (m^4)
Girder	0.656	0.837	0.549	0.319	0.067	0.219	0.285
Slab	0.385	1.700	0.654	0.544	0.114	0.001	0.115
Total	1.041		1.203				**0.401**


A1
A2
P1
P2
P3
GH1
GH2
BEARING 1
BEARING 2
BEARING 3
BEARING 4
BEARING 5
FIX
EXP
122440
50600
30500
19300
22040
G1
G2
G3
G4
PINNED
BEARING DETAIL @ ABUTMENT
(BEARING 1)
FIXED & EXPANSION
BEARING DETAIL @ PIER 1
(BEARING 2)
EXPANSION
BEARING DETAIL @ PIER 2
(BEARING 3)
FIXED
BEARING DETAIL @ GIRBER HINGE, GH1
(BEARING 4)
EXPANSION
BEARING DETAIL @ GERBER HINGE, GH2
(BEARING 5)
SECTION A - A
SECTION B - B
SECTION C - C
SECTION D - D
SECTION E - E
PART PLAN
℄ OF BEARING
℄ OF GIRDER
280x660x25mm ELASTOMERIC BEARING PAD
280x720x25mm ELASTOMERIC BEARING PAD
#25 ANCHOR BOLT
#40 STAINLESS STEEL ANCHOR W/ 75x100 STEEL PIPE SLEEVE
#40 STAINLESS STEEL ANCHOR W/O PIPE SLEEVE
#40 STAINLESS STEEL ANCHOR
PCDG
DIAPHRAGM



B. CROSS SECTION OF ABUTMENT



A. CROSS SECTION OF PIER

Pier

	P1	P2	P3
a	9.00	9.00	9.00
b	1.00	1.20	1.20
c	4.30	4.30	4.30
d	1.40	1.40	1.40
e	1.50	1.50	1.50
f	3.06	3.06	3.06
g	1.80	1.80	1.80
h	3.49	3.49	3.49
i	1.80	1.80	1.80
j	13.41	13.41	13.41
k	1.60	1.60	1.60
L	1.80	1.80	1.80
m	5.60	5.60	5.60

Abutment

	A1	A2
a	0.80	0.80
b	1.80	1.727
c	8.540	9.030
d	1.40	1.40
e	10.00	10.00
f	0.40	0.40
g	0.80	0.80
h	6.00	6.00