

**JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)**

**DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS  
REPUBLIC OF THE PHILIPPINES**

**THE DETAILED DESIGN STUDY  
ON  
UPGRADING INTER-URBAN HIGHWAY SYSTEM  
ALONG THE PAN-PHILIPPINE HIGHWAY  
(PLARIDEL, CABANATUAN AND SAN JOSE BYPASSES)**

**FINAL REPORT**

**APPENDICES**



**December 2002**

**KATAHIRA & ENGINEERS INTERNATIONAL  
YACHIYO ENGINEERING CO., LTD**

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# DRAFT FINAL REPORT (APPENDICES)

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### **Slope Stability Calculation for Interchange Ramp**

## 1.0 GENERAL

### 1.1 Interchange Alignment and Profile

The start of the Plaridel Bypass is a connection to the North Luzon Expressway (NLE) with a semi Y-type interchange about 500m west of the existing Buroi Interchange (Figure 1). The outbound side of the proposed interchange is a 500m long ramp (Ramp C) overcrossing the NLE with a 4-span 90m bridge. The profile of the proposed Ramp C is shown in Figure 2.

### 1.2 Cross-Section

Due to the present condition of the site, the north approach of the NLE bridge overcrossing requires a road embankment of about 12.25m at the highest section while the south approach requires about 10.5m of road embankment.

Figure 3 shows the north approach cross-section of the road embankment with 12.0m width at the top and 57.74m base. The side slopes are taken at 1.5:1 with a 3.0m berm at the second level and 1.5m berm at the first level. The total height of embankment is about 12.25m

On the other hand, the south approach cross-section is shown in Figure 4 with a 12.0m wide top and a 47.71m base. The side slope is also 1.5:1 with a 3.0m berm. The total embankment height is about 10.47m.

### 1.3 Soil Condition

The site underlying soil is predominantly clay with ground water at 0.5m below the ground surface. Silty sand is found at 3.5m (about 2m thick) and 4.5m (about 1.0m thick) below the natural ground level for boreholes BH-25 and BH-26 respectively. Below the sand layer is clay which is persistent until the end of the boreholes at 31m and 32.90m below ground.

Figure 5 shows the soil profile on each side of the approach road while Tables 1 and 2 shows the summary of N-values for both boreholes.

Table 1 Soil Data for Borehole BH-25

Depth (m)	Soil Layer	N-values
0 – 3.5	Clay	4 – 10
3.5 – 5.5	Silty Sand	4 - 10
5.5 – 11.0	Clay	4 – 14
11.0 – 19.0	Clay	18 - 29
19.0 – 26.0	Clay	32 - 40
26.0 – 31.0	Clay	> 50

B.M. NO.	COORDINATES		DESCRIPTION
	NORTHING	EASTING	
1	1,641,232.841	488,100.464	IT IS LOCATED ON A RICE PADDY INTERSECTION ON THE LEFT OF THE ALIGNMENT IN BAHANGAY BUKOL 2, OQUINTO, BULACAL. IT IS 20M. FROM END OF DIRT ROAD.
2	1,641,598.386	488,743.032	IT IS LOCATED ON A RICE PADDY INTERSECTION ON THE LEFT OF THE ALIGNMENT IN BAHANGAY PULONG GUSAT, PLARDEL.

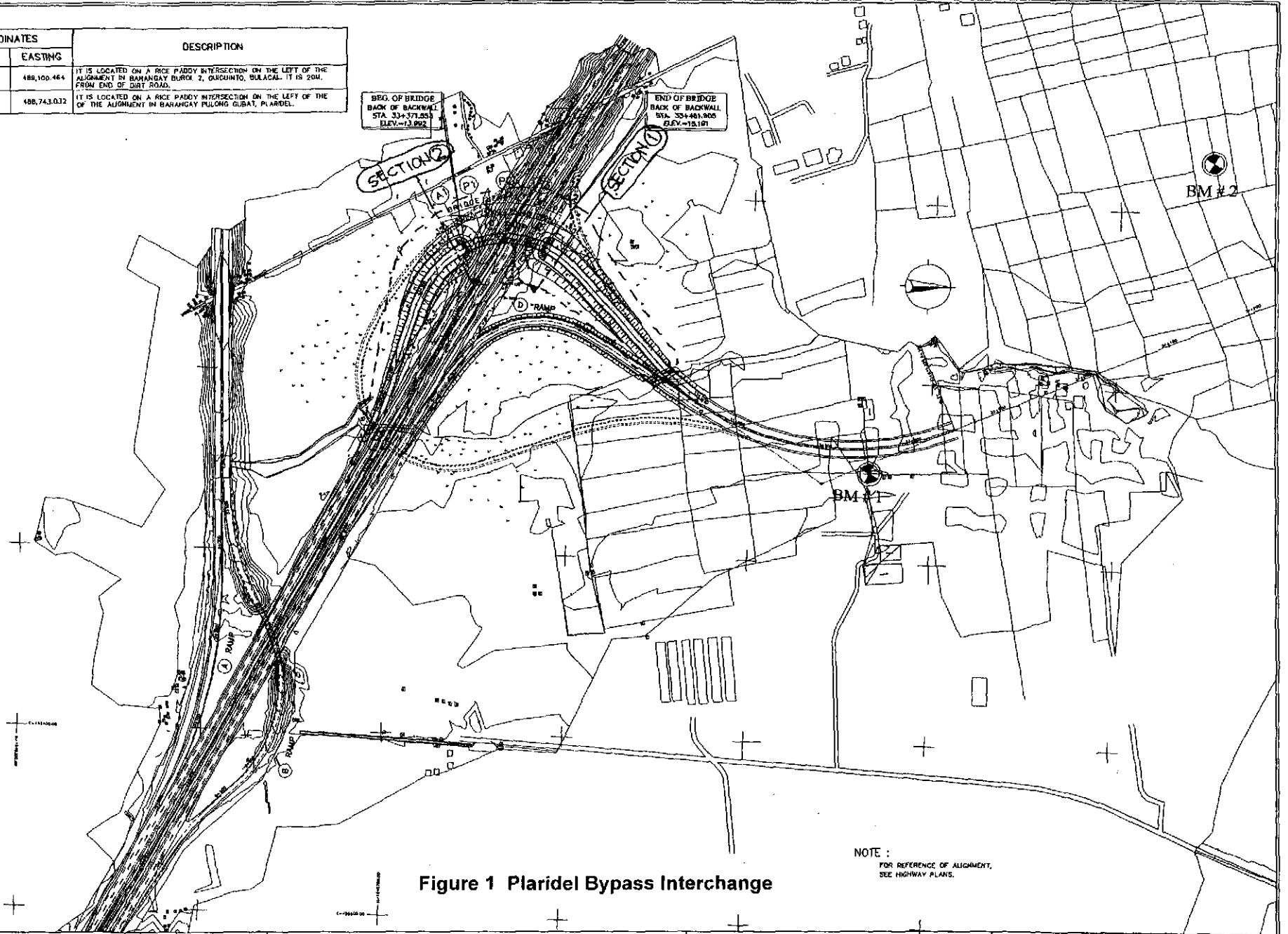


Figure 1 Plaridel Bypass Interchange

NOTE :  
FOR REFERENCE OF ALIGNMENT,  
SEE HIGHWAY PLANS.

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INTERNATIONAL

**YEO** YACHIOI ENGINEERING  
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DATE	SIGNATURE	REPUBLIC OF THE PHILIPPINES DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
DESIGNED	F. P. DE JESUS	BUREAU OF DESIGN
CHECKED	A. C. SANTOS	OFFICE OF THE SECRETARY
SUBMITTED	M. VICTOR REAL LEDESMA	Project Director
Reviewed By:	ADRIANO M. GONZALEZ Chief, Bridges Section	Recommended By:
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		Approved By:

PROJECT AND LOCATION :  
THE DETAILED DESIGN STUDY ON  
UPGRADING INTER-URBAN HIGHWAY SYSTEM  
ALONG THE PAN-PHILIPPINE HIGHWAY  
(Plaridel, Cabanatuan and San Jose Bypasses)

PLARIDEL BYPASS - CONTRACT PACKAGE I

SCALE :  
AS SHOWN  
FULL SIZE A1

SHEET CONTENTS :  
INTERCHANGE RAMP  
HORIZONTAL AND VERTICAL CONTROL  
MONUMENTS

SHEET NO. :  
RB-05



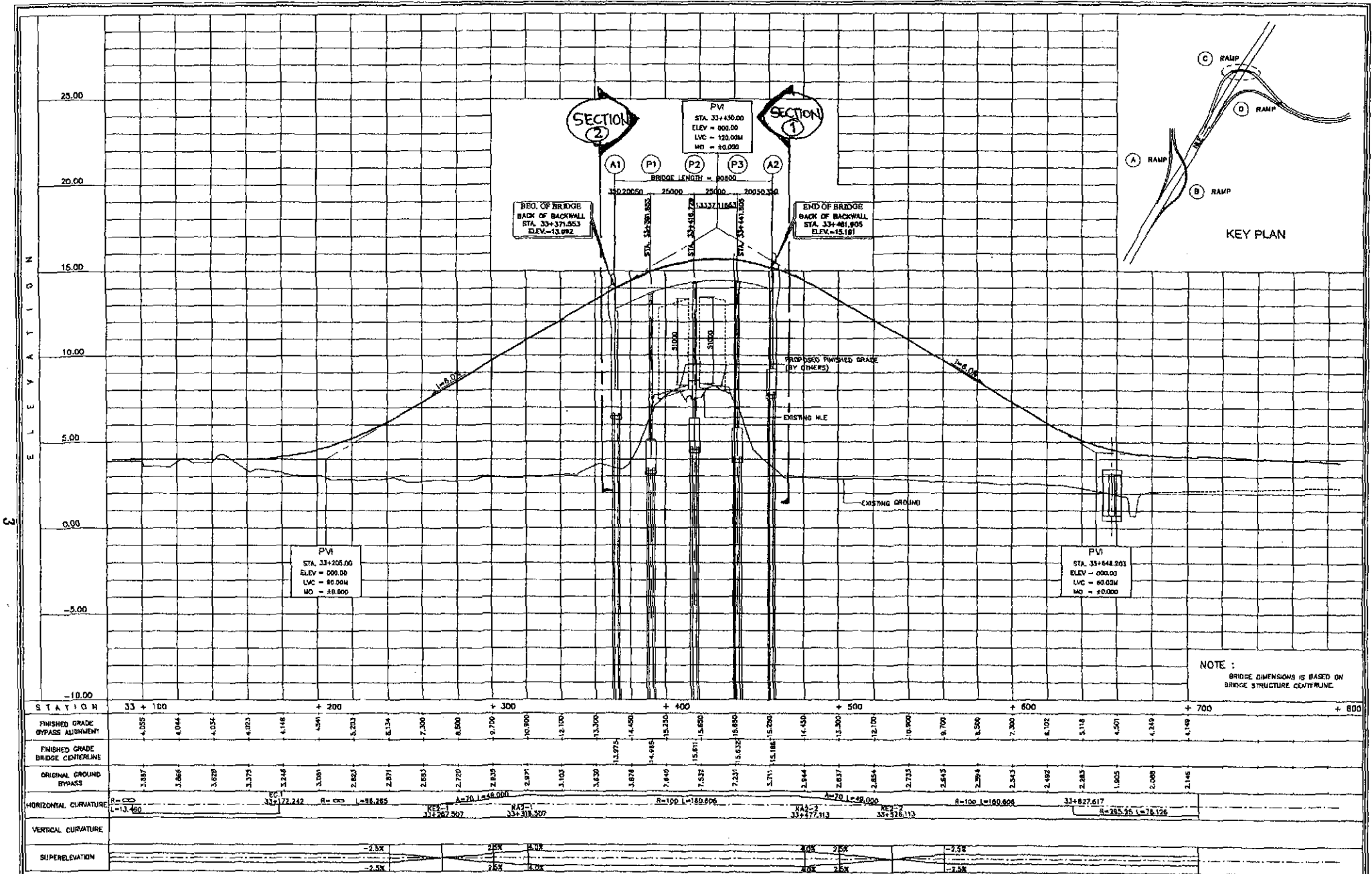


Figure 2 Profile of Interchange Ramp C

 JAPAN INTERNATIONAL COOPERATION AGENCY		 DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS				SCALE: AS SHOWN FULL SIZE A1		SHEET CONTENTS: INTERCHANGE RAMP (C) RAMP GENERAL PROFILE		SHEET NO.: RB-06	
DESIGNED BY	DATE	SIGNATURE	SUBMITTED BY: <b>M. KUSUMI</b> TEAM LEADER		CHECKED BY: <b>J. C. SANTOS</b>		APPROVED BY: <b>DANLO C. TRAVANO</b> Project Director		OFFICE OF THE SECRETARY Recommended By: <b>ADRIANO M. DORAY</b> Chief, Bridge Division Recommended By: <b>DILBERTO S. REYES</b> Director (OPC)		
KATAHIRA & ENGINEERS INTERNATIONAL		 YEO FACIYO ENGINEERING CO., LTD.		OFFICE OF THE SECRETARY (This space left for the use of the Secretary/Approved)		APPROVED BY: <b>MANUEL M. BENDAN</b> Undersecretary <b>SMELIN A. DATUMANG</b> Secretary		THE UNFINISHED DESIGN STUDY ON UPGRADING INTER-URBAN HIGHWAY SYSTEM ALONG THE PAN-PHILIPPINE HIGHWAY (Plaridel, Cabanatuan and San Jose Bypasses)		PLARIDEL BYPASS - CONTRACT PACKAGE I	

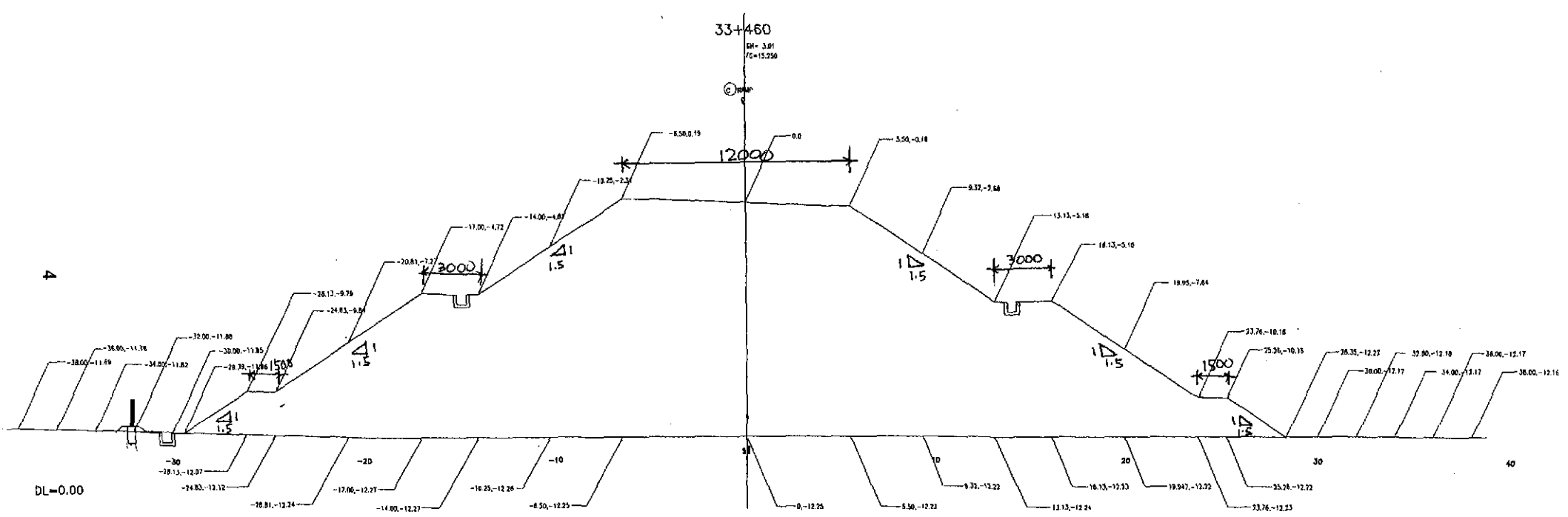


Figure 3 North Approach Embankment Cross-Section

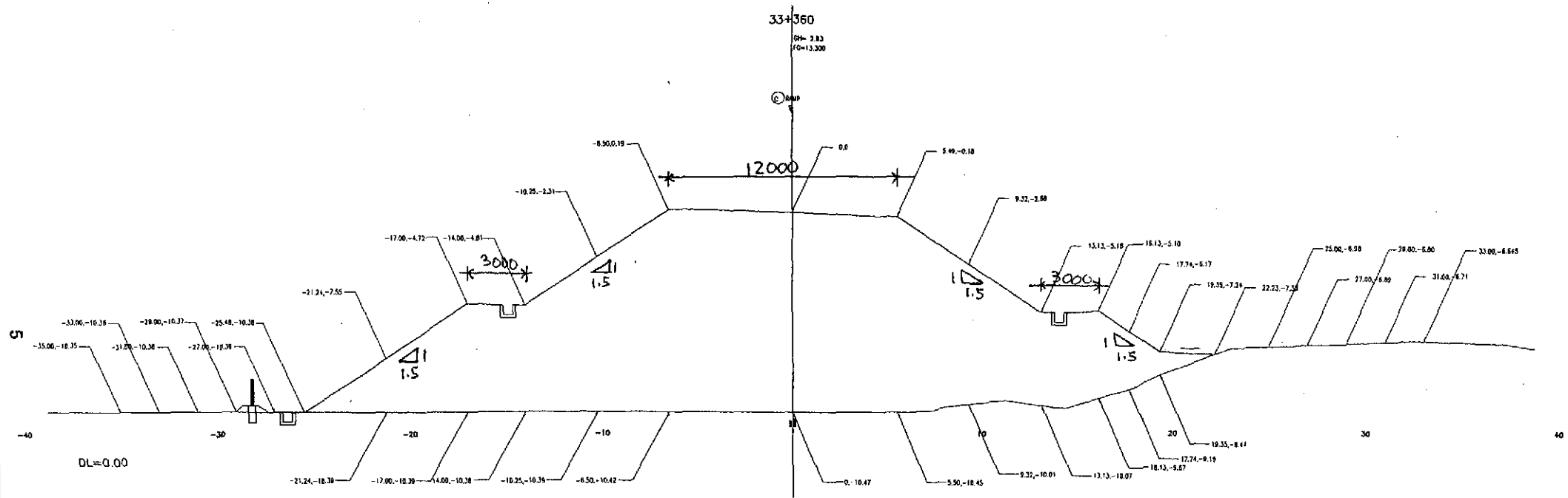


Figure 4 South Approach Embankment Cross-Section

Table 2 Soil Data for Borehole BH-26

Depth (m)	Soil Layer	N-values
0 – 4.5	Clay	8 – 15
4.5 – 5.5	Silty Sand	7 - 8
5.5 – 9.0	Clay	7 – 12
9.0 – 12.0	Clay	18 - 23
12.0 – 27.0	Clay	26 - 51
27.0 – 32.9	Clay	> 50

In the analysis, the angle of internal friction for sandy soil and the cohesion for cohesive soil is required, but the data available is only the N-values at the boreholes. The N-values obtained at each borehole will be converted to the parameters required for analysis. Figure 6 shows the relationship between N-values and angle of internal friction for sandy soil and cohesion for cohesive soils.

#### 1.4 Design Outline and Methodology

This report presents the stability analysis of the embankment for the Interchange road ramps and the safety of embankments to failure.

- For slopes in relatively homogenous soil, the failure surface is approximated by a circular arc, along which the resisting and rupturing forces can be analyzed.
- The stability of embankment is evaluated by comparison of the forces resisting failure with those tending to cause rupture along the assumed slope surface. The ratio of the forces is the factor of safety.
- A free body of slope is considered to be acted upon by known or assumed forces. Shear stresses induced on the assumed failure surface by the body and external forces are compared with the available shear strength of the material. In the analysis, the load-deformation characteristic of the material is not taken into account.
- The method of slices, which is the rotational failure analysis, is used in the limit equilibrium solutions. The minimum factor of safety is calculated by trying several circles. The soil mass within the assumed slip surface is divided into several slices, and the forces acting on each slice are considered. The effect of earthquake may be considered by applying an appropriate horizontal force on the slice.

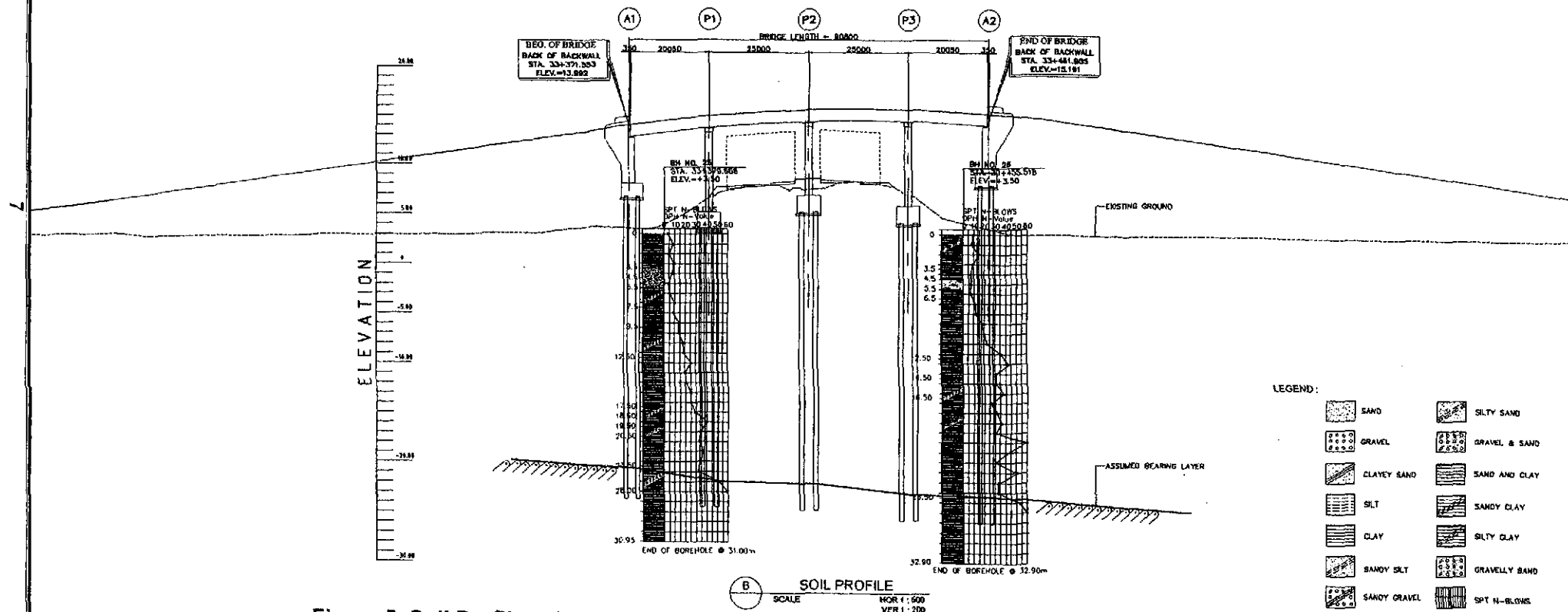
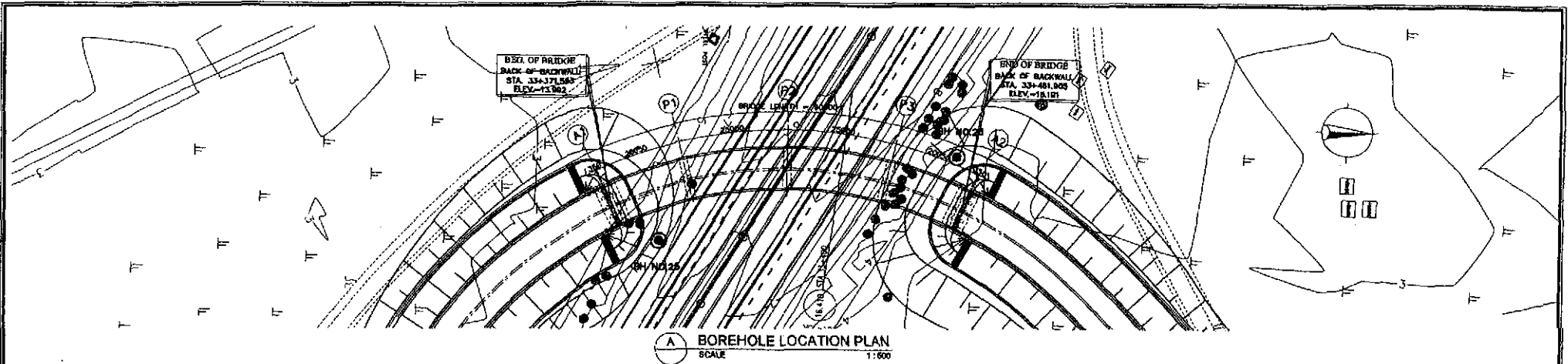
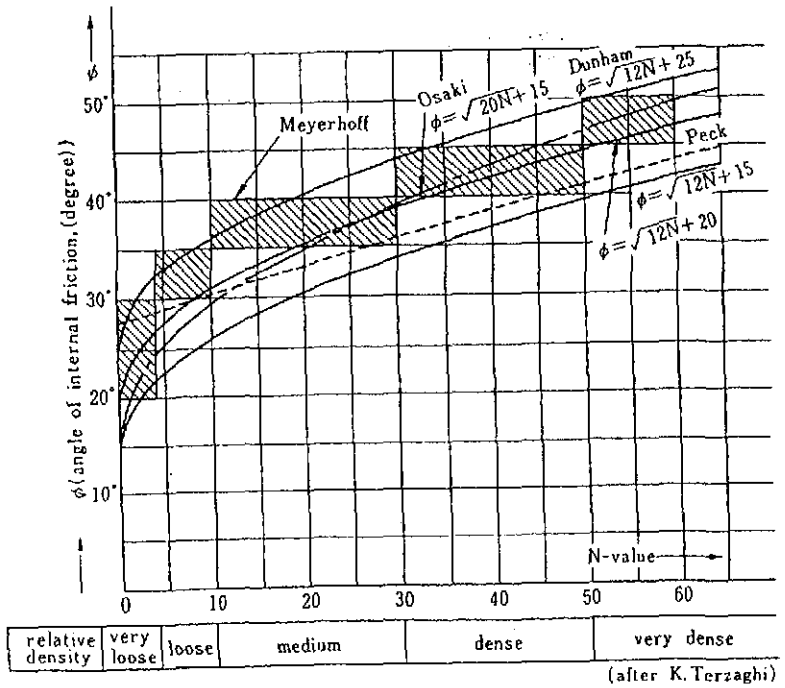
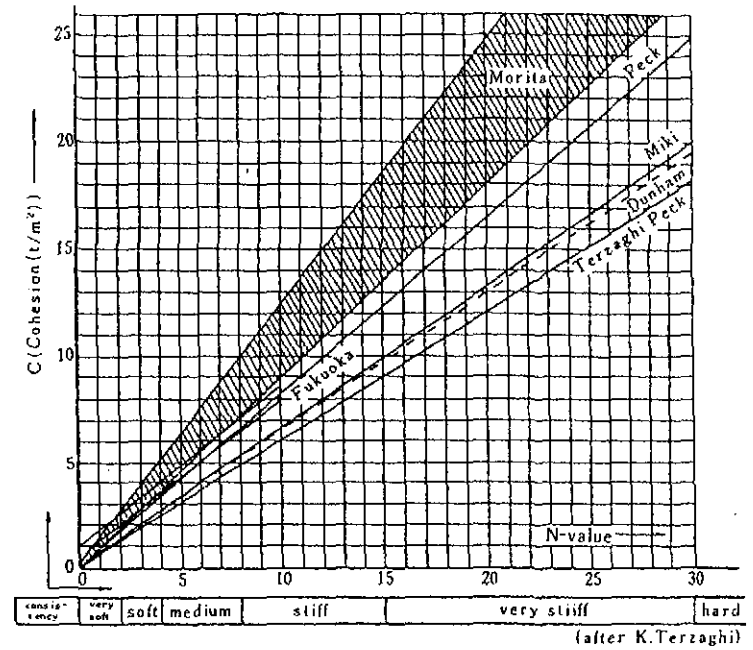


Figure 5 Soil Profile at Interchange

	DATE	SIGNATURE				PROJECT AND LOCATION :	SCALE :	SHEET CONTENTS :	SHEET NO. :
	DESIGNED	F. P. DE JESUS	REPUBLIC OF THE PHILIPPINES DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS			THE DETAILED DESIGN STUDY ON UPGRADING INTER-URBAN HIGHWAY SYSTEM ALONG THE PAN-PHILIPPINE HIGHWAY (Plaridel, Cabanatuan and San Jose Bypasses) PLARIDEL BYPASS - CONTRACT PACKAGE I	AS SHOWN FULL SIZE A1	INTERCHANGE RAMP BOREHOLE LOCATION PLAN AND SOIL PROFILE	RB-10
	CHECKED	J. C. SANTON	BUREAU OF DESIGN OFFICE OF THE SECRETARY						
SUBMITTED	AL. MARIANO	Submitted By: DANILO C. TALAJALO Project Director	Reviewed By: JOSEMAN M. BANCAY Chief, Bridge Division	Recommended By: BILBERTO S. REYES Director	Recommended By: MANUEL M. BOMBON Undersecretary				



Angle of Internal Friction and N-value for Sandy Soil



Cohesion and N-value for Cohesive Soil

Figure 6 Relationships Between N-values,  $\Phi$  and Cohesion

- Required Factor of Safety

For a reasonable assurance of stability, the following safety factors are considered (NAVFAC DM – 7.1):

▪ Permanent or sustained loading	-	1.5
▪ Temporary loading condition	-	1.3
▪ Transient, e.g. Earthquake	-	1.15

## 2.0 ANALYSIS MODEL

Following the cross-sections shown in Figures 3 and 4 for the north and south embankment approaches, an analytical model is established by dividing the embankment and existing soil into layers with different geometry and soil characteristics.

Figure 7 presents the analytical model for the embankment on the north approach with seven soil layers. The ground water is assumed at 0.5m below the existing ground surface.

On the other hand, Figure 8 presents the analytical model for the embankment on the south approach with six soil layers. The ground water is also taken at 0.50m below the ground surface.

For both models, a surcharge of  $1.08 \text{ tf/m}^2$  is applied equivalent to 0.60m of soil.

A circular slip surface is assumed as the failure surface for both models and the minimum safety factor is calculated for the different trial circles. The analysis is carried-out using the software **COSTANA ver 2** which follows the recommendations of the Japan Public Highway Corporation.

Interchange Right Embankment

縮尺 : 1 / 800

層番号	飽和重量 ( $t f / m^3$ )	湿潤重量 ( $t f / m^3$ )	$\Phi$ (deg)	Cohesion ( $t f / m^2$ )	粘着力の 一次係数	水平震度	鉛直震度
1	1.900	1.800	35.0	0.00	0.00	0.100	0.000
2	1.900	1.800	35.0	0.00	0.00	0.100	0.000
3	1.900	1.800	35.0	0.00	0.00	0.100	0.000
4	1.700	1.600	0.0	8.00	0.00	0.000	0.000
5	1.700	1.600	30.0	1.00	0.00	0.000	0.000
6	1.700	1.600	0.0	7.00	0.00	0.000	0.000
7	1.700	1.600	0.0	15.00	0.00	0.000	0.000

水の単位体積重量 = 1.000 ( $t f / m^3$ )

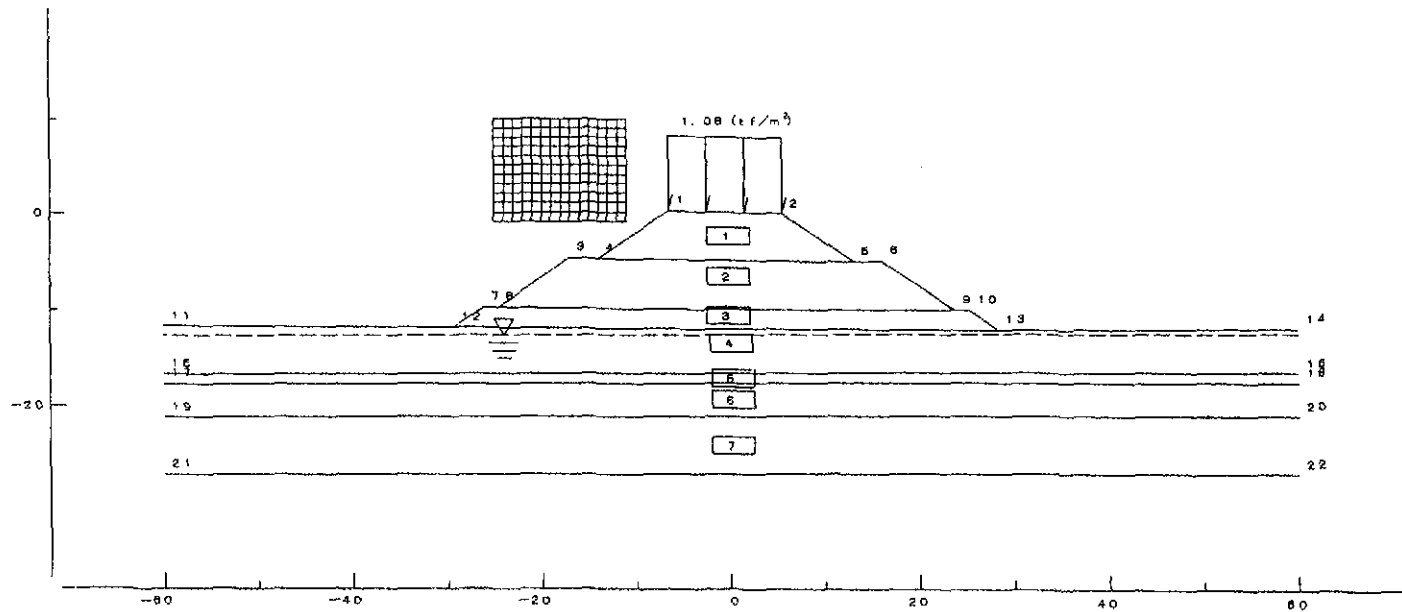


Figure 7 North Approach Embankment Analysis Model



Interchange Left Embankment

縮尺 : 1 / 800

層番号	飽和重量 ( $\text{tf}/\text{m}^3$ )	湿潤重量 ( $\text{tf}/\text{m}^3$ )	$\phi$ (deg)	Cohesion ( $\text{tf}/\text{m}^2$ )	粘着力の 一次係数	水平震度	鉛直震度
1	1.900	1.900	35.0	0.00	0.00	0.100	0.000
2	1.900	1.900	35.0	0.00	0.00	0.100	0.000
3	1.700	1.700	0.0	6.80	0.00	0.000	0.000
4	1.700	1.700	29.0	1.00	0.00	0.000	0.000
5	1.700	1.700	0.0	6.00	0.00	0.000	0.000
6	1.700	1.700	0.0	15.00	0.00	0.000	0.000

水の単位体積重量 = 1.000 ( $\text{tf}/\text{m}^3$ )

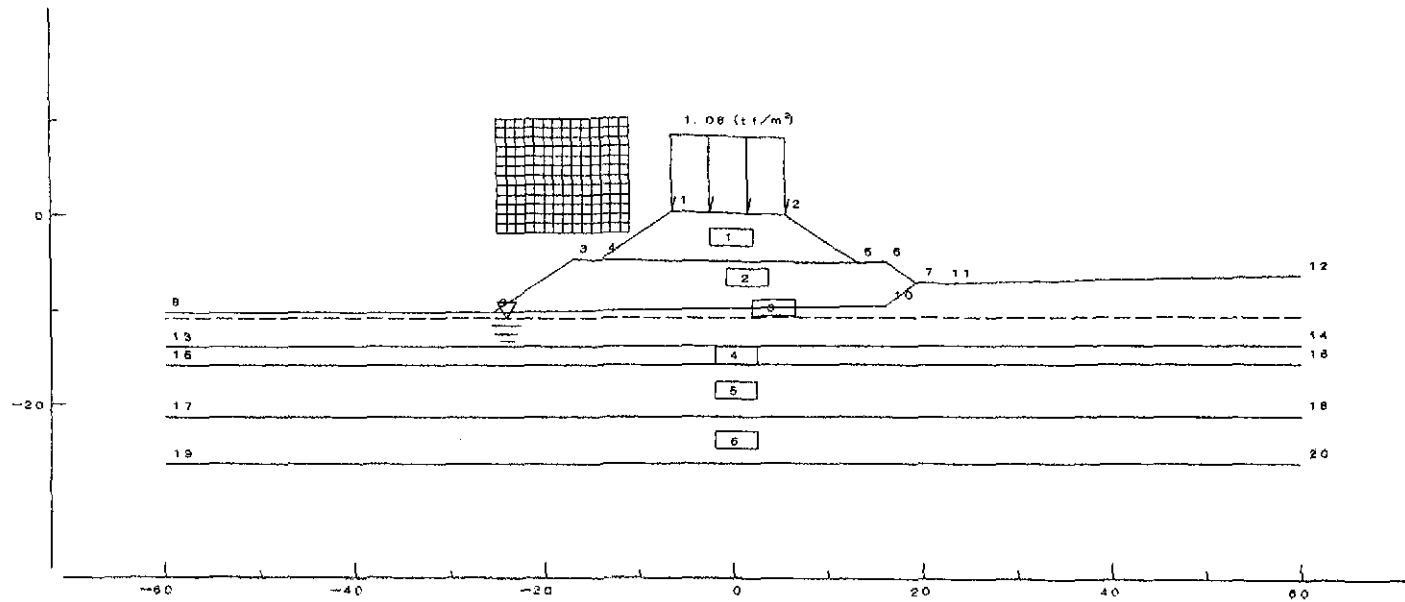


Figure 8 South Approach Embankment Analysis Model

### 3.0 RESULTS

The results of analysis indicates that both the north and south approaches of the Interchange ramp are relatively stable with the minimum factors of safety under service condition greater than 1.5. Figures 9 to 14 and Tables 3, 4a and 4b present the results of the analysis.

Table 3 Results of Analysis for North Embankment Approach

Service Load Condition		Seismic Condition	
Minimum Factor of Safety	1.67	Minimum Factor of Safety	1.50
Calculated Radius of Failure	24.03	Calculated Radius of Failure	24.03
Resisting Moment (tf-m)	8199.0	Resisting Moment (tf-m)	8073.0
Rupture Moment (tf-m)	4921.8	Rupture Moment (tf-m)	5390.9

Table 4a Results of Analysis for South Embankment Approach (Left Side Failure)

Service Load Condition		Seismic Condition	
Minimum Factor of Safety	1.54	Minimum Factor of Safety	1.38
Calculated Radius of Failure	20.25	Calculated Radius of Failure	21.94
Resisting Moment (tf-m)	5025.4	Resisting Moment (tf-m)	5588.8
Rupture Moment (tf-m)	3263.9	Rupture Moment (tf-m)	4036.6

Table 4b Results of Analysis for South Embankment Approach (Right Side Failure)

Service Load Condition		Seismic Condition	
Minimum Factor of Safety	2.07	Minimum Factor of Safety	1.90
Calculated Radius of Failure	19.76	Calculated Radius of Failure	20.05
Resisting Moment (tf-m)	5588.5	Resisting Moment (tf-m)	5551.8
Rupture Moment (tf-m)	2696.6	Rupture Moment (tf-m)	2939.01

Interchange Right Embankment

縮尺 : 1 / 800

Minimum Safety Factor  $F_s$  MIN = 1.666  
 円弧の中心 X = -18.00 (m)  
 Y = 3.00 (m)  
 半径 R = 24.03 (m)  
 抵抗モーメント  $M_R$  = 8199.00 (tf·m)  
 起動モーメント  $M_o$  = 4921.77 (tf·m)

層番号	飽和重量 (tf/m <sup>3</sup> )	湿潤重量 (tf/m <sup>3</sup> )	内部摩擦角 (度)	粘着力 (tf/m <sup>2</sup> )	粘着力の 一次係数	水平震度	鉛直震度
1	1.900	1.800	35.0	0.00	0.00	0.000	0.000
2	1.900	1.800	35.0	0.00	0.00	0.000	0.000
3	1.900	1.800	35.0	0.00	0.00	0.000	0.000
4	1.700	1.600	0.0	8.00	0.00	0.000	0.000
5	1.700	1.600	30.0	1.00	0.00	0.000	0.000
6	1.700	1.600	0.0	7.00	0.00	0.000	0.000
7	1.700	1.600	0.0	16.00	0.00	0.000	0.000

水の単位体積重量 = 1.000 (tf/m<sup>3</sup>)

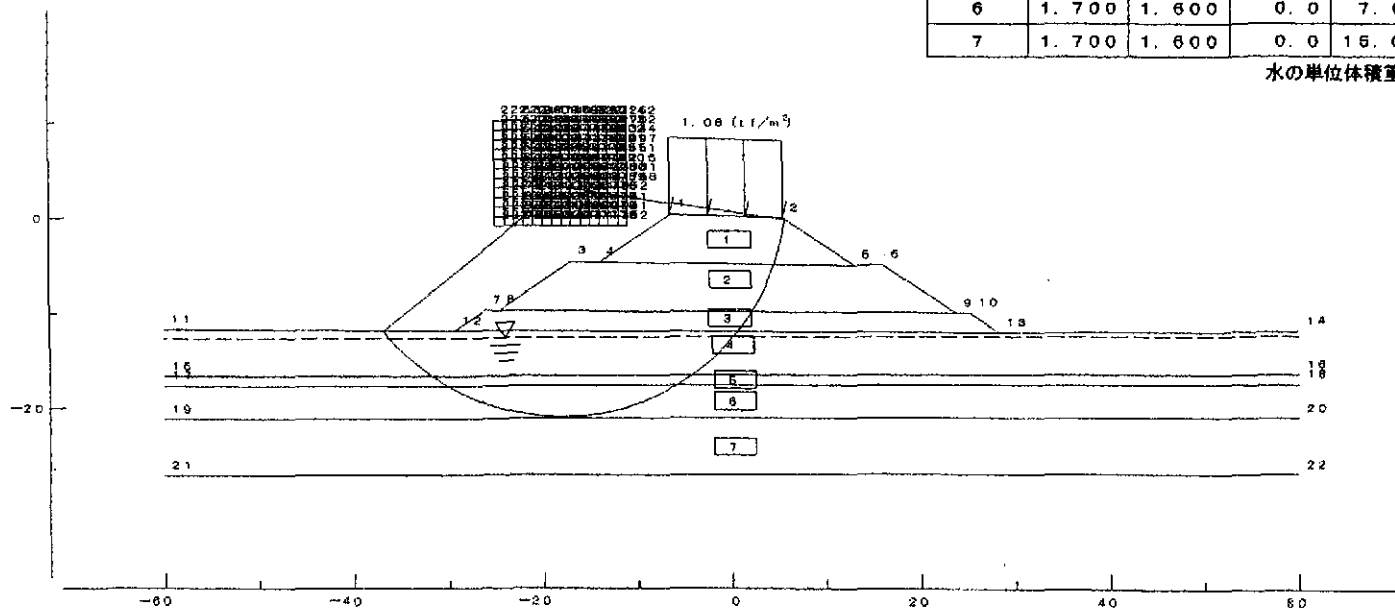


Figure 9 North Approach Embankment Stability – Service Condition

Interchange Right Embankment

縮尺 : 1 / 800

Minimum Safety Factor  $F_{s \text{ MIN}} = 1.498$   
 円弧の中心 X = -18.00 (m)  
 Y = 3.00 (m)  
 半径 R = 24.03 (m)  
 抵抗モーメント  $M_R = 8072.95 \text{ (tf}\cdot\text{m)}$   
 起動モーメント  $M_0 = 5390.94 \text{ (tf}\cdot\text{m)}$

層番号	飽和重量 ( $\text{tf}/\text{m}^3$ )	湿潤重量 ( $\text{tf}/\text{m}^3$ )	内部摩擦角 (度)	粘着力 ( $\text{tf}/\text{m}^2$ )	粘着力の 一次係数	水平震度	鉛直震度
1	1.900	1.800	35.0	0.00	0.00	0.100	0.000
2	1.900	1.800	35.0	0.00	0.00	0.100	0.000
3	1.900	1.800	35.0	0.00	0.00	0.100	0.000
4	1.700	1.600	0.0	8.00	0.00	0.000	0.000
5	1.700	1.600	30.0	1.00	0.00	0.000	0.000
6	1.700	1.600	0.0	7.00	0.00	0.000	0.000
7	1.700	1.600	0.0	15.00	0.00	0.000	0.000

水の単位体積重量 = 1.000 ( $\text{tf}/\text{m}^3$ )

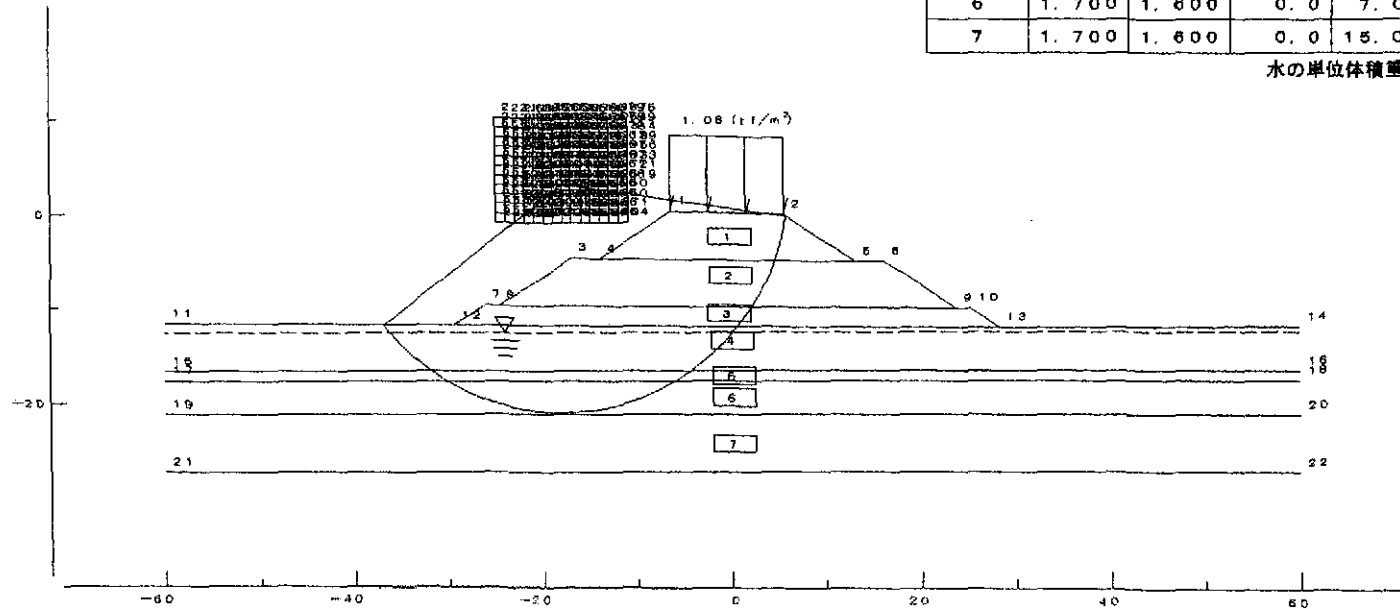


Figure 10 North Approach Embankment Stability – Seismic Condition

Interchange Left Embankment

縮尺 : 1 / 800

Minimum Safety Factor  $F_s \text{ MIN} = 1.540$   
 円弧の中心  $X = -16.00 \text{ (m)}$   
 $Y = 2.00 \text{ (m)}$   
 半径  $R = 20.25 \text{ (m)}$   
 抵抗モーメント  $M_R = 5025.44 \text{ (tf}\cdot\text{m)}$   
 起動モーメント  $M_o = 3263.88 \text{ (tf}\cdot\text{m)}$

層番号	飽和重量 ( $\text{tf}/\text{m}^3$ )	湿潤重量 ( $\text{tf}/\text{m}^3$ )	内部摩擦角 (度)	粘着力 ( $\text{tf}/\text{m}^2$ )	粘着力の 一次係数	水平震度	鉛直震度
1	1.900	1.900	35.0	0.00	0.00	0.000	0.000
2	1.900	1.900	35.0	0.00	0.00	0.000	0.000
3	1.700	1.700	0.0	6.50	0.00	0.000	0.000
4	1.700	1.700	29.0	1.00	0.00	0.000	0.000
5	1.700	1.700	0.0	6.00	0.00	0.000	0.000
6	1.700	1.700	0.0	15.00	0.00	0.000	0.000

水の単位体積重量 =  $1.000 \text{ (tf}/\text{m}^3)$

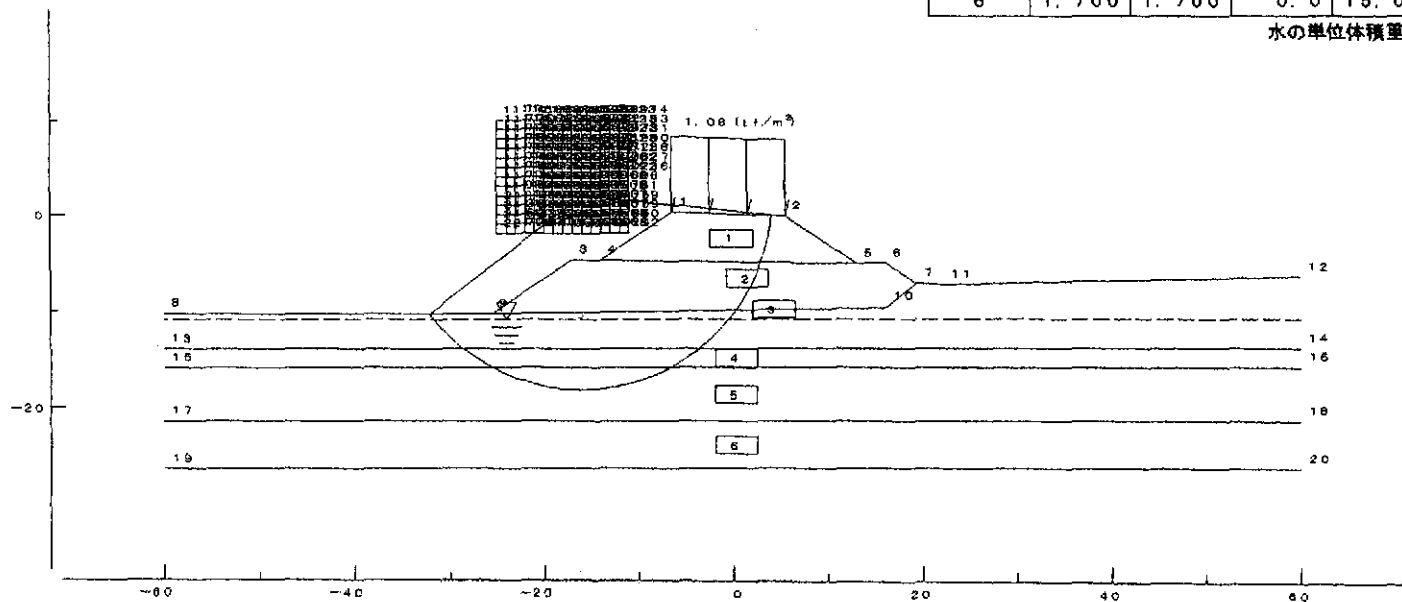


Figure 11 South Approach Embankment Stability – Service Condition (Left)

Interchange Left Embankment

縮尺 : 1 / 800

Minimum Safety Factor  $F_{s \text{ MIN}} = 1.385$   
 円弧の中心 X = -16.00 (m)  
 Y = 4.00 (m)  
 半径 R = 21.94 (m)  
 抵抗モーメント  $M_R = 5588.79 \text{ (tf}\cdot\text{m)}$   
 起動モーメント  $M_o = 4036.64 \text{ (tf}\cdot\text{m)}$

層番号	飽和重量 ( $\text{tf}/\text{m}^3$ )	湿潤重量 ( $\text{tf}/\text{m}^3$ )	内部摩擦角 (度)	粘着力 ( $\text{tf}/\text{m}^2$ )	粘着力の 一次係数	水平震度	鉛直震度
1	1.900	1.900	35.0	0.00	0.00	0.100	0.000
2	1.900	1.900	35.0	0.00	0.00	0.100	0.000
3	1.700	1.700	0.0	6.60	0.00	0.000	0.000
4	1.700	1.700	29.0	1.00	0.00	0.000	0.000
5	1.700	1.700	0.0	6.00	0.00	0.000	0.000
6	1.700	1.700	0.0	15.00	0.00	0.000	0.000

水の単位体積重量 = 1.000 ( $\text{tf}/\text{m}^3$ )

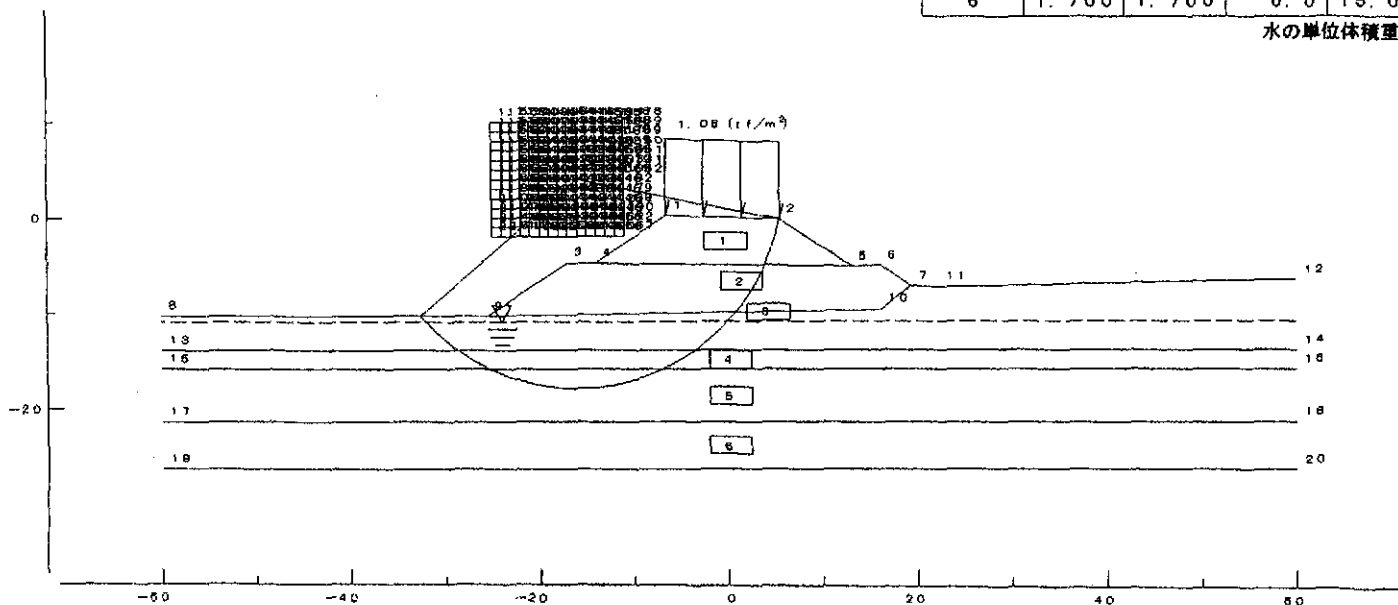


Figure 12 South Approach Embankment Stability – Seismic Condition (Left)

Interchange Left Embankment

縮尺 : 1 / 800

Minimum Safety Factor  $F_{B \text{ MIN}} = 2.072$   
 円弧の中心 X = 13.00 (m)  
 Y = 0.00 (m)  
 半径 R = 19.76 (m)  
 抵抗モーメント  $M_R = 5588.46 \text{ (tf} \cdot \text{m)}$   
 起動モーメント  $M_o = 2696.56 \text{ (tf} \cdot \text{m)}$

層番号	飽和重量 ( $\text{tf}/\text{m}^3$ )	湿潤重量 ( $\text{tf}/\text{m}^3$ )	内部摩擦角 (度)	粘着力 ( $\text{tf}/\text{m}^2$ )	粘着力の 一次係数	水平震度	鉛直震度
1	1.900	1.900	35.0	0.00	0.00	0.000	0.000
2	1.900	1.900	35.0	0.00	0.00	0.000	0.000
3	1.700	1.700	0.0	6.50	0.00	0.000	0.000
4	1.700	1.700	29.0	1.00	0.00	0.000	0.000
5	1.700	1.700	0.0	6.00	0.00	0.000	0.000
6	1.700	1.700	0.0	15.00	0.00	0.000	0.000

水の単位体積重量 = 1.000 ( $\text{tf}/\text{m}^3$ )

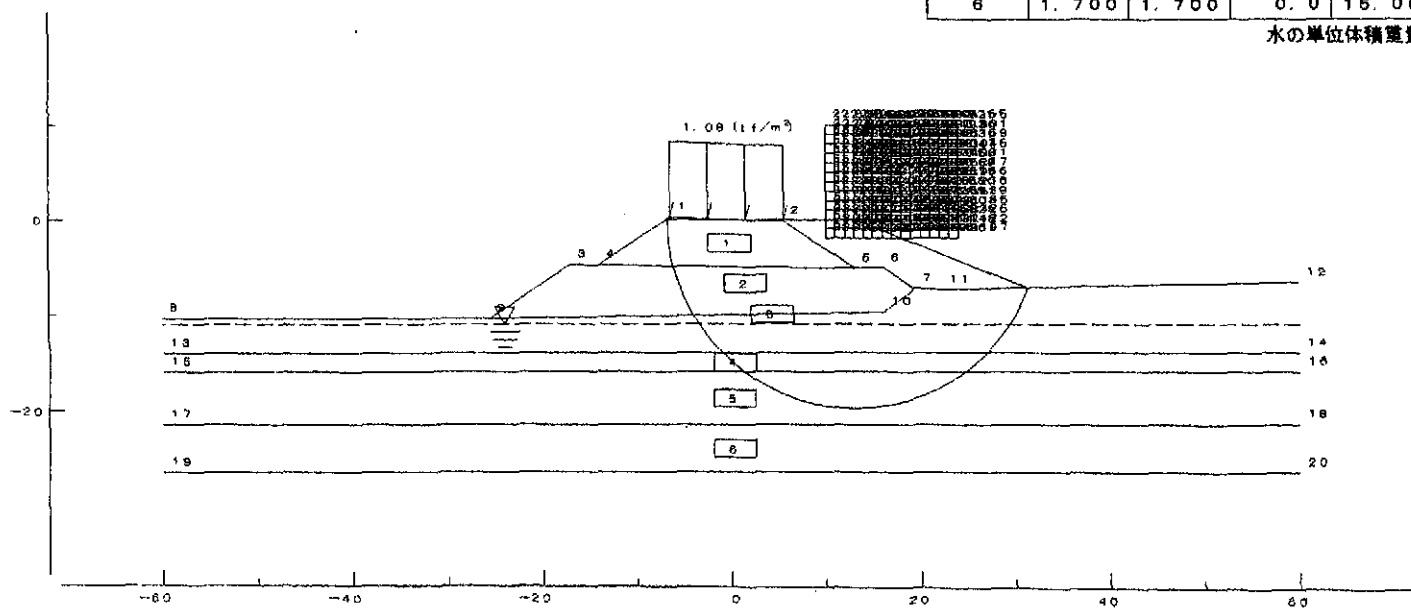


Figure 13 South Approach Embankment Stability – Service Condition (Right)

Interchange Left Embankment

縮尺 : 1 / 800

Minimum Safety Factor  $F_s \text{ MIN} = 1.889$   
 円弧の中心 X = 12.00 (m)  
 Y = 1.00 (m)  
 半径 R = 20.05 (m)  
 抵抗モーメント  $M_R = 5551.81 \text{ (tf}\cdot\text{m)}$   
 起動モーメント  $M_o = 2939.01 \text{ (tf}\cdot\text{m)}$

層番号	飽和重量 ( $\text{tf}/\text{m}^3$ )	湿潤重量 ( $\text{tf}/\text{m}^3$ )	内部摩擦角 (度)	粘着力 ( $\text{tf}/\text{m}^2$ )	粘着力の 一次係数	水平震度	鉛直震度
1	1.900	1.900	35.0	0.00	0.00	0.100	0.000
2	1.900	1.900	35.0	0.00	0.00	0.100	0.000
3	1.700	1.700	0.0	6.50	0.00	0.000	0.000
4	1.700	1.700	29.0	1.00	0.00	0.000	0.000
5	1.700	1.700	0.0	6.00	0.00	0.000	0.000
6	1.700	1.700	0.0	15.00	0.00	0.000	0.000

水の単位体積重量 = 1.000 ( $\text{tf}/\text{m}^3$ )

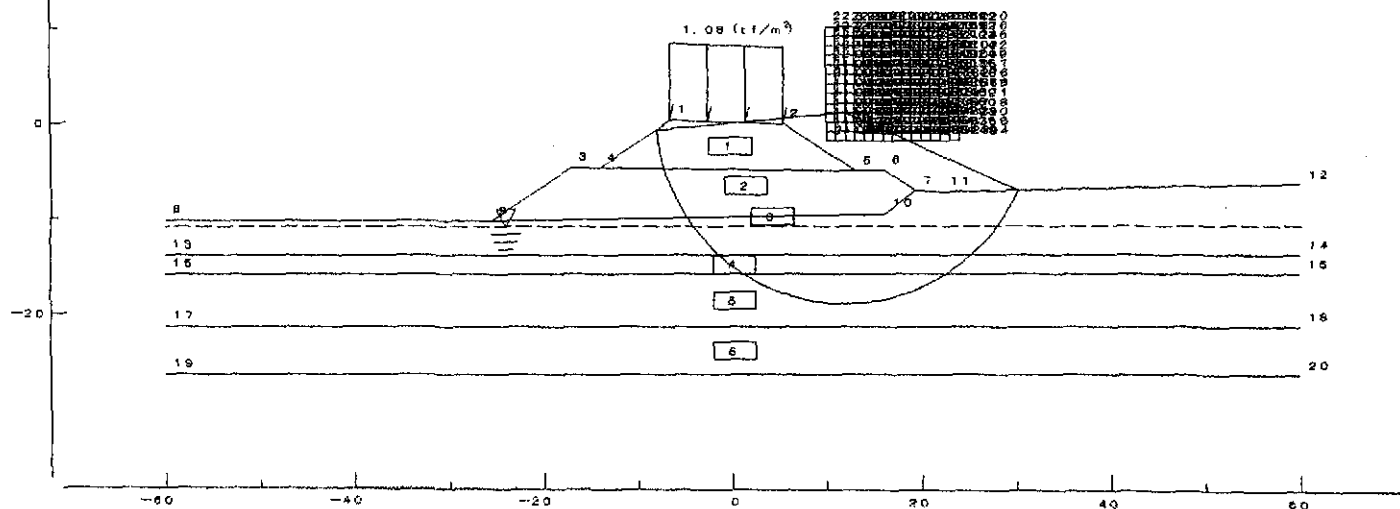


Figure 14 South Approach Embankment Stability – Seismic Condition (Right)



# APPENDIX A

## NORTH APPROACH EMBANKMENT

```
***** 富士通 エフ・アイ・ピー *****
*
* // C O S T A N A //
*
*  斜面安定計算プログラム
*
*  VERSION 4  LEVEL 2
*
*  (2002.10. 7)
*
* Interchange Right Embankment
*
*
*****
```

	1	2	3	4	5	6	7	8
1	TITLE Interchange Right Embankment							
2	ANALY	0	0.000					
3	DORO	1	2					
4	CONTR	0	0	0.000				
5	EARTH	1	1	2	0.0000.000			
6	LIST	1	0	0	0	00		
7	NODE	1	-6.50	0.19	0.00			
8		2	5.50	-0.18	0.00			
9		3	-17.00	-4.72	0.00			
10		4	-14.00	-4.81	0.00			
11		5	13.13	-5.18	0.00			
12		6	16.13	-5.10	0.00			
13		7	-26.13	-9.79	0.00			
14		8	-24.63	-9.81	0.00			
15		9	23.76	-10.18	0.00			
16		10	25.26	-10.16	0.00			
17		11	-60.00	-11.70	0.00			
18		12	-29.39	-11.96	0.00			
19		13	28.35	-12.22	0.00			
20		14	60.00	-12.16	0.00			
21		15	-60.00	-16.75	0.00			
22		16	60.00	-16.75	0.00			
23		17	-60.00	-17.75	0.00			
24		18	60.00	-17.75	0.00			
25		19	-60.00	-21.25	0.00			
26		20	60.00	-21.25	0.00			
27		21	-60.00	-27.25	0.00			
28		22	60.00	-27.25	0.00			
29	WATER	1	-60.00	-12.75	1.0000			
30		2	60.00	-12.75				
31	LAYER	1	4	1	4	5	2	
32		2	6	3	8	9	6	5
33		3	6	7	12	13	10	9
34		4	6	11	15	16	14	13
35		5	4	15	17	18	16	
36		6	4	17	19	20	18	
37		7	4	19	21	22	20	
38	MATE	11.900	1.8000.0000.0000.000	35.0	0.000.1000.000			0.00
39		21.900	1.8000.0000.0000.000	35.0	0.000.1000.000			0.00
40		31.900	1.8000.0000.0000.000	35.0	0.000.1000.000			0.00
41		41.700	1.6000.0000.0008.000	0.0	0.000.0000.000			0.00
42		51.700	1.6000.0000.0001.000	30.0	0.000.0000.000			0.00
43		61.700	1.6000.0000.0007.000	0.0	0.000.0000.000			0.00
44		71.700	1.6000.0000.00015.00	0.0	0.000.0000.000			0.00
45	ZAHYO		0.00					
46	GRID	20	-25.00	10.00	1.00	1.00	15	12
47	CIRCL	0	1.00	30.00	30.00	16.25		
48	VLOAD	1	-6.50	0.19	1.08	5.50	-0.18	1.08
49	NEVER	2	-6.50	0.19				
50			-14.00	-4.81				

	1	2	3	4	5	6	7	8
51	2	-17.00	-4.72					
52		-24.63	-9.81					
53	2	-26.13	-9.79					
54		-29.39	-11.96					

/// 入力データリスト ///

( DATA 01. ) // タイトル //

Interchange Right Embankment

( DATA 02. ) // 解析種別 //

解析種別                                 ..... 最小安全率計算  
 計算方法                                 ..... 日本道路公団基準 (全応力法)  
 起動モーメントの単位体積重量..... 1 (=0 飽和単位体積重量)  
   ..... (=1 水中単位体積重量)

( DATA 03. ) // コントロール // (最小安全率計算)

二次追求の回数                         ..... 0 (=0 行わない)  
   ..... (>0 行う)  
 二次追求の指示                         ..... 0 (=0 常時)  
   ..... (=1 地震時)  
 実行                                     ..... 0 (=0 入力データチェック及び、安定計算を行う)  
   ..... (=1 入力データチェックのみ行う)  
 最小安全率の基準値                   ..... .000

( DATA 04. ) // 地震荷重 //

地震荷重                                 ..... 1 (=0 全層同じ震度を用いる)  
   ..... (=1 層ごとに異なった震度を用いる)  
 起動力, 抵抗力                         ..... 1 (=0 起動力のみ考慮)  
   ..... (=1 起動力と抵抗力を考慮)  
 作用点                                   ..... 2 (=0 すべり面に作用)  
   ..... (=1 重心に作用)  
   ..... (=2 抵抗側:すべり面に作用  
   起動側:重心に作用)  
 単位体積重量                             ..... 0 (=0 飽和単位体積重量)  
   ..... (=1 水中単位体積重量)  
 水平震度                                 ..... .000  
 鉛直震度                                 ..... .000

( DATA 05. ) // 出力リスト // (最小安全率計算)

安全率テーブルリスト                   ..... 1 (=0 出力しない)  
   ..... (=1 出力する)  
 半径ごとの安全率リスト               ..... 0 (=0 出力しない)  
   ..... (=1 出力する)  
 半径ごとの分力リスト                   ..... 0 (=0 出力しない)  
   ..... (=1 出力する)  
 ゾーンごとの分力リスト                 ..... 0 (=0 出力しない)  
   ..... (=1 出力する)  
 スライスごとの分力リスト               ..... 0 (=0 出力しない)  
   ..... (=1 出力する)

( DATA 06. ) // 節点 //

節点番号	節点の座標値 (m)		沈下前の Y 座標値 (m)
	X	Y	
1	( -6.50 ,	.19 )	.00
2	( 5.50 ,	-.18 )	.00
3	( -17.00 ,	-4.72 )	.00
4	( -14.00 ,	-4.81 )	.00
5	( 13.13 ,	-5.18 )	.00
6	( 16.13 ,	-5.10 )	.00
7	( -26.13 ,	-9.79 )	.00
8	( -24.63 ,	-9.81 )	.00
9	( 23.76 ,	-10.18 )	.00
10	( 25.26 ,	-10.16 )	.00
11	( -60.00 ,	-11.70 )	.00
12	( -29.39 ,	-11.96 )	.00
13	( 28.35 ,	-12.22 )	.00
14	( 60.00 ,	-12.16 )	.00
15	( -60.00 ,	-16.75 )	.00
16	( 60.00 ,	-16.75 )	.00
17	( -60.00 ,	-17.75 )	.00
18	( 60.00 ,	-17.75 )	.00
19	( -60.00 ,	-21.25 )	.00
20	( 60.00 ,	-21.25 )	.00
21	( -60.00 ,	-27.25 )	.00
22	( 60.00 ,	-27.25 )	.00

( DATA 07. ) // 水位線 //

水の単位体積重量 (tf/m<sup>3</sup>) = 1.000

点の番号	座標値 (m)	
	X	Y
1	( -60.00 ,	-12.75 )
2	( 60.00 ,	-12.75 )

( DATA 08. ) // 層の形状 //

地層番号	構成節点数	地層を構成する節点番号							
1	4	1	4	5	2				
2	6	3	8	9	6	5	4		
3	6	7	12	13	10	9	8		
4	6	11	15	16	14	13	12		
5	4	15	17	18	16				
6	4	17	19	20	18				
7	4	19	21	22	20				

( DATA 09. ) // 土の特性 //

地層 番号	飽和単位 体積重量 (tf/m <sup>3</sup> )	湿潤単位 体積重量 (tf/m <sup>3</sup> )	間隙水圧算定 単位体積重量 (tf/m <sup>3</sup> )	係数 $\alpha$	粘着力 (tf/m <sup>2</sup> )	粘着力の 一次係数	内部 摩擦角 (度)	アンカーの周面 摩擦抵抗 $\tau$ (tf/m <sup>2</sup> )
1	1.900	1.800	.000	.000	.00	.00	35.0	.00
2	1.900	1.800	.000	.000	.00	.00	35.0	.00
3	1.900	1.800	.000	.000	.00	.00	35.0	.00
4	1.700	1.600	.000	.000	8.00	.00	.0	.00
5	1.700	1.600	.000	.000	1.00	.00	30.0	.00
6	1.700	1.600	.000	.000	7.00	.00	.0	.00
7	1.700	1.600	.000	.000	15.00	.00	.0	.00

( DATA 09. ) // 土の特性 //

地層 番号	水平 震度 (KH)	鉛直 震度 (KV)	地層 番号	水平 震度 (KH)	鉛直 震度 (KV)	地層 番号	水平 震度 (KH)	鉛直 震度 (KV)
1	.100	.000	2	.100	.000	3	.100	.000
4	.000	.000	5	.000	.000	6	.000	.000
7	.000	.000						

( DATA 11. ) // 格子 //

すべり面の位置	格子の左上の座標値 X (m)      Y (m)	X方向の ピッチ (m)	Y方向の ピッチ (m)	X方向の 格子点数	Y方向の 格子点数	傾き
左すべり	( -25.00 ,    10.00 )	1.00	1.00	15	12	.000

( DATA 12. ) // 半径 (垂線法) //

半径	.....	0 ( =0 最大半径より $\Delta R$ ピッチで決める ) ( =1 最小半径より $\Delta R$ ピッチで決める )
半径のピッチ $\Delta R$ (m)	.....	1.00
最大半径を与えるY座標値 (m)	.....	30.00
最小半径を与えるY座標値 (m)	.....	30.00
地表面からの深さ (m)	.....	16.25

( DATA 15.1 ) // 分布荷重 (鉛直) //

荷重番号	左 端			右 端			抵抗力 の係数
	X (m)	Y (m)	荷重 (tf)	X (m)	Y (m)	荷重 (tf)	
1	( -6.50 ,	.19 )	1.08	( 5.50 ,	- .18 )	1.08	.000

( DATA 16. ) // 円弧を切ってはならない線 // ( N = 3 )

構成節点数	X (m)	Y (m)
2	( -6.50 ,	.19 )
	( -14.00 ,	-4.81 )
2	( -17.00 ,	-4.72 )
	( -24.63 ,	-9.81 )
2	( -26.13 ,	-9.79 )
	( -29.39 ,	-11.96 )



\*\*\*\*\*  
 \* 安全率 (格子のグループ番号 = 1 ; 二次追求の回数 = 0) \*  
 \*\*\*\*\*

// 常 時 //

円の中心座標

* Y (m) *	X * (m) *	-25.00	-24.00	-23.00	-22.00	-21.00	-20.00	-19.00	-18.00
10.00		2.510 ( 33.00)	2.398 ( 32.55)	2.286 ( 32.15)	2.172 ( 31.80)	2.048 ( 31.50)	1.861 ( 31.27)	1.796 ( 31.11)	1.823 ( 30.79)
9.00		2.519 ( 32.13)	2.402 ( 31.65)	2.286 ( 31.22)	2.168 ( 30.85)	2.042 ( 30.54)	1.869 ( 30.29)	1.769 ( 30.12)	1.793 ( 29.96)
8.00		2.538 ( 31.28)	2.412 ( 30.77)	2.291 ( 30.31)	2.169 ( 29.92)	2.039 ( 29.58)	1.873 ( 29.32)	1.743 ( 29.13)	1.765 ( 29.01)
7.00		2.564 ( 30.44)	2.434 ( 29.90)	2.303 ( 29.42)	2.175 ( 28.99)	2.041 ( 28.63)	1.879 ( 28.35)	1.719 ( 28.14)	1.738 ( 28.01)
6.00		2.593 ( 29.61)	2.462 ( 29.05)	2.327 ( 28.53)	2.189 ( 28.08)	2.049 ( 27.69)	1.887 ( 27.38)	1.699 ( 27.15)	1.714 ( 27.02)
5.00		2.625 ( 28.78)	2.495 ( 28.22)	2.358 ( 27.67)	2.216 ( 27.18)	2.068 ( 26.76)	1.901 ( 26.42)	1.681 ( 26.17)	1.693 ( 26.02)
4.00		2.661 ( 27.94)	2.530 ( 27.39)	2.394 ( 26.83)	2.249 ( 26.30)	2.097 ( 25.84)	1.925 ( 25.47)	1.669 ( 25.20)	1.677 ( 25.03)
3.00		2.702 ( 27.11)	2.571 ( 26.56)	2.436 ( 26.00)	2.290 ( 25.45)	2.134 ( 24.94)	1.960 ( 24.53)	1.666 ( 24.22)	1.666 ( 24.03)
2.00		2.750 ( 26.28)	2.617 ( 25.72)	2.481 ( 25.17)	2.339 ( 24.62)	2.180 ( 24.07)	2.002 ( 23.61)	1.726 ( 23.26)	1.667 ( 23.04)
1.00		2.806 ( 25.45)	2.670 ( 24.89)	2.533 ( 24.34)	2.392 ( 23.78)	2.237 ( 23.23)	2.056 ( 22.71)	1.811 ( 22.31)	1.675 ( 22.06)
.00		2.872 ( 24.62)	2.732 ( 24.06)	2.593 ( 23.51)	2.452 ( 22.95)	2.302 ( 22.40)	2.124 ( 21.84)	1.888 ( 21.38)	1.689 ( 21.07)
-1.00		2.952 ( 23.78)	2.806 ( 23.23)	2.664 ( 22.67)	2.522 ( 22.12)	2.374 ( 21.56)	2.206 ( 21.01)	1.977 ( 20.47)	1.710 ( 20.10)

\*\*\*\*\*  
 \* 安全率 (格子のグループ番号 = 1 ; 二次追求の回数 = 0) \*  
 \*\*\*\*\*

// 常 時 //

円の中心座標

* X * (m)	-17.00	-16.00	-15.00	-14.00	-13.00	-12.00	-11.00
Y (m) *							
10.00	1.861 ( 30.24)	1.927 ( 29.68)	2.021 ( 29.13)	2.164 ( 28.57)	2.422 ( 28.02)	999.999 ( .00)	999.999 ( .00)
9.00	1.828 ( 29.40)	1.888 ( 28.85)	1.975 ( 28.30)	2.104 ( 27.74)	2.325 ( 27.19)	999.999 ( .00)	999.999 ( .00)
8.00	1.797 ( 28.57)	1.851 ( 28.02)	1.933 ( 27.46)	2.049 ( 26.91)	2.245 ( 26.35)	999.999 ( .00)	999.999 ( .00)
7.00	1.768 ( 27.74)	1.817 ( 27.19)	1.894 ( 26.63)	1.999 ( 26.08)	2.175 ( 25.52)	999.999 ( .00)	999.999 ( .00)
6.00	1.741 ( 26.91)	1.786 ( 26.35)	1.858 ( 25.80)	1.955 ( 25.24)	2.115 ( 24.69)	999.999 ( .00)	999.999 ( .00)
5.00	1.717 ( 25.97)	1.759 ( 25.52)	1.826 ( 24.97)	1.916 ( 24.41)	2.063 ( 23.86)	999.999 ( .00)	999.999 ( .00)
4.00	1.697 ( 24.97)	1.734 ( 24.69)	1.798 ( 24.14)	1.881 ( 23.58)	2.018 ( 23.03)	999.999 ( .00)	999.999 ( .00)
3.00	1.681 ( 23.97)	1.714 ( 23.86)	1.774 ( 23.30)	1.852 ( 22.75)	1.981 ( 22.19)	999.999 ( .00)	999.999 ( .00)
2.00	1.673 ( 22.97)	1.700 ( 23.00)	1.755 ( 22.47)	1.830 ( 21.92)	999.999 ( .00)	999.999 ( .00)	999.999 ( .00)
1.00	1.678 ( 21.97)	1.696 ( 22.00)	1.744 ( 21.64)	1.815 ( 21.08)	999.999 ( .00)	999.999 ( .00)	999.999 ( .00)
.00	1.693 ( 20.97)	1.706 ( 21.00)	1.742 ( 20.81)	1.811 ( 20.25)	999.999 ( .00)	999.999 ( .00)	999.999 ( .00)
-1.00	1.716 ( 19.97)	1.730 ( 20.00)	1.758 ( 19.97)	1.821 ( 19.42)	999.999 ( .00)	999.999 ( .00)	999.999 ( .00)

\*\*\*\*\*  
 \* 安全率 (格子のグループ番号 = 1 ; 二次追求の回数 = 0) \*  
 \*\*\*\*\*

// 地震時 //

円の中心座標

* X	-25.00	-24.00	-23.00	-22.00	-21.00	-20.00	-19.00	-18.00
* (m)								
Y								
(m)								
10.00	2.265 ( 33.00)	2.153 ( 32.55)	2.042 ( 32.15)	1.929 ( 31.80)	1.809 ( 31.50)	1.633 ( 31.27)	1.566 ( 31.11)	1.577 ( 30.79)
9.00	2.283 ( 32.13)	2.166 ( 31.65)	2.051 ( 31.22)	1.935 ( 30.85)	1.812 ( 30.54)	1.647 ( 30.29)	1.549 ( 30.12)	1.561 ( 29.96)
8.00	2.309 ( 31.28)	2.185 ( 30.77)	2.065 ( 30.31)	1.944 ( 29.92)	1.818 ( 29.58)	1.660 ( 29.32)	1.534 ( 29.13)	1.544 ( 29.01)
7.00	2.343 ( 30.44)	2.215 ( 29.90)	2.085 ( 29.42)	1.959 ( 28.99)	1.829 ( 28.63)	1.673 ( 28.35)	1.521 ( 28.14)	1.529 ( 28.01)
6.00	2.380 ( 29.61)	2.250 ( 29.05)	2.117 ( 28.53)	1.982 ( 28.08)	1.845 ( 27.69)	1.689 ( 27.38)	1.510 ( 27.15)	1.516 ( 27.02)
5.00	2.421 ( 28.78)	2.291 ( 28.22)	2.155 ( 27.67)	2.016 ( 27.18)	1.871 ( 26.76)	1.710 ( 26.42)	1.502 ( 26.17)	1.505 ( 26.02)
4.00	2.465 ( 27.94)	2.335 ( 27.39)	2.200 ( 26.83)	2.057 ( 26.30)	1.907 ( 25.84)	1.741 ( 25.47)	1.499 ( 25.20)	1.499 ( 25.03)
3.00	2.516 ( 27.11)	2.384 ( 26.56)	2.250 ( 26.00)	2.105 ( 25.45)	1.951 ( 24.94)	1.782 ( 24.53)	1.505 ( 24.22)	1.498 ( 24.03)
2.00	2.573 ( 26.28)	2.439 ( 25.72)	2.304 ( 25.17)	2.162 ( 24.62)	2.005 ( 24.07)	1.831 ( 23.61)	1.568 ( 23.26)	1.507 ( 23.04)
1.00	2.638 ( 25.45)	2.502 ( 24.89)	2.366 ( 24.34)	2.225 ( 23.78)	2.071 ( 23.23)	1.892 ( 22.71)	1.656 ( 22.31)	1.523 ( 22.06)
.00	2.715 ( 24.62)	2.574 ( 24.06)	2.436 ( 23.51)	2.295 ( 22.95)	2.144 ( 22.40)	1.968 ( 21.84)	1.739 ( 21.38)	1.546 ( 21.07)
-1.00	2.805 ( 23.78)	2.659 ( 23.23)	2.517 ( 22.67)	2.374 ( 22.12)	2.226 ( 21.56)	2.058 ( 21.01)	1.834 ( 20.47)	1.576 ( 20.10)

\*\*\*\*\*  
 \* 安全率 (格子のグループ番号 = 1 ; 二次追求の回数 = 0) \*  
 \*\*\*\*\*

// 地震時 //

円の中心座標

* X * (m)	-17.00	-16.00	-15.00	-14.00	-13.00	-12.00	-11.00
Y * (m) *							
10.00	1.594 ( 30.24)	1.632 ( 29.68)	1.688 ( 29.13)	1.779 ( 28.57)	1.954 ( 28.02)	999.999 ( .00)	999.999 ( .00)
9.00	1.576 ( 29.40)	1.610 ( 28.85)	1.662 ( 28.30)	1.743 ( 27.74)	1.891 ( 27.19)	999.999 ( .00)	999.999 ( .00)
8.00	1.559 ( 28.57)	1.589 ( 28.02)	1.639 ( 27.46)	1.711 ( 26.91)	1.841 ( 26.35)	999.999 ( .00)	999.999 ( .00)
7.00	1.543 ( 27.74)	1.571 ( 27.19)	1.618 ( 26.63)	1.683 ( 26.08)	1.800 ( 25.52)	999.999 ( .00)	999.999 ( .00)
6.00	1.530 ( 26.91)	1.555 ( 26.35)	1.599 ( 25.80)	1.659 ( 25.24)	1.765 ( 24.69)	999.999 ( .00)	999.999 ( .00)
5.00	1.518 ( 25.97)	1.542 ( 25.52)	1.584 ( 24.97)	1.639 ( 24.41)	1.737 ( 23.86)	999.999 ( .00)	999.999 ( .00)
4.00	1.509 ( 24.97)	1.532 ( 24.69)	1.571 ( 24.14)	1.623 ( 23.58)	1.714 ( 23.03)	999.999 ( .00)	999.999 ( .00)
3.00	1.504 ( 23.97)	1.525 ( 23.86)	1.563 ( 23.30)	1.612 ( 22.75)	1.698 ( 22.19)	999.999 ( .00)	999.999 ( .00)
2.00	1.506 ( 22.97)	1.524 ( 23.00)	1.559 ( 22.47)	1.607 ( 21.92)	999.999 ( .00)	999.999 ( .00)	999.999 ( .00)
1.00	1.520 ( 21.97)	1.530 ( 22.00)	1.563 ( 21.64)	1.608 ( 21.08)	999.999 ( .00)	999.999 ( .00)	999.999 ( .00)
.00	1.544 ( 20.97)	1.551 ( 21.00)	1.575 ( 20.81)	1.620 ( 20.25)	999.999 ( .00)	999.999 ( .00)	999.999 ( .00)
-1.00	1.576 ( 19.97)	1.584 ( 20.00)	1.603 ( 19.97)	1.645 ( 19.42)	999.999 ( .00)	999.999 ( .00)	999.999 ( .00)

// 格子のグループ番号 = 1 //

```

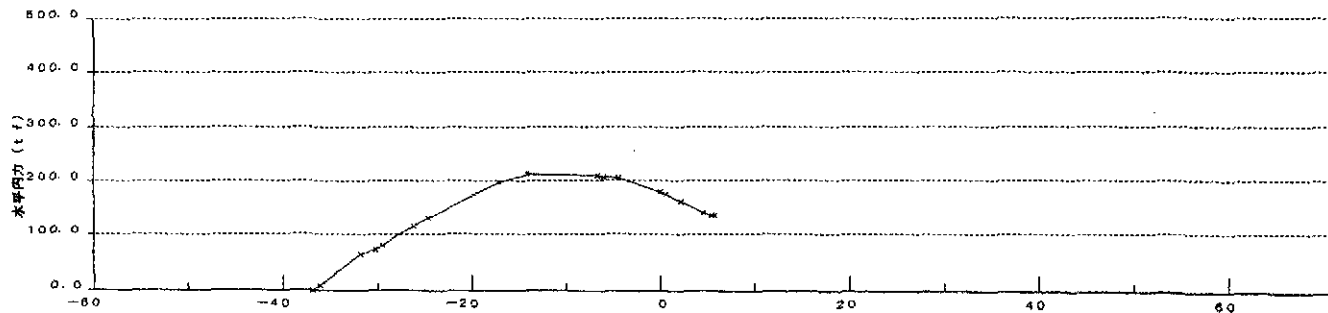
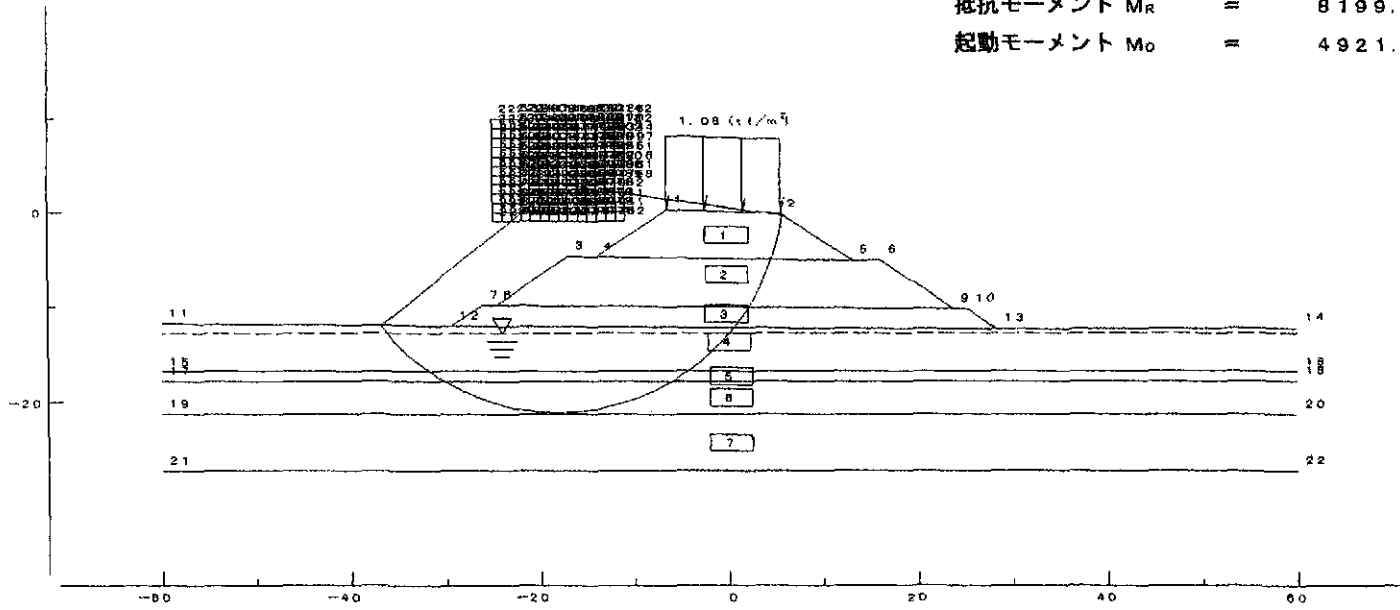
*****
*                               *                               *
*      Service Load             *      Under Earthquake      *
*                               *                               *
*****
*                               *                               *
* Min. F.S.      =      1.666  * Min. F.S.      =      1.498  *
*                               *                               *
* Center      X (m) = -18.00  * Center      X (m) = -18.00  *
*                               *                               *
*              Y (m) =   3.00  *              Y (m) =   3.00  *
*                               *                               *
* Radius R      (m) =   24.03  * Radius R      (m) =   24.03  *
*                               *                               *
* Resiting Moment(tfm) = 8199.00 * Resisting Moment(tfm) = 8072.95 *
*                               *                               *
* Sliding Moment(tfm) = 4921.77 * Sliding Moment(tfm) = 5390.94 *
*                               *                               *
*****

```

Interchange Right Embankment

縮尺 : 1 / 800

最小安全率	$F_s$ MIN	=	1.666
円弧の中心	X	=	-18.00 (m)
	Y	=	3.00 (m)
	半径 R	=	24.03 (m)
抵抗モーメント	$M_R$	=	8199.00 (tf·m)
起動モーメント	$M_o$	=	4921.77 (tf·m)



水圧内力分布図 (常時)

## APPENDIX B

### SOUTH APPROACH EMBANKMENT

(LEFT SIDE FAILURE)

```
***** 富士通 エフ・アイ・ピー *****
*
* // C O S T A N A //
*
* 斜面安定計算プログラム
*
* VERSION 4 LEVEL 2
*
* (2002.10. 7)
*
* Interchange Left Embankment
*
*****
```

	1	2	3	4	5	6	7	8
1	TITLE Interchange Left Embankment							
2	ANALY	0	0.000					
3	DORO	1	2					
4	CONTR	0	0	0.000				
5	EARTH	1	1	2	0.0000.000			
6	LIST	1	0	0	0	00		
7	NODE	1	-6.50	0.19	0.00			
8		2	5.49	-0.18	0.00			
9		3	-17.00	-4.72	0.00			
10		4	-14.00	-4.81	0.00			
11		5	13.13	-5.18	0.00			
12		6	16.13	-5.10	0.00			
13		7	19.35	-7.24	0.00			
14		8	-60.00	-10.35	0.00			
15		9	-25.48	-10.38	0.00			
16		10	16.13	-9.67	0.00			
17		11	22.23	-7.38	0.00			
18		12	60.00	-6.60	0.00			
19		13	-60.00	-13.97	0.00			
20		14	60.00	-13.97	0.00			
21		15	-60.00	-15.97	0.00			
22		16	60.00	-15.97	0.00			
23		17	-60.00	-21.47	0.00			
24		18	60.00	-21.47	0.00			
25		19	-60.00	-26.47	0.00			
26		20	60.00	-26.47	0.00			
27	WATER	1	-60.00	-10.971.0000				
28		2	60.00	-10.97				
29	LAYER	1	4	1	4	5	2	
30		2	7	3	9	10	7	6
31		3	8	8	13	14	12	11
32		4	4	13	15	16	14	5
33		5	4	15	17	18	16	4
34		6	4	17	19	20	18	9
35	MATE	11.	9001.9000.0000.0000.000	35.0	0.000.1000.000			0.00
36		21.	9001.9000.0000.0000.000	35.0	0.000.1000.000			0.00
37		31.	7001.7000.0000.0006.500	0.0	0.000.0000.000			0.00
38		41.	7001.7000.0000.0001.000	29.0	0.000.0000.000			0.00
39		51.	7001.7000.0000.0006.000	0.0	0.000.0000.000			0.00
40		61.	7001.7000.0000.00015.00	0.0	0.000.0000.000			0.00
41	ZAHYO		0.00					
42	GRID	20	-25.00	10.00	1.00	1.00	15	13
43	CIRCL	0	1.00	30.00	30.00	13.50		
44	VLOAD	1	-6.50	0.19	1.08	5.49	-0.18	1.08
45	NEVER	2	-6.50	0.19				
46			-14.00	-4.81				
47		2	-17.00	-4.72				
48			-25.48	-10.38				

.....+.....1.....+.....2.....+.....3.....+.....4.....+.....5.....+.....6.....+.....7.....+.....8



/// 入力データリスト ///

( DATA 01. ) // タイトル //

Interchange Left Embankment

( DATA 02. ) // 解析種別 //

解析種別	.....	最小安全率計算
計算方法	.....	日本道路公団基準 (全応力法)
起動モーメントの単位体積重量	.....	1 ( =0 飽和単位体積重量 ) ( =1 水中単位体積重量 )

( DATA 03. ) // コントロール // (最小安全率計算)

二次追求の回数	.....	0 ( =0 行わない ) ( >0 行う )
二次追求の指示	.....	0 ( =0 常時 ) ( =1 地震時 )
実行	.....	0 ( =0 入力データチェック及び、安定計算を行う ) ( =1 入力データチェックのみ行う )
最小安全率の基準値	.....	.000

( DATA 04. ) // 地震荷重 //

地震荷重	.....	1 ( =0 全層同じ震度を用いる ) ( =1 層ごとに異なった震度を用いる )
起動力、抵抗力	.....	1 ( =0 起動力のみ考慮 ) ( =1 起動力と抵抗力を考慮 )
作用点	.....	2 ( =0 すべり面に作用 ) ( =1 重心に作用 ) ( =2 抵抗力側:すべり面に作用 起動力側:重心に作用 )
単位体積重量	.....	0 ( =0 飽和単位体積重量 ) ( =1 水中単位体積重量 )
水平震度	.....	.000
鉛直震度	.....	.000

( DATA 05. ) // 出力リスト // (最小安全率計算)

安全率テーブルリスト	.....	1 ( =0 出力しない ) ( =1 出力する )
半径ごとの安全率リスト	.....	0 ( =0 出力しない ) ( =1 出力する )
半径ごとの分力リスト	.....	0 ( =0 出力しない ) ( =1 出力する )
ゾーンごとの分力リスト	.....	0 ( =0 出力しない ) ( =1 出力する )
スライスごとの分力リスト	.....	0 ( =0 出力しない ) ( =1 出力する )

## ( DATA 06. ) // 節点 //

節点番号	節点の座標値 (m)		沈下前のY座標値 (m)
	X	Y	
1	( -6.50 ,	.19 )	.00
2	( 5.49 ,	-.18 )	.00
3	( -17.00 ,	-4.72 )	.00
4	( -14.00 ,	-4.81 )	.00
5	( 13.13 ,	-5.18 )	.00
6	( 16.13 ,	-5.10 )	.00
7	( 19.35 ,	-7.24 )	.00
8	( -60.00 ,	-10.35 )	.00
9	( -25.48 ,	-10.38 )	.00
10	( 16.13 ,	-9.67 )	.00
11	( 22.23 ,	-7.38 )	.00
12	( 60.00 ,	-6.60 )	.00
13	( -60.00 ,	-13.97 )	.00
14	( 60.00 ,	-13.97 )	.00
15	( -60.00 ,	-15.97 )	.00
16	( 60.00 ,	-15.97 )	.00
17	( -60.00 ,	-21.47 )	.00
18	( 60.00 ,	-21.47 )	.00
19	( -60.00 ,	-26.47 )	.00
20	( 60.00 ,	-26.47 )	.00

## ( DATA 07. ) // 水位線 //

水の単位体積重量 (tf/m<sup>3</sup>) = 1.000

点の番号	座標値 (m)	
	X	Y
1	( -60.00 ,	-10.97 )
2	( 60.00 ,	-10.97 )

## ( DATA 08. ) // 層の形状 //

地層番号	構成節点数	地層を構成する節点番号							
1	4	1	4	5	2				
2	7	3	9	10	7	6	5	4	
3	8	8	13	14	12	11	7	10	9
4	4	13	15	16	14				
5	4	15	17	18	16				
6	4	17	19	20	18				

## ( DATA 09. ) // 土の特性 //

地層番号	飽和単位体積重量 (tf/m <sup>3</sup> )	湿潤単位体積重量 (tf/m <sup>3</sup> )	間隙水圧算定単位体積重量 (tf/m <sup>3</sup> )	係数 α	粘着力 (tf/m <sup>2</sup> )	粘着力の一次係数	内部摩擦角 (度)	アカーの周面摩擦抵抗 τ (tf/m <sup>2</sup> )
1	1.900	1.900	.000	.000	.00	.00	35.0	.00
2	1.900	1.900	.000	.000	.00	.00	35.0	.00
3	1.700	1.700	.000	.000	6.50	.00	.0	.00
4	1.700	1.700	.000	.000	1.00	.00	29.0	.00

( DATA 09. ) // 土の特性 //

地層 番号	飽和単位 体積重量 (tf/m <sup>3</sup> )	湿潤単位 体積重量 (tf/m <sup>3</sup> )	間隙水圧算定 単位体積重量 (tf/m <sup>3</sup> )	係数 $\alpha$	粘着力 (tf/m <sup>2</sup> )	粘着力の 一次係数	内部 摩擦角 (度)	アンカーの周面 摩擦抵抗 $\tau$ (tf/m <sup>2</sup> )
5	1.700	1.700	.000	.000	6.00	.00	.0	.00
6	1.700	1.700	.000	.000	15.00	.00	.0	.00

( DATA 09. ) // 土の特性 //

地層 番号	水平 震度 (KH)	鉛直 震度 (KV)	地層 番号	水平 震度 (KH)	鉛直 震度 (KV)	地層 番号	水平 震度 (KH)	鉛直 震度 (KV)
1	.100	.000	2	.100	.000	3	.000	.000
4	.000	.000	5	.000	.000	6	.000	.000

( DATA 11. ) // 格子 //

すべり面の位置	格子の左上の座標値 X (m)      Y (m)	X方向の ピッチ (m)	Y方向の ピッチ (m)	X方向の 格子点数	Y方向の 格子点数	傾き
左すべり	( -25.00 ,    10.00 )	1.00	1.00	15	13	.000

( DATA 12. ) // 半径 (垂線法) //

半径	.....	0 ( =0 最大半径より $\Delta R$ ピッチで決める ) ( =1 最小半径より $\Delta R$ ピッチで決める )
半径のピッチ $\Delta R$ (m)	.....	1.00
最大半径を与えるY座標値 (m)	.....	30.00
最小半径を与えるY座標値 (m)	.....	30.00
地表面からの深さ (m)	.....	13.50

( DATA 15.1 ) // 分布荷重 (鉛直) //

荷重番号	左 端			右 端			抵抗力 の係数
	X (m)	Y (m)	荷重 (tf)	X (m)	Y (m)	荷重 (tf)	
1	( -6.50 ,	.19 )	1.08	( 5.49 ,	- .18 )	1.08	.000

( DATA 16. ) // 円弧を切ってはならない線 // ( N = 2 )

構成節点数	X (m)	Y (m)
2	( -6.50 ,	.19 )
	( -14.00 ,	-4.81 )
2	( -17.00 ,	-4.72 )
	( -25.48 ,	-10.38 )

\*\*\*\*\*  
 \* 安全率 (格子のグループ番号 = 1 ; 二次追求の回数 = 0) \*  
 \*\*\*\*\*

// 常 時 //

円の中心座標

* Y (m) *	X * (m) *	-25.00	-24.00	-23.00	-22.00	-21.00	-20.00	-19.00	-18.00
10.00		1.744 ( 30.25)	1.712 ( 29.80)	1.685 ( 29.40)	1.662 ( 29.05)	1.648 ( 28.75)	1.643 ( 28.52)	1.646 ( 28.36)	1.661 ( 28.04)
9.00		1.740 ( 29.38)	1.706 ( 28.90)	1.677 ( 28.47)	1.653 ( 28.10)	1.633 ( 27.79)	1.623 ( 27.54)	1.622 ( 27.37)	1.631 ( 27.21)
8.00		1.737 ( 28.53)	1.702 ( 28.02)	1.671 ( 27.56)	1.644 ( 27.17)	1.623 ( 26.83)	1.607 ( 26.57)	1.601 ( 26.38)	1.605 ( 26.26)
7.00		1.737 ( 27.69)	1.699 ( 27.15)	1.666 ( 26.67)	1.638 ( 26.24)	1.615 ( 25.88)	1.597 ( 25.60)	1.584 ( 25.39)	1.584 ( 25.26)
6.00		1.740 ( 26.86)	1.699 ( 26.30)	1.664 ( 25.78)	1.633 ( 25.33)	1.608 ( 24.94)	1.589 ( 24.63)	1.575 ( 24.40)	1.566 ( 24.27)
5.00		1.747 ( 26.03)	1.702 ( 25.47)	1.664 ( 24.92)	1.631 ( 24.43)	1.604 ( 24.01)	1.583 ( 23.67)	1.568 ( 23.42)	1.558 ( 23.27)
4.00		1.758 ( 25.19)	1.710 ( 24.64)	1.668 ( 24.08)	1.632 ( 23.55)	1.603 ( 23.09)	1.580 ( 22.72)	1.563 ( 22.45)	1.553 ( 22.28)
3.00		1.775 ( 24.36)	1.722 ( 23.81)	1.676 ( 23.25)	1.637 ( 22.70)	1.605 ( 22.19)	1.580 ( 21.78)	1.562 ( 21.47)	1.550 ( 21.28)
2.00		1.982 ( 23.53)	1.741 ( 22.98)	1.690 ( 22.42)	1.647 ( 21.87)	1.612 ( 21.32)	1.584 ( 20.86)	1.564 ( 20.51)	1.551 ( 20.29)
1.00		2.195 ( 22.70)	1.768 ( 22.14)	1.712 ( 21.59)	1.664 ( 21.03)	1.625 ( 20.48)	1.594 ( 19.96)	1.571 ( 19.56)	1.556 ( 19.31)
.00		2.367 ( 21.87)	1.805 ( 21.31)	1.743 ( 20.76)	1.690 ( 20.20)	1.645 ( 19.65)	1.611 ( 19.09)	1.585 ( 18.63)	1.569 ( 18.32)
-1.00		2.539 ( 21.04)	1.930 ( 20.48)	1.786 ( 19.93)	1.726 ( 19.37)	1.676 ( 18.81)	1.637 ( 18.26)	1.608 ( 17.72)	1.590 ( 17.35)
-2.00		2.726 ( 20.20)	2.263 ( 19.65)	1.843 ( 19.09)	1.775 ( 18.54)	1.719 ( 17.98)	1.674 ( 17.43)	1.642 ( 16.87)	1.621 ( 16.40)

\*\*\*\*\*  
 \* 安全率 (格子のグループ番号 = 1 ; 二次追求の回数 = 0) \*  
 \*\*\*\*\*

// 常時 //

円の中心座標

* X	-17.00	-16.00	-15.00	-14.00	-13.00	-12.00	-11.00
* (m)							
Y							
(m)							
10.00	1.693 ( 27.49)	1.752 ( 26.93)	1.887 ( 26.38)	2.193 ( 25.82)	2.278 ( 25.27)	2.346 ( 24.75)	999.999 ( .00)
9.00	1.658 ( 26.65)	1.709 ( 26.10)	1.823 ( 25.55)	2.117 ( 24.99)	2.255 ( 24.44)	2.331 ( 23.89)	999.999 ( .00)
8.00	1.627 ( 25.82)	1.670 ( 25.27)	1.767 ( 24.71)	1.979 ( 24.16)	2.231 ( 23.60)	2.319 ( 23.05)	999.999 ( .00)
7.00	1.598 ( 24.99)	1.634 ( 24.44)	1.718 ( 23.88)	1.891 ( 23.33)	2.208 ( 22.77)	2.304 ( 22.22)	999.999 ( .00)
6.00	1.572 ( 24.16)	1.603 ( 23.60)	1.675 ( 23.05)	1.823 ( 22.49)	2.186 ( 21.94)	2.290 ( 21.39)	999.999 ( .00)
5.00	1.553 ( 23.22)	1.576 ( 22.77)	1.639 ( 22.22)	1.766 ( 21.66)	2.022 ( 21.11)	2.276 ( 20.55)	999.999 ( .00)
4.00	1.546 ( 22.22)	1.554 ( 21.94)	1.608 ( 21.39)	1.721 ( 20.83)	1.931 ( 20.28)	2.266 ( 19.72)	999.999 ( .00)
3.00	1.543 ( 21.22)	1.544 ( 21.11)	1.587 ( 20.55)	1.685 ( 20.00)	1.865 ( 19.44)	999.999 ( .00)	999.999 ( .00)
2.00	1.543 ( 20.22)	1.540 ( 20.25)	1.578 ( 19.72)	1.665 ( 19.17)	1.818 ( 18.61)	999.999 ( .00)	999.999 ( .00)
1.00	1.548 ( 19.22)	1.545 ( 19.25)	1.574 ( 18.89)	1.656 ( 18.33)	1.799 ( 17.78)	999.999 ( .00)	999.999 ( .00)
.00	1.560 ( 18.22)	1.557 ( 18.25)	1.579 ( 18.06)	1.657 ( 17.50)	1.792 ( 16.95)	999.999 ( .00)	999.999 ( .00)
-1.00	1.580 ( 17.22)	1.578 ( 17.25)	1.592 ( 17.22)	1.669 ( 16.67)	1.801 ( 16.12)	999.999 ( .00)	999.999 ( .00)
-2.00	1.610 ( 16.22)	1.609 ( 16.25)	1.623 ( 16.28)	1.693 ( 15.84)	1.827 ( 15.28)	999.999 ( .00)	999.999 ( .00)

\*\*\*\*\*  
 \* 安全率 (格子のグループ番号 = 1 ; 二次追求の回数 = 0) \*  
 \*\*\*\*\*

// 地震時 //

円の中心座標

* Y (m)	X * (m)	-25.00	-24.00	-23.00	-22.00	-21.00	-20.00	-19.00	-18.00
10.00		1.575 ( 30.25)	1.540 ( 29.80)	1.509 ( 29.40)	1.482 ( 29.05)	1.462 ( 28.75)	1.451 ( 28.52)	1.446 ( 28.36)	1.450 ( 28.04)
9.00		1.577 ( 29.38)	1.541 ( 28.90)	1.508 ( 28.47)	1.479 ( 28.10)	1.455 ( 27.79)	1.439 ( 27.54)	1.432 ( 27.37)	1.432 ( 27.21)
8.00		1.582 ( 28.53)	1.543 ( 28.02)	1.508 ( 27.56)	1.478 ( 27.17)	1.452 ( 26.83)	1.431 ( 26.57)	1.419 ( 26.38)	1.416 ( 26.26)
7.00		1.588 ( 27.69)	1.547 ( 27.15)	1.511 ( 26.67)	1.478 ( 26.24)	1.451 ( 25.88)	1.429 ( 25.60)	1.411 ( 25.39)	1.404 ( 25.26)
6.00		1.598 ( 26.86)	1.554 ( 26.30)	1.515 ( 25.78)	1.481 ( 25.33)	1.452 ( 24.94)	1.428 ( 24.63)	1.409 ( 24.40)	1.395 ( 24.27)
5.00		1.612 ( 26.03)	1.565 ( 25.47)	1.523 ( 24.92)	1.486 ( 24.43)	1.455 ( 24.01)	1.430 ( 23.67)	1.410 ( 23.42)	1.395 ( 23.27)
4.00		1.630 ( 25.19)	1.579 ( 24.64)	1.534 ( 24.08)	1.495 ( 23.55)	1.461 ( 23.09)	1.434 ( 22.72)	1.412 ( 22.45)	1.397 ( 22.28)
3.00		1.654 ( 24.36)	1.599 ( 23.81)	1.550 ( 23.25)	1.507 ( 22.70)	1.471 ( 22.19)	1.441 ( 21.78)	1.418 ( 21.47)	1.402 ( 21.28)
2.00		1.858 ( 23.53)	1.625 ( 22.98)	1.572 ( 22.42)	1.525 ( 21.87)	1.486 ( 21.32)	1.453 ( 20.86)	1.428 ( 20.51)	1.410 ( 20.29)
1.00		2.070 ( 22.70)	1.659 ( 22.14)	1.601 ( 21.59)	1.550 ( 21.03)	1.507 ( 20.48)	1.471 ( 19.96)	1.444 ( 19.56)	1.424 ( 19.31)
.00		2.245 ( 21.87)	1.703 ( 21.31)	1.639 ( 20.76)	1.584 ( 20.20)	1.536 ( 19.65)	1.497 ( 19.09)	1.466 ( 18.63)	1.445 ( 18.32)
-1.00		2.422 ( 21.04)	1.833 ( 20.48)	1.690 ( 19.93)	1.628 ( 19.37)	1.576 ( 18.81)	1.532 ( 18.26)	1.499 ( 17.72)	1.475 ( 17.35)
-2.00		2.616 ( 20.20)	2.165 ( 19.65)	1.756 ( 19.09)	1.687 ( 18.54)	1.628 ( 17.98)	1.580 ( 17.43)	1.543 ( 16.87)	1.517 ( 16.40)



\*\*\*\*\*  
 \* 安全率 (格子のグループ番号 = 1 ; 二次追求の回数 = 0) \*  
 \*\*\*\*\*

// 地震時 //

円の中心座標

* X	-17.00	-16.00	-15.00	-14.00	-13.00	-12.00	-11.00
* (m)							
Y							
(m)							
10.00	1.463 ( 27.49)	1.499 ( 26.93)	1.597 ( 26.38)	1.834 ( 25.82)	1.873 ( 25.27)	1.887 ( 24.75)	999.999 ( .00)
9.00	1.443 ( 26.65)	1.471 ( 26.10)	1.553 ( 25.55)	1.784 ( 24.99)	1.869 ( 24.44)	1.892 ( 23.89)	999.999 ( .00)
8.00	1.424 ( 25.82)	1.447 ( 25.27)	1.516 ( 24.71)	1.679 ( 24.16)	1.865 ( 23.60)	1.899 ( 23.05)	999.999 ( .00)
7.00	1.407 ( 24.99)	1.426 ( 24.44)	1.484 ( 23.88)	1.615 ( 23.33)	1.861 ( 22.77)	1.905 ( 22.22)	999.999 ( .00)
6.00	1.394 ( 24.16)	1.408 ( 23.60)	1.457 ( 23.05)	1.568 ( 22.49)	1.858 ( 21.94)	1.910 ( 21.39)	999.999 ( .00)
5.00	1.385 ( 23.22)	1.394 ( 22.77)	1.435 ( 22.22)	1.531 ( 21.66)	1.732 ( 21.11)	1.917 ( 20.55)	999.999 ( .00)
4.00	1.385 ( 22.22)	1.385 ( 21.94)	1.419 ( 21.39)	1.503 ( 20.83)	1.667 ( 20.28)	1.927 ( 19.72)	999.999 ( .00)
3.00	1.390 ( 21.22)	1.385 ( 21.11)	1.411 ( 20.55)	1.484 ( 20.00)	1.624 ( 19.44)	999.999 ( .00)	999.999 ( .00)
2.00	1.398 ( 20.22)	1.391 ( 20.25)	1.414 ( 19.72)	1.478 ( 19.17)	1.598 ( 18.61)	999.999 ( .00)	999.999 ( .00)
1.00	1.412 ( 19.22)	1.405 ( 19.25)	1.422 ( 18.89)	1.483 ( 18.33)	1.594 ( 17.78)	999.999 ( .00)	999.999 ( .00)
.00	1.432 ( 18.22)	1.426 ( 18.25)	1.439 ( 18.06)	1.498 ( 17.50)	1.604 ( 16.95)	999.999 ( .00)	999.999 ( .00)
-1.00	1.461 ( 17.22)	1.456 ( 17.25)	1.465 ( 17.22)	1.524 ( 16.67)	1.629 ( 16.12)	999.999 ( .00)	999.999 ( .00)
-2.00	1.501 ( 16.22)	1.498 ( 16.25)	1.508 ( 16.28)	1.563 ( 15.84)	1.672 ( 15.28)	999.999 ( .00)	999.999 ( .00)

// 格子のグループ番号 = 1 //

```

*****
*                               *                               *
*   Service Condition           *   Under Earthquake           *
*                               *                               *
*****
*                               *                               *
*   Min. F.S. = 1.540          *   Min. F.S. = 1.385          *
*                               *                               *
*   Center X(m) = -16.00      *   Center X(m) = -16.00      *
*                               *                               *
*   Y(m) = 2.00              *   Y(m) = 4.00              *
*                               *                               *
*   Radius R (m) = 20.25     *   Radius R (m) = 21.94     *
*                               *                               *
*   Resisting Moment(tfm) = 5025.44 *   Resisting Moment(tfm) = 5588.79 *
*                               *                               *
*   Sliding Moment(tfm) = 3263.88 *   Sliding Moment(tfm) = 4036.64 *
*                               *                               *
*****

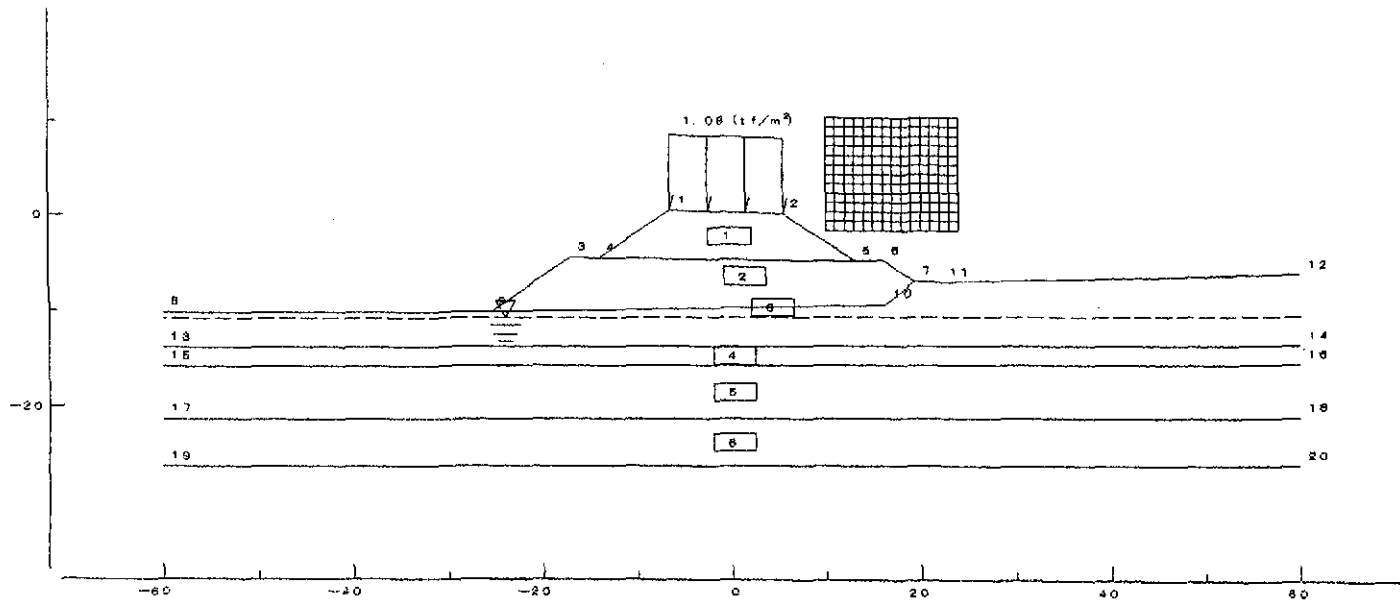
```

Interchange Left Embankment

縮尺 : 1 / 800

層番号	飽和重量 ( $t f / m^3$ )	湿潤重量 ( $t f / m^3$ )	内部摩擦角 (度)	粘着力 ( $t f / m^2$ )	粘着力の 一次係数	水平展度	鉛直展度
1	1.900	1.900	35.0	0.00	0.00	0.100	0.000
2	1.900	1.900	35.0	0.00	0.00	0.100	0.000
3	1.700	1.700	0.0	8.60	0.00	0.000	0.000
4	1.700	1.700	29.0	1.00	0.00	0.000	0.000
5	1.700	1.700	0.0	6.00	0.00	0.000	0.000
6	1.700	1.700	0.0	15.00	0.00	0.000	0.000

水の単位体積重量 = 1.000 ( $t f / m^3$ )

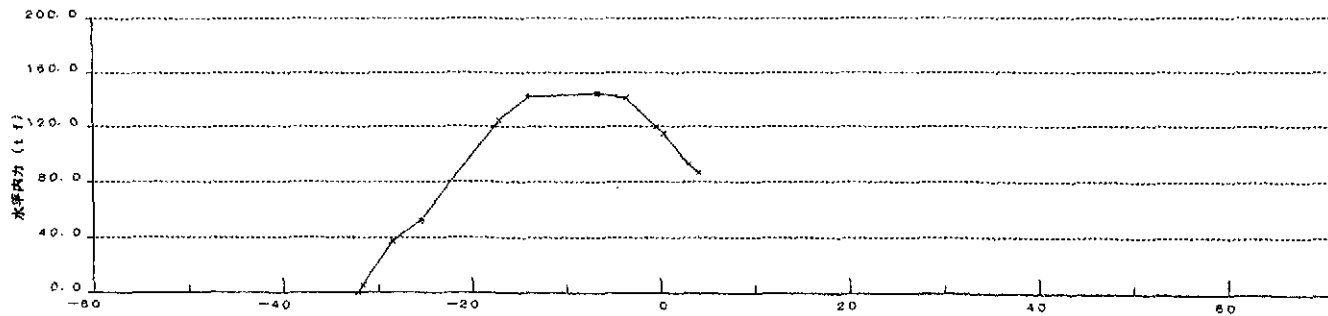
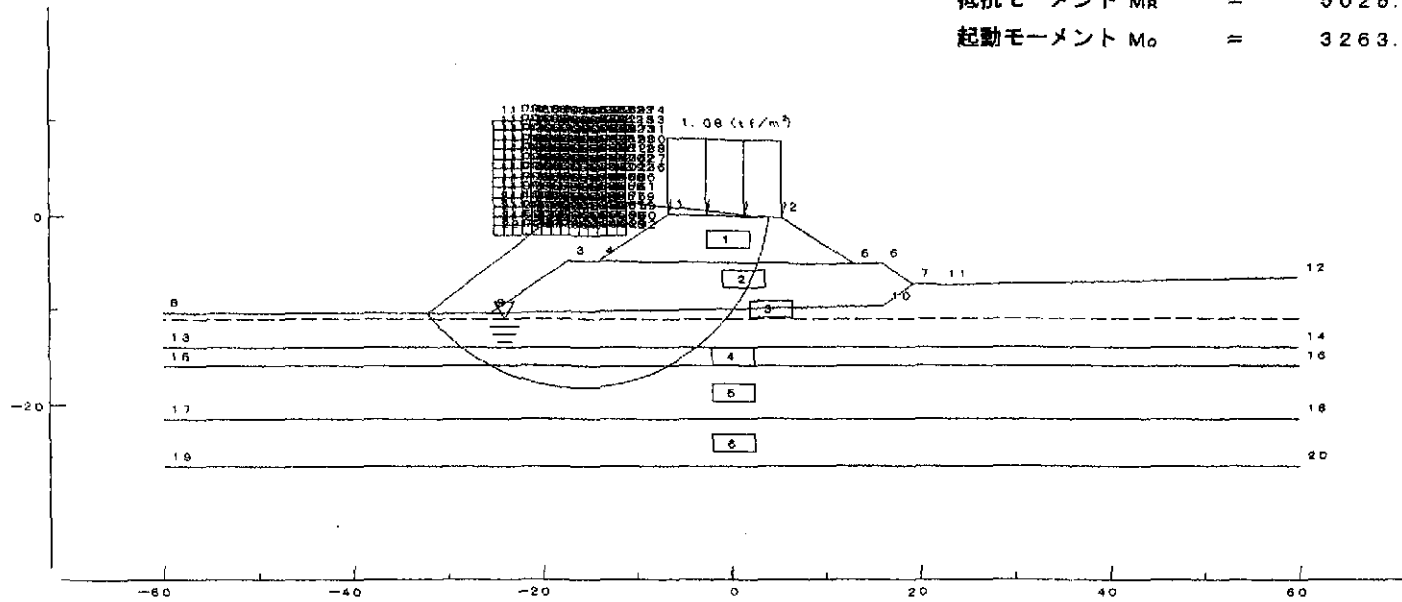


モデル図

Interchange Left Embankment

縮尺 : 1 / 800

最小安全率  $F_s \text{ MIN} = 1.540$   
 円弧の中心  $X = -16.00 \text{ (m)}$   
                    $Y = 2.00 \text{ (m)}$   
 半径  $R = 20.26 \text{ (m)}$   
 抵抗モーメント  $M_R = 5025.44 \text{ (tf}\cdot\text{m)}$   
 起動モーメント  $M_o = 3263.88 \text{ (tf}\cdot\text{m)}$



水平内力分布図 (常時)

# APPENDIX C

## SOUTH APPROACH EMBANKMENT

(RIGHT SIDE FAILURE)

```
***** 富士通 エフ・アイ・ピー *****
*
* // C O S T A N A //
*
* 斜面安定計算プログラム
*
* VERSION 4 LEVEL 2
*
* (2002.10. 7)
*
* Interchange Left Embankment
*
*****
```

	1	2	3	4	5	6	7	8
1	TITLE Interchange Left Embankment							
2	ANALY	0	0.000					
3	DORO	1	2					
4	CONTR	0	0	0.000				
5	EARTH	1	1	2	0.0000.000			
6	LIST	1	0	0	0	00		
7	NODE	1	-6.50	0.19	0.00			
8		2	5.49	-0.18	0.00			
9		3	-17.00	-4.72	0.00			
10		4	-14.00	-4.81	0.00			
11		5	13.13	-5.18	0.00			
12		6	16.13	-5.10	0.00			
13		7	19.35	-7.24	0.00			
14		8	-60.00	-10.35	0.00			
15		9	-25.48	-10.38	0.00			
16		10	16.13	-9.67	0.00			
17		11	22.23	-7.38	0.00			
18		12	60.00	-6.60	0.00			
19		13	-60.00	-13.97	0.00			
20		14	60.00	-13.97	0.00			
21		15	-60.00	-15.97	0.00			
22		16	60.00	-15.97	0.00			
23		17	-60.00	-21.47	0.00			
24		18	60.00	-21.47	0.00			
25		19	-60.00	-26.47	0.00			
26		20	60.00	-26.47	0.00			
27	WATER	1	-60.00	-10.97	1.0000			
28		2	60.00	-10.97				
29	LAYER	1	4	1	4	5	2	
30		2	7	3	9	10	7	6
31		3	8	8	13	14	12	11
32		4	4	13	15	16	14	5
33		5	4	15	17	18	16	4
34		6	4	17	19	20	18	9
35	MATE	11.900	1.9000.0000.0000.000	35.0	0.000.1000.000			0.00
36		21.900	1.9000.0000.0000.000	35.0	0.000.1000.000			0.00
37		31.700	1.7000.0000.0006.500	0.0	0.000.0000.000			0.00
38		41.700	1.7000.0000.0001.000	29.0	0.000.0000.000			0.00
39		51.700	1.7000.0000.0006.000	0.0	0.000.0000.000			0.00
40		61.700	1.7000.0000.00015.00	0.0	0.000.0000.000			0.00
41	ZAHYO		0.00					
42	GRID	21	10.00	10.00	1.00	1.00	15	13
43	CIRCL	0	1.00	30.00	30.00	15.50		
44	VLOAD	1	-6.50	0.19	1.08	5.49	-0.18	1.08
45	NEVER	2	5.49	-0.19				
46			13.13	-5.18				
47		2	16.13	-5.10				
48			19.35	-7.24				

.....+.....1.....+.....2.....+.....3.....+.....4.....+.....5.....+.....6.....+.....7.....+.....8



## ( DATA 06. ) // 節点 //

節点番号	節点の座標値 (m)		沈下前のY座標値 (m)
	X	Y	
1	( -6.50 ,	.19 )	.00
2	( 5.49 ,	-.18 )	.00
3	( -17.00 ,	-4.72 )	.00
4	( -14.00 ,	-4.81 )	.00
5	( 13.13 ,	-5.18 )	.00
6	( 16.13 ,	-5.10 )	.00
7	( 19.35 ,	-7.24 )	.00
8	( -60.00 ,	-10.35 )	.00
9	( -25.48 ,	-10.38 )	.00
10	( 16.13 ,	-9.67 )	.00
11	( 22.23 ,	-7.38 )	.00
12	( 60.00 ,	-6.60 )	.00
13	( -60.00 ,	-13.97 )	.00
14	( 60.00 ,	-13.97 )	.00
15	( -60.00 ,	-15.97 )	.00
16	( 60.00 ,	-15.97 )	.00
17	( -60.00 ,	-21.47 )	.00
18	( 60.00 ,	-21.47 )	.00
19	( -60.00 ,	-26.47 )	.00
20	( 60.00 ,	-26.47 )	.00

## ( DATA 07. ) // 水位線 //

水の単位体積重量 (tf/m<sup>3</sup>) = 1.000

点の番号	座標値 (m)	
	X	Y
1	( -60.00 ,	-10.97 )
2	( 60.00 ,	-10.97 )

## ( DATA 08. ) // 層の形状 //

地層番号	構成節点数	地層を構成する節点番号							
1	4	1	4	5	2				
2	7	3	9	10	7	6	5	4	
3	8	8	13	14	12	11	7	10	9
4	4	13	15	16	14				
5	4	15	17	18	16				
6	4	17	19	20	18				

## ( DATA 09. ) // 土の特性 //

地層番号	飽和単位体積重量 (tf/m <sup>3</sup> )	湿潤単位体積重量 (tf/m <sup>3</sup> )	間隙水圧算定単位体積重量 (tf/m <sup>3</sup> )	係数 $\alpha$	粘着力 (tf/m <sup>2</sup> )	粘着力の一次係数	内部摩擦角 (度)	アンカーの周面摩擦抵抗 $\tau$ (tf/m <sup>2</sup> )
1	1.900	1.900	.000	.000	.00	.00	35.0	.00
2	1.900	1.900	.000	.000	.00	.00	35.0	.00
3	1.700	1.700	.000	.000	6.50	.00	.0	.00
4	1.700	1.700	.000	.000	1.00	.00	29.0	.00



( DATA 09. ) // 土の特性 //

地層 番号	飽和単位 体積重量 (tf/m <sup>3</sup> )	湿潤単位 体積重量 (tf/m <sup>3</sup> )	間隙水圧算定 単位体積重量 (tf/m <sup>3</sup> )	係数 $\alpha$	粘着力 (tf/m <sup>2</sup> )	粘着力の 一次係数	内部 摩擦角 (度)	アンカーの周面 摩擦抵抗 $\tau$ (tf/m <sup>2</sup> )
5	1.700	1.700	.000	.000	6.00	.00	.0	.00
6	1.700	1.700	.000	.000	15.00	.00	.0	.00

( DATA 09. ) // 土の特性 //

地層 番号	水平 震度 (KH)	鉛直 震度 (KV)	地層 番号	水平 震度 (KH)	鉛直 震度 (KV)	地層 番号	水平 震度 (KH)	鉛直 震度 (KV)
1	.100	.000	2	.100	.000	3	.000	.000
4	.000	.000	5	.000	.000	6	.000	.000

( DATA 11. ) // 格子 //

すべり面の位置	格子の左上の座標値		X方向の	Y方向の	X方向の	Y方向の	傾き
	X (m)	Y (m)	ピッチ (m)	ピッチ (m)	格子点数	格子点数	
右すべり	( 10.00 ,	10.00 )	1.00	1.00	15	13	.000

( DATA 12. ) // 半径 (垂線法) //

半径	.....	0 ( =0 最大半径より $\Delta R$ ピッチで決める ) ( =1 最小半径より $\Delta R$ ピッチで決める )
半径のピッチ $\Delta R$ (m)	.....	1.00
最大半径を与えるY座標値 (m)	.....	30.00
最小半径を与えるY座標値 (m)	.....	30.00
地表面からの深さ (m)	.....	15.50

( DATA 15.1 ) // 分布荷重 (鉛直) //

荷重番号	左 端			右 端			抵抗力 の係数
	X (m)	Y (m)	荷重 (tf)	X (m)	Y (m)	荷重 (tf)	
1	( -6.50 ,	.19 )	1.08	( 5.49 ,	- .18 )	1.08	.000

( DATA 16. ) // 円弧を切ってはならない線 // ( N = 2 )

構成節点数	X (m)	Y (m)
2	( 5.49 ,	- .19 )
	( 13.13 ,	-5.18 )
2	( 16.13 ,	-5.10 )
	( 19.35 ,	-7.24 )

\*\*\*\*\*  
 \* 安全率 (格子のグループ番号 = 1 : 二次追求の回数 = 0) \*  
 \*\*\*\*\*

// 常 時 //

円の中心座標

* * X * (m) Y * (m) *	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00
10.00	2.887 ( 26.63)	2.684 ( 27.08)	2.568 ( 27.58)	2.491 ( 28.13)	2.440 ( 28.68)	2.407 ( 29.23)	2.388 ( 29.77)	2.381 ( 30.32)
9.00	2.784 ( 25.73)	2.599 ( 26.21)	2.495 ( 26.75)	2.427 ( 27.29)	2.382 ( 27.84)	2.354 ( 28.39)	2.340 ( 28.94)	2.338 ( 29.48)
8.00	2.684 ( 24.84)	2.519 ( 25.36)	2.426 ( 25.91)	2.366 ( 26.46)	2.327 ( 27.00)	2.304 ( 27.55)	2.295 ( 28.10)	2.297 ( 28.63)
7.00	2.590 ( 23.98)	2.444 ( 24.53)	2.362 ( 25.07)	2.308 ( 25.62)	2.275 ( 26.17)	2.258 ( 26.72)	2.254 ( 27.26)	2.257 ( 27.63)
6.00	2.501 ( 23.14)	2.375 ( 23.69)	2.301 ( 24.24)	2.255 ( 24.78)	2.228 ( 25.33)	2.216 ( 25.88)	2.216 ( 26.43)	2.223 ( 26.63)
5.00	2.422 ( 22.30)	2.311 ( 22.85)	2.246 ( 23.40)	2.206 ( 23.95)	2.185 ( 24.49)	2.178 ( 25.04)	2.184 ( 25.59)	2.196 ( 25.64)
4.00	2.350 ( 21.47)	2.253 ( 22.01)	2.196 ( 22.56)	2.162 ( 23.11)	2.147 ( 23.66)	2.146 ( 24.21)	2.156 ( 24.60)	2.178 ( 24.64)
3.00	2.287 ( 20.63)	2.201 ( 21.18)	2.152 ( 21.73)	2.125 ( 22.27)	2.116 ( 22.82)	2.121 ( 23.37)	2.137 ( 23.60)	2.173 ( 23.65)
2.00	2.233 ( 19.79)	2.157 ( 20.34)	2.115 ( 20.89)	2.096 ( 21.44)	2.093 ( 21.98)	2.106 ( 22.53)	2.132 ( 22.60)	2.192 ( 22.65)
1.00	2.190 ( 18.96)	2.123 ( 19.50)	2.089 ( 20.05)	2.077 ( 20.60)	2.082 ( 21.15)	2.102 ( 21.63)	2.154 ( 21.60)	2.219 ( 21.66)
.00	2.161 ( 18.12)	2.103 ( 18.67)	2.077 ( 19.22)	2.072 ( 19.76)	2.089 ( 20.31)	2.127 ( 20.63)	2.185 ( 20.60)	2.255 ( 20.67)
-1.00	2.151 ( 17.28)	2.101 ( 17.83)	2.085 ( 18.38)	2.095 ( 18.93)	2.119 ( 19.47)	2.163 ( 19.63)	2.227 ( 19.60)	2.304 ( 19.69)
-2.00	2.166 ( 16.45)	2.130 ( 16.99)	2.122 ( 17.54)	2.132 ( 18.09)	2.159 ( 18.64)	2.212 ( 18.63)	2.282 ( 18.60)	2.368 ( 18.72)

\*\*\*\*\*  
 \* 安全率 (格子のグループ番号 = 1 ; 二次追求の回数 = 0) \*  
 \*\*\*\*\*

// 常時 //

円の中心座標

* X * (m)	18.00	19.00	20.00	21.00	22.00	23.00	24.00
Y * (m) *							
10.00	2.382 ( 30.72)	2.389 ( 30.87)	2.409 ( 31.09)	2.442 ( 31.37)	2.918 ( 31.70)	3.258 ( 32.09)	3.559 ( 32.53)
9.00	2.339 ( 29.72)	2.353 ( 29.89)	2.380 ( 30.12)	2.419 ( 30.42)	2.964 ( 30.77)	3.302 ( 31.18)	3.614 ( 31.65)
8.00	2.302 ( 28.73)	2.322 ( 28.91)	2.357 ( 29.16)	2.466 ( 29.48)	3.018 ( 29.86)	3.365 ( 30.29)	3.693 ( 30.78)
7.00	2.270 ( 27.74)	2.298 ( 27.94)	2.340 ( 28.20)	2.633 ( 28.54)	3.091 ( 28.95)	3.447 ( 29.41)	3.756 ( 29.84)
6.00	2.244 ( 26.76)	2.281 ( 26.97)	2.333 ( 27.26)	2.749 ( 27.62)	3.180 ( 28.06)	3.540 ( 28.55)	3.812 ( 28.84)
5.00	2.227 ( 25.77)	2.274 ( 26.00)	2.345 ( 26.32)	2.863 ( 26.71)	3.280 ( 27.18)	3.645 ( 27.71)	3.880 ( 27.84)
4.00	2.221 ( 24.79)	2.289 ( 25.04)	2.364 ( 25.39)	2.982 ( 25.82)	3.393 ( 26.33)	3.754 ( 26.86)	3.963 ( 26.84)
3.00	2.237 ( 23.81)	2.309 ( 24.09)	2.459 ( 24.48)	3.111 ( 24.95)	3.520 ( 25.50)	3.836 ( 25.86)	4.065 ( 25.84)
2.00	2.261 ( 22.84)	2.337 ( 23.16)	2.730 ( 23.59)	3.257 ( 24.11)	3.658 ( 24.66)	3.936 ( 24.86)	4.192 ( 24.84)
1.00	2.292 ( 21.88)	2.374 ( 22.24)	2.929 ( 22.72)	3.414 ( 23.28)	3.811 ( 23.83)	4.062 ( 23.86)	4.351 ( 23.84)
.00	2.335 ( 20.93)	2.422 ( 21.35)	3.130 ( 21.89)	3.584 ( 22.44)	3.948 ( 22.86)	4.222 ( 22.86)	4.555 ( 22.84)
-1.00	2.390 ( 20.01)	2.653 ( 20.50)	3.332 ( 21.06)	3.776 ( 21.61)	4.111 ( 21.86)	4.427 ( 21.86)	4.820 ( 21.84)
-2.00	2.460 ( 19.12)	2.997 ( 19.67)	3.548 ( 20.22)	3.996 ( 20.78)	4.318 ( 20.86)	4.691 ( 20.86)	5.170 ( 20.84)

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 \* 安全率 (格子のグループ番号 = 1 ; 二次追求の回数 = 0) \*  
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// 地震時 //

円の中心座標

* X * (m) Y * (m) *	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00
10.00	2.326 ( 26.63)	2.197 ( 27.08)	2.132 ( 27.58)	2.094 ( 28.13)	2.073 ( 28.68)	2.064 ( 29.23)	2.065 ( 29.77)	2.074 ( 30.32)
9.00	2.265 ( 25.73)	2.148 ( 26.21)	2.090 ( 26.75)	2.057 ( 27.29)	2.040 ( 27.84)	2.034 ( 28.39)	2.038 ( 28.94)	2.050 ( 29.48)
8.00	2.207 ( 24.84)	2.102 ( 25.36)	2.051 ( 25.91)	2.023 ( 26.46)	2.009 ( 27.00)	2.006 ( 27.55)	2.013 ( 28.10)	2.028 ( 28.63)
7.00	2.151 ( 23.98)	2.059 ( 24.53)	2.015 ( 25.07)	1.991 ( 25.62)	1.980 ( 26.17)	1.981 ( 26.72)	1.991 ( 27.26)	2.005 ( 27.63)
6.00	2.099 ( 23.14)	2.021 ( 23.69)	1.982 ( 24.24)	1.961 ( 24.78)	1.955 ( 25.33)	1.959 ( 25.88)	1.972 ( 26.43)	1.987 ( 26.63)
5.00	2.054 ( 22.30)	1.986 ( 22.85)	1.952 ( 23.40)	1.936 ( 23.95)	1.933 ( 24.49)	1.941 ( 25.04)	1.958 ( 25.59)	1.976 ( 25.64)
4.00	2.015 ( 21.47)	1.956 ( 22.01)	1.926 ( 22.56)	1.914 ( 23.11)	1.915 ( 23.66)	1.927 ( 24.21)	1.946 ( 24.60)	1.973 ( 24.64)
3.00	1.983 ( 20.63)	1.931 ( 21.18)	1.906 ( 21.73)	1.898 ( 22.27)	1.904 ( 22.82)	1.921 ( 23.37)	1.943 ( 23.60)	1.981 ( 23.65)
2.00	1.959 ( 19.79)	1.913 ( 20.34)	1.893 ( 20.89)	1.890 ( 21.44)	1.900 ( 21.98)	1.922 ( 22.53)	1.953 ( 22.60)	2.012 ( 22.65)
1.00	1.944 ( 18.96)	1.904 ( 19.50)	1.889 ( 20.05)	1.891 ( 20.60)	1.907 ( 21.15)	1.935 ( 21.63)	1.986 ( 21.60)	2.050 ( 21.66)
.00	1.943 ( 18.12)	1.908 ( 18.67)	1.898 ( 19.22)	1.906 ( 19.76)	1.932 ( 20.31)	1.974 ( 20.63)	2.031 ( 20.60)	2.100 ( 20.67)
-1.00	1.959 ( 17.28)	1.930 ( 17.83)	1.927 ( 18.38)	1.947 ( 18.93)	1.978 ( 19.47)	2.025 ( 19.63)	2.087 ( 19.60)	2.163 ( 19.69)
-2.00	2.001 ( 16.45)	1.981 ( 16.99)	1.984 ( 17.54)	2.004 ( 18.09)	2.037 ( 18.64)	2.089 ( 18.63)	2.158 ( 18.60)	2.242 ( 18.72)

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 \* 安全率 (格子のグループ番号 = 1 ; 二次追求の回数 = 0) \*  
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// 地震時 //

円の中心座標

* Y (m)	X (m)	18.00	19.00	20.00	21.00	22.00	23.00	24.00
10.00		2.087 ( 30.72)	2.103 ( 30.87)	2.130 ( 31.09)	2.168 ( 31.37)	2.605 ( 31.70)	2.922 ( 32.09)	3.204 ( 32.53)
9.00		2.062 ( 29.72)	2.083 ( 29.89)	2.116 ( 30.12)	2.159 ( 30.42)	2.660 ( 30.77)	2.977 ( 31.18)	3.270 ( 31.65)
8.00		2.041 ( 28.73)	2.068 ( 28.91)	2.106 ( 29.16)	2.213 ( 29.48)	2.723 ( 29.86)	3.048 ( 30.29)	3.357 ( 30.78)
7.00		2.024 ( 27.74)	2.058 ( 27.94)	2.103 ( 28.20)	2.378 ( 28.54)	2.804 ( 28.95)	3.138 ( 29.41)	3.429 ( 29.84)
6.00		2.014 ( 26.76)	2.055 ( 26.97)	2.109 ( 27.26)	2.497 ( 27.62)	2.900 ( 28.06)	3.239 ( 28.55)	3.496 ( 28.84)
5.00		2.011 ( 25.77)	2.061 ( 26.00)	2.131 ( 26.32)	2.615 ( 26.71)	3.008 ( 27.18)	3.353 ( 27.71)	3.574 ( 27.84)
4.00		2.018 ( 24.79)	2.085 ( 25.04)	2.160 ( 25.39)	2.739 ( 25.82)	3.129 ( 26.33)	3.473 ( 26.86)	3.668 ( 26.84)
3.00		2.045 ( 23.81)	2.117 ( 24.09)	2.261 ( 24.48)	2.876 ( 24.95)	3.266 ( 25.50)	3.566 ( 25.86)	3.781 ( 25.84)
2.00		2.080 ( 22.84)	2.156 ( 23.16)	2.530 ( 23.59)	3.030 ( 24.11)	3.414 ( 24.66)	3.679 ( 24.86)	3.919 ( 24.84)
1.00		2.123 ( 21.88)	2.205 ( 22.24)	2.734 ( 22.72)	3.197 ( 23.28)	3.579 ( 23.83)	3.818 ( 23.86)	4.090 ( 23.84)
.00		2.179 ( 20.93)	2.267 ( 21.35)	2.943 ( 21.89)	3.380 ( 22.44)	3.731 ( 22.86)	3.991 ( 22.86)	4.305 ( 22.84)
-1.00		2.248 ( 20.01)	2.504 ( 20.50)	3.157 ( 21.06)	3.588 ( 21.61)	3.910 ( 21.86)	4.211 ( 21.86)	4.583 ( 21.84)
-2.00		2.335 ( 19.12)	2.855 ( 19.67)	3.391 ( 20.22)	3.827 ( 20.78)	4.135 ( 20.86)	4.491 ( 20.86)	4.946 ( 20.84)

// 格子のグループ番号 = 1 //

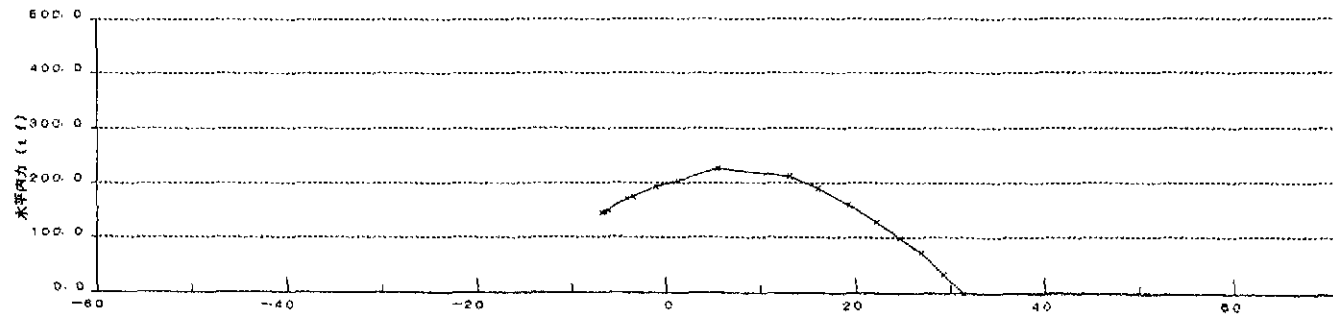
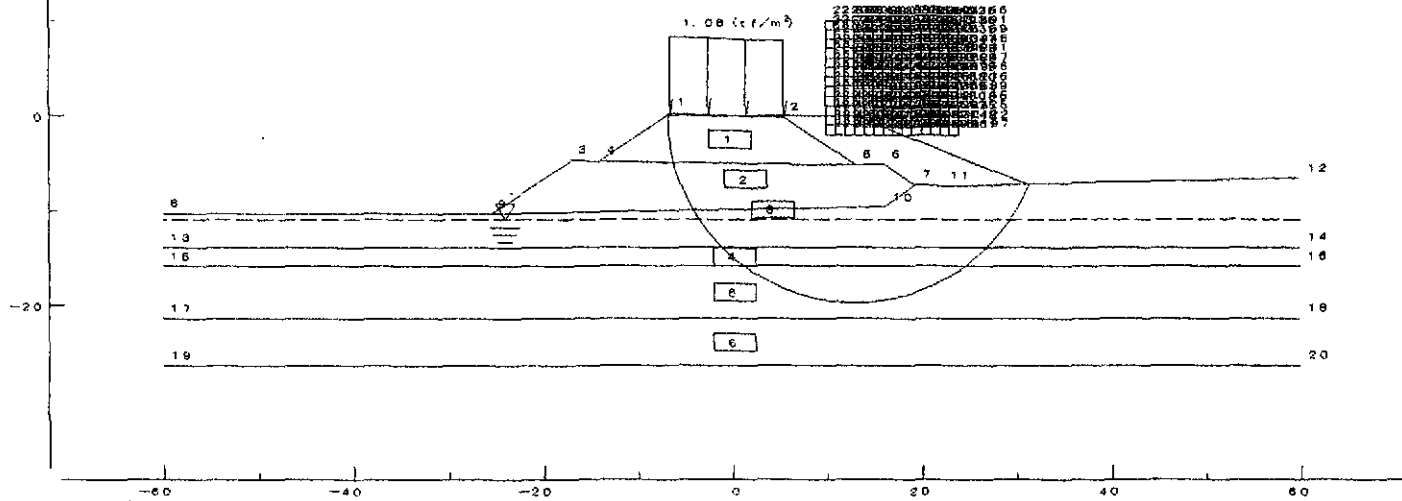
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*****
*                               *                               *
*   Service Condition           *   Under Earthquake           *
*                               *                               *
*****
*                               *                               *
*   Min. F.S. = 2.072          *   Min. F.S. = 1.889          *
*                               *                               *
*   Center X (m) = 13.00      *   Center X (m) = 12.00      *
*                               *                               *
*   Y (m) = .00              *   Y (m) = 1.00              *
*                               *                               *
*   Radius R (m) = 19.76     *   Radius R (m) = 20.05     *
*                               *                               *
*   Resisting Moment(tfm) = 5588.46 * Resisting Moment(tfm) = 5551.81 *
*                               *                               *
*   Sliding Moment(tfm) = 2696.56  * Sliding Moment(tfm) = 2939.01 *
*                               *                               *
*****
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Interchange Left Embankment

縮尺 : 1 / 800

最小安全率	$F_{s MIN}$	=	2.072
円弧の中心	X	=	13.00 (m)
	Y	=	0.00 (m)
	半径 R	=	19.76 (m)
抵抗モーメント	$M_R$	=	5588.46 (tf·m)
起動モーメント	$M_o$	=	2696.56 (tf·m)



水平内力分布図 (常時)

## **APPENDIX 9.3-1**

### **Hydrological Characteristics of Watersheds and Related Discharges (Plaridel Bypass)**

## APPENDIX 9.3-1 HYDROLOGICAL CHARACTERISTICS OF WATERSHEDS AND RELATED DISCHARGES (PLARIDEL BYPASS)

Catchment Area No.	Station Limits	Catchment Area (km <sup>2</sup> )	Diff. in Elev., Δh (m)	Length (m)	T <sub>c</sub> (min)	RAINFALL INTENSITY			Coefficient C	DISCHARGE, Q			PROPOSED DRAINAGE STRUCTURE			REMARKS (General Recommendation)
						2 yrs	10 yrs	25 yrs		2 yrs	10 yrs	25 yrs	STATION	RCPC/RCBC	CAPACITY cms	
1	33 + 315 - 33 + 480	0.217	1.00	950.00	51.68	48.67	92.29	114.24	0.50	1.47	2.78	2.45	33 + 156	2-4.00 x 2.50	84.28	Extend the existing RCBC
													33 + 300	1-910 mm φ	1.47	Storm Water Drainage
													33 + 320	2-910 mm φ	1.63	Storm Water Drainage
															87.38	Total
2	33 + 515 - 33 + 915	2.658	1.00	1050.00	57.99	45.05	85.47	105.87	0.50	16.65	31.58	39.12	33 + 500	3-3.00 x 2.40	64.35	Storm Water Drainage
															64.35	Total
3	33 + 915 - 34 + 115	2.280	1.00	2500.00	157.25	27.65	52.79	65.40	0.50	8.76	16.73	20.72	34 + 000	3-3.00 x 2.10	45.65	Storm Water Drainage
4	34 + 115 - 34 + 545	0.056	1.00	600.00	30.47	65.37	122.65	151.48	0.50	0.51	0.96	1.19	34+200	1-910 mm φ	1.13	Irrigation Structure
													34+286	1-910 mm φ	1.28	Irrigation Structure
													34+450	1-910 mm φ	0.92	Irrigation Structure
															3.33	Total
5	34 + 545 - 34 + 795	0.802	2.00	2300.00	109.41	33.54	63.88	79.17	0.50	3.74	7.12	8.83	34+555	1-910 mm φ	1.17	Storm Water Drainage
													34+635	1-910 mm φ	1.42	Storm Water Drainage
													34+715	1-1070 mm φ	1.11	Irrigation Structure
													34+775	2-2.40 x 1.80	21.30	Irrigation Structure
															25.00	Total
6	34 + 795 - 35 + 380	0.100	3.00	300.00	8.99	109.74	205.56	253.59	0.50	1.53	2.86	3.52	34+900	1-910 mm φ	1.02	Storm Water Drainage
													35+135	1-910 mm φ	1.36	Storm Water Drainage
													35+380	1-910 mm φ	1.32	Irrigation Structure
															3.70	Total
7	35 + 380 - 35 + 670	0.121	2.00	650.00	27.52	69.00	129.38	159.75	0.50	1.16	2.17	2.68	35 + 535	1-910 mm φ	0.85	Storm Water Drainage
													35 + 670	2-910 mm φ	1.67	Irrigation Structure
															2.52	Total
8	35 + 670 - 36 + 065	0.277	1.00	1150.00	64.38	43.18	81.96	101.52	0.50	1.66	3.15	3.91	35 + 825	1-1070 mm φ	1.34	Irrigation Structure
													35 + 965	1-910 mm φ	1.16	Irrigation Structure
													35 + 055	1-910 mm φ	0.88	Irrigation Structure
															3.38	Total

## APPENDIX 9.3-1 HYDROLOGICAL CHARACTERISTICS OF WATERSHEDS AND RELATED DISCHARGES (PLARIDEL BYPASS)

Catchment Area No.	Station Limits	Catchment Area (km <sup>2</sup> )	Diff. in Elev., Δh (m)	Length (m)	Tc (min)	RAINFALL INTENSITY			Coefficient C	DISCHARGE, Q			PROPOSED DRAINAGE STRUCTURE			REMARKS (General Recommendation)
						2 yrs	10 yrs	25 yrs		2 yrs	10 yrs	25 yrs	STATION	RCPC/RCBC	CAPACITY cms	
9	36 + 065 - 36 + 255	0.938	3.00	3000.00	127.05	31.05	59.13	73.33	0.50	4.05	7.71	9.56	36+075	1-910 mm φ	1.02	Irrigation Structure
													36+125	2-3.00 x 2.75	48.82	Irrigation Structure
													36+255	1-910 mm φ	0.83	Irrigation Structure
															50.67	Total
10	36 + 255 - 36 + 655	0.069	3.00	250.00	7.29	120.76	226.37	279.50	0.50	1.16	2.18	2.70	36+285	1-910 mm φ	1.04	Irrigation Structure
													36+365	1-910 mm φ	1.06	Irrigation Structure
													36+445	1-910 mm φ	1.13	Irrigation Structure
													36+525	1-910 mm φ	0.95	Irrigation Structure
													36+565	1-910 mm φ	1.11	Irrigation Structure
															5.30	Total
11	36 + 655 - 36 + 895	0.071	3.00	400.00	12.52	95.74	179.09	220.96	0.50	0.95	1.78	2.19	36 + 660	1-910 mm φ	1.08	Irrigation Structure
													36 + 890	1-910 mm φ	1.13	Irrigation Structure
															2.21	Total
12	36 + 895 - 37 + 235	0.069	3.00	500.00	16.18	81.70	160.98	198.76	0.50	0.78	1.54	1.90	37 + 040	1-910 mm φ	1.13	Storm Water Drainage
													37 + 223	1-910 mm φ	0.96	Storm Water Drainage
															2.09	Total
13	37 + 235 - 37 + 730	0.135	3.00	600.00	19.96	60.23	147.44	181.98	0.50	1.11	2.76	3.41	37+244	1-910 mm φ	0.55	0
													37+335	1-910 mm φ	1.04	Irrigation Structure
													37+465	1-910 mm φ	1.13	Irrigation Structure
													37+630	1-910 mm φ	1.06	Irrigation Structure
															3.78	Total
14	37 + 730 - 38 + 115	0.256	1.00	950.00	51.68	48.67	92.29	114.24	0.50	1.73	3.28	4.06	37+728	1-910 mm φ	1.14	Irrigation Structure
													37+852	1-910 mm φ	1.20	Irrigation Structure
													38+090	1-910 mm φ	1.02	Storm Water Drainage
															3.36	Total
15	38 + 115 - 38 + 400	0.057	2.00	500.00	18.92	66.13	151.17	186.60	0.50	0.52	1.19	1.47	38+140	1-910 mm φ	0.91	Irrigation Structure
													38+195	1-910 mm φ	0.97	Irrigation Structure
															1.88	Total

## APPENDIX 9.3-1 HYDROLOGICAL CHARACTERISTICS OF WATERSHEDS AND RELATED DISCHARGES (PLARIDEL BYPASS)

Catchment Area No.	Station Limits		Catchment Area (km <sup>2</sup> )	Diff. in Elev., Δh (m)	Length (m)	Tc (min)	RAINFALL INTENSITY			Coefficient C	DISCHARGE, Q			PROPOSED DRAINAGE STRUCTURE			REMARKS (General Recommendation)
							2 yrs	10 yrs	25 yrs		2 yrs	10 yrs	25 yrs	STATION	RCPC/RCBC	CAPACITY cms	
16	38 + 400	38 + 705	0.030	2.00	300.00	10.51	101.69	190.34	234.71	0.50	0.42	0.79	0.98	38+414	1-910 mm φ	1.11	Irrigation Structure
														38+590	1-910 mm φ	1.13	Irrigation Structure
														38+690	1-910 mm φ	1.13	Storm Water Drainage
																3.37	Total
17	38 + 705	39 + 115	0.394	1.00	750.00	39.38	57.3	108.45	134.08	0.50	3.14	5.93	7.34	38+720	2-3.00 x 2.10	47.74	Irrigation Structure
														38+862	1-910 mm φ	1.08	Irrigation Structure
														38+982	1-910 mm φ	0.92	Irrigation Structure
														39+045	1-910 mm φ	1.26	Storm Water Drainage
														39+190	1-910 mm φ	0.92	Storm Water Drainage
																51.92	Total
18	39 + 115	39 + 395	0.024	1.00	150.00	6.19	127.89	239.86	296.26	0.50	0.42	0.80	0.98	39+365	1-910 mm φ	1.13	Storm Water Drainage
19	39 + 395	39 + 740	0.096	1.00	375.00	17.75	72.78	155.36	191.79	0.50	0.97	2.07	2.55	39+595	1-910 mm φ	1.13	Irrigation Structure
														39+720	1-910 mm φ	1.11	Irrigation Structure
																2.24	Total
20	39 + 740	40 + 170	0.128	1.00	300.00	13.73	92.16	172.31	212.69	0.50	1.64	3.07	3.79	39 + 815	1-910 mm φ	1.04	Irrigation Structure
														39 + 920	1-910 mm φ	1.09	Irrigation Structure
														40 + 015	1-910 mm φ	1.13	Irrigation Structure
														40 + 200	1-910 mm φ	1.26	Irrigation Structure
																4.52	Total
21	40 + 170	40 + 485	18.710	See Hydrology Report								125.40	40 + 355.30 40 + 391.16		125.40	Bridge No 1	
22	40 + 485	40 + 865	0.170	1.00	500.00	24.70	72.57	136.05	155.69	0.50	1.72	3.21	3.68	40+586	1-910 mm φ	1.14	Irrigation Structure
														40+717	1-910 mm φ	1.34	Irrigation Structure
														40+862	1-910 mm φ	1.29	Irrigation Structure
																3.77	Total

## APPENDIX 9.3-1 HYDROLOGICAL CHARACTERISTICS OF WATERSHEDS AND RELATED DISCHARGES (PLARIDEL BYPASS)

Catchment Area No.	Station Limits		Catchment Area (km <sup>2</sup> )	Diff. in Elev., Δh (m)	Length (m)	Tc (min)	RAINFALL INTENSITY			Coefficient C	DISCHARGE, Q			PROPOSED DRAINAGE STRUCTURE			REMARKS (General Recommendation)	
							2 yrs	10 yrs	25 yrs		2 yrs	10 yrs	25 yrs	STATION	RCPC/RCBC	CAPACITY cms		
23	40 + 865	41 + 165	0.072	1.00	300.00	13.73	92.16	172.31	212.69	0.50	0.92	1.72	2.13	41 + 110	1-1070 mm φ	1.76	Irrigation Structure	
24	41 + 165	41 + 345	17.630	See Hydrology Report										124.90	41 + 200	1-910 mm φ	0.88	Irrigation Structure
														41 + 323.369 41 + 357.729		124.90	Bridge No 2	
																125.78	Total	
25	41 + 345	41 + 650	0.156	1.00	450.00	21.89	68.27	142.82	176.3	0.50	1.48	3.09	3.82	41 + 415	1-910 mm φ	1.67	Irrigation Structure	
														41 + 565	1-910 mm φ	1.47	Irrigation Structure	
																3.14	Total	
26	41 + 650	41 + 970		See Hydrology Report											41 + 635.069 41 + 665.929			Bridge No 3
														41+740	1-910 mm φ	1.16	Storm Water Drainage	
														41+860	1-910 mm φ	1.23	Storm Water Drainage	
																2.39	Total	
27	41 + 970	42 + 025	14.350	See Hydrology Report										109.20	41 + 968.103 41 + 992.963		109.20	Bridge No 4
28	42 + 025	42 + 305	0.035	2.00	150.00	4.74	135.60	254.40	314.40	0.50	0.65	1.22	1.51	42+060	1-910 mm φ	1.20	Irrigation Structure	
														42+180	1-910 mm φ	1.39	Irrigation Structure	
														42+305	1-910 mm φ	1.16	Irrigation Structure	
																3.75	Total	
29	42 + 305	42 + 535	0.040	2.00	200.00	6.60	125.23	234.82	290.02	0.50	0.69	1.30	1.61	42 + 455	1-910 mm φ	1.32	Irrigation Structure	
30	42 + 535	42 + 975	0.047	4.00	200.00	5.05	135.28	253.79	313.64	0.50	0.88	1.65	2.04	42+605	1-910 mm φ	1.09	Irrigation Structure	
														42+705	1-910 mm φ	1.13	Irrigation Structure	
														42+755	1-910 mm φ	1.16	Irrigation Structure	
														42+830	1-910 mm φ	1.16	Irrigation Structure	
														42+890	1-910 mm φ	1.09	Irrigation Structure	
														42+955	1-910 mm φ	1.06	Irrigation Structure	
																6.70	Total	

## APPENDIX 9.3-1 HYDROLOGICAL CHARACTERISTICS OF WATERSHEDS AND RELATED DISCHARGES (PLARIDEL BYPASS)

Catchment Area No.	Station Limits		Catchment Area (km <sup>2</sup> )	Diff. in Elev., Δh (m)	Length (m)	Tc (min)	RAINFALL INTENSITY			Coefficient C	DISCHARGE, Q			PROPOSED DRAINAGE STRUCTURE			REMARKS (General Recommendation)
							2 yrs	10 yrs	25 yrs		2 yrs	10 yrs	25 yrs	STATION	RCPC/RCBC	CAPACITY cms	
31	42 + 975	43 + 255	0.307	3.00	2000.00	79.70	38.68	73.55	91.08	0.50	1.65	3.14	3.89	43+000	1-1520 mm φ	4.48	Irrigation Structure
														43+055	1-1070 mm φ	2.00	Irrigation Structure
														43+140	1-910 mm φ	1.09	Storm Water Drainage
														43 + 255	1-1070 mm φ	1.49	Irrigation Structure
																9.06	Total
32	43 + 255	43 + 665	0.197	2.00	600.00	23.33	74.34	139.34	172.01	0.50	2.04	3.82	4.71	43 + 500	1-1520 mm φ	6.08	Irrigation Structure
33	43 + 665	43 + 695	1.063	2.00	3000.00	148.51	28.48	54.33	67.32	0.50	4.21	8.03	9.95	43 + 678	2-3.00 x 2.75	65.86	Irrigation Structure
34	43 + 695	44 + 015	0.082	1.00	300.00	13.73	92.16	172.3	212.69	0.50	1.05	1.96	2.42	43 + 774	1-1070 mm φ	2.03	Irrigation Structure
35	44 + 015	44 + 255	0.109	5.00	600.00	16.40	80.45	160.19	197.78	0.50	1.22	2.43	3.00	44 + 015	1-1220 mm φ	2.03	Irrigation Structure
														44 + 240	1-1.20 x 0.60	1.16	Irrigation Structure
																3.59	Total
36	44 + 255	44 + 545	0.070	5.00	500.00	13.29	93.46	174.78	215.7	0.50	0.91	1.69	2.09	44 + 265	1-1.20 x 0.60	0.90	Irrigation Structure
														44 + 380	1-910 mm φ	1.11	Irrigation Structure
														44 + 470	1-1220 mm φ	2.93	Irrigation Structure
														44 + 537	1-1220 mm φ	2.92	Irrigation Structure
																7.86	Total
37	44 + 545	44 + 715	0.538	6.00	1000.00	27.50	69.00	129.38	159.75	0.50	5.16	9.68	11.96	44 + 660	1-2.40 x 1.80	12.54	Irrigation Structure
38	44 + 715	45 + 115	0.057	3.00	400.00	12.52	45.74	179.09	220.96	0.50	0.76	1.42	1.75	45 + 110	1-910 mm φ	1.44	Irrigation Structure
39	45 + 115	45 + 270	0.028	9.00	150.00	2.66	135.6	254.4	314.4	0.50	0.53	0.99	1.22	45 + 262	2-3.00 x 2.40	48.76	Irrigation Structure
40	45 + 270	45 + 335	7.175	See Hydrology Report								85.60	45 + 316.142 45 + 351.102	85.60	Bridge No 5		
41	45 + 335	45 + 825	0.029	4.00	125.00	2.94	135.6	254.4	314.4	0.50	0.54	1.02	1.26	45 + 365	1-1070 mm φ	2.07	Irrigation Structure
42	45 + 825	45 + 865		See Hydrology Report									45 + 824.690 45 + 865.550		Bridge No 6		
43	45 + 865	46 + 230	0.046	4.00	300.00	8.05	115.84	217.07	267.92	0.50	0.75	1.40	1.73	45 + 914	1-910 mm φ	1.26	Irrigation Structure
														46 + 000	1-910 mm φ	1.81	Irrigation Structure
														46 + 120	1-910 mm φ	1.04	Irrigation Structure
																4.11	Total

## APPENDIX 9.3-1 HYDROLOGICAL CHARACTERISTICS OF WATERSHEDS AND RELATED DISCHARGES (PLARDEL BYPASS)

Catchment Area No.	Station Limits		Catchment Area (km <sup>2</sup> )	Diff. in Elev., Δh (m)	Length (m)	Tc (min)	RAINFALL INTENSITY			Coefficient C	DISCHARGE, Q			PROPOSED DRAINAGE STRUCTURE			REMARKS (General Recommendation)	
							2 yrs	10 yrs	25 yrs		2 yrs	10 yrs	25 yrs	STATION	RCPC/RCBC	CAPACITY cms		
44	46 + 230	46 + 695	0.037	2.00	200.00	6.60	125.23	234.82	290.02	0.50	0.64	1.20	1.49	46 + 250	1-910 mm φ	0.98	Irrigation Structure	
														46 + 300	1-910 mm φ	0.77	Storm Water Drainage	
														46 + 640	1-910 mm φ	1.20	Irrigation Structure	
																2.95	Total	
45	46 + 695	46 + 875	1.350	See Hydrology Report							0.50	0.27	0.50	0.62	46 + 706.109		14.70	Bridge No. 7
				46 + 751.769														
				46 + 794	1-910 mm φ	1.09	Irrigation Structure											
															15.79	Total		
46	46 + 875	47 + 180	0.015	1.00	150.00	6.19	127.89	239.83	296.26	0.50	0.27	0.50	0.62	46 + 940	1-910 mm φ	1.13	Storm Water Drainage	
														47 + 080	1-910 mm φ	1.22	Storm Water Drainage	
																2.35	Total	
47	47 + 180	49 + 285	889.100	See Hydrology Report							0.50	1.11	2.09	2.58	47 + 448	3-2.40 x 2.40	35.33	Irrigation Structure
				47 + 515	3-3.00 x 210	30.51	Storm Water Drainage											
				47 + 635	3-1.80 x 1.50	57.90	Storm Water Drainage											
				47 + 950	3-150 x 1.50	57.90	Storm Water Drainage											
				48 + 125.681		5020.00	Bridge No. 8 (Angat)											
				49 + 245.681														
		5201.64	Total															
48	49 + 285	49 + 430	11.650	See Hydrology Report							0.50	1.11	2.09	2.58	49 + 344.007		119.80	Bridge No. 9
														49 + 384.95				
49	49 + 430	49 + 800	0.059	8.00	175.00	3.32	135.6	254.4	314.4	0.50	1.11	2.09	2.58	49 + 475	1-910 mm φ	1.09	Storm Water Drainage	
														49 + 730	1-1070 mm φ	1.62	Irrigation Canal	
																2.71	Total	
50	49 + 800	50 + 135	0.059	8.00	175.00	3.32	135.60	254.40	314.40	0.50	1.11	2.09	2.58	49 + 900	1-1070 mm φ	1.61	Irrigation Canal	
														50 + 133	1-1070 mm φ	2.17	Storm Water Drainage	
																3.78	Total	
51	50 + 135	50 + 255	12.300	See Hydrology Report							0.50	1.11	2.09	2.58	50 + 244.207		101.40	Bridge No. 10
														50 + 261.087				



APPENDIX 9.3-1 HYDROLOGICAL CHARACTERISTICS OF WATERSHEDS AND RELATED DISCHARGES (PLARIDEL BYPASS)

Catchment Area No.	Station Limits		Catchment Area (km <sup>2</sup> )	Diff. in Elev., Δh (m)	Length (m)	Tc (min)	RAINFALL INTENSITY			Coefficient C	DISCHARGE, Q			PROPOSED DRAINAGE STRUCTURE			REMARKS (General Recommendation)
							2 yrs	10 yrs	25 yrs		2 yrs	10 yrs	25 yrs	STATION	RCPC/RCBC	CAPACITY cms	
52	50 + 255	50 + 615	0.042	3.00	275.00	8.14	115.25	215.97	266.55	0.50	0.67	1.26	1.56	50 + 355	1-910 mm φ	1.58	Storm Water Drainage
														50 + 535	1-910 mm φ	1.58	Storm Water Drainage
																3.16	Total
53	50 + 615	50 + 815	0.032	3.00	200.00	5.64	131.45	246.57	304.65	0.50	0.59	1.10	1.36	50 + 735	1-910 mm φ	1.20	Irrigation Structure
54	50 + 815	51 + 255	0.151	1.00	450.00	21.88	68.27	142.82	176.3	0.50	1.43	2.99	3.70	50 + 890	1-1220 mm φ	3.04	Irrigation Structure
55	51 + 255	51 + 660	0.115	2.00	400.00	14.64	89.47	167.22	206.46	0.50	1.43	2.67	3.30	51 + 275	2-1070 mm φ	3.75	Irrigation Structure
														51 + 353	1-1070 mm φ	1.62	Irrigation Structure
																5.37	Total
56	51 + 660	52 + 050	0.022	6.00	100.00	1.95	135.6	254.4	314.4	0.50	0.42	0.78	0.96				Side Ditch & Lateral Pipes
57	52 + 050	52 + 415	0.015	2.00	100.00	2.97	135.6	254.6	0	0.50	0.29	0.54	0.00				Side Ditch & Lateral Pipes
58	52 + 415	52 + 745	0.026	5.00	200.00	4.64	135.6	254.4	314.4	0.50	0.49	0.92	1.14				Side Ditch & Lateral Pipes
59	52 + 745	53 + 010	0.048	9.00	250.00	4.78	135.6	254.4	314.4	0.50	0.90	1.69	2.09				Side Ditch & Lateral Pipes
60	53 + 010	53 + 555	0.337	13.00	700.00	13.55	92.69	173.32	213.92	0.50	4.34	8.12	10.02	53 + 235	1-2.40 x 1.80	19.66	Storm Water Drainage
61	53 + 555	53 + 705	0.049	11.00	300.00	5.45	132.68	248.89	307.54	0.50	0.90	1.69	2.09				Side Ditch & Lateral Pipes
62	53 + 705	54 + 015	0.046	8.00	350.00	7.36	120.31	225.51	278.43	0.50	0.78	1.46	1.80	53 + 775	2-910 mm φ	2.08	Storm Water Drainage
63	54 + 015	54 + 315	0.053	6.00	300.00	6.89	123.35	231.27	285.6	0.50	0.91	1.70	2.10	54 + 295	1-1070 mm φ	2.25	Storm Water Drainage
64	54 + 315	54 + 640	0.069	2.00	300.00	10.51	101.69	190.34	234.71	0.50	0.97	1.82	2.24	54 + 475	1-1070 mm φ	2.11	Storm Water Drainage
65	54 + 640	54 + 865	0.034	5.00	200.00	4.64	135.6	254.4	314.4	0.50	0.64	1.21	1.49	54 + 795	1-910 mm φ	1.25	Storm Water Drainage
66	54 + 865	55 + 215	2.563	4.00	3000.00	113.73	32.87	62.58	77.59	0.50	11.71	22.29	27.64	55 + 035	2-3.0 x 2.10	42.51	Storm Water Drainage
67	55 + 215	55 + 385	4.740	4.00	3000.00	113.73	32.87	62.58	77.59	0.50	21.66	41.23	51.12	55 + 318	2-3.00 x 2.75	54.56	Storm Water Drainage