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APPENDIX 9-1 Development Strategies and Major Projects by Region

APPENDIX 9.1-1 REGIONAL STRATEGIES BY SECTOR AND SELECTED MAJOR ON-GOING PROJECT, REGION I, II AND VIII

Region	Agriculture	Industry	Social Services	Infrastructure	Selected Major On-Going Projects
Ilocos (I)	* improvement of the technological, financial and marketing components of the different agricultural programs together with specialization in and intensification of the production of a number of high-value cash crops while exercising care that production does not conflict with ecological objectives	* expansion of manufacturing and other industrial employment generating activities in the urban centers, and household-based or small industries in the rural areas * further boost to tourism sector through the continous development of tourists attractions	* strengthening of expanded rural health services and nutrition program * expansion of non-formal training of unemployed adults and out-of-school youth	* expansion of irrigation facilities * improvement of critical trunkline roads in depressed areas and exiting road linkages to neighboring regions * development of railways as an alternate mode of land transport * vigorous pursuance of electrification program and tapping of other sources of energy (geothermal energy)	1. Philippine Rural Infrastructure Project (PRIP) 2. National Irrigation System Improvement I 3. Philippine-Japan Highway Loan Project - Phase II 4. Manila North Road Improvement Project
Cagayan Valley (II)	* attainment of the nutrition, export generation and import substitution and energy development * priority for classification of public forest land to help establish an appropriate land use pattern	* promotion of cottage and small industries, and secondarily, on selected medium industries	* additional social infrastructure support in underserved areas	* construction of farm-to-market roads	1. Philippine-Japan Highway Loan Project, Phase II 2. Magat River Multi-Purpose Project (Power Phase) 3. Cagayan Integrated Agricultural Development Project 4. Philippine Rural Infrastructure Project 5. Chico River Irrigation Project 6. Magat River Multi-Purpose Project (Irrigation) 7. National Irrigation Systems Improvement Project I
Eastern Visayas (VIII)	* tapping of prime arable lands for expanded production and by developing new technologies for upland and marginal farms	* complement Metro Manila and Cebu in the promotion of new industrial ventures * operation of Tongonan Geothermal Project to provide energy requirement of the Copper Smelter and Phosphatic Fertilizer Plant and Industrial Estate in Isabel Leyte.	* realignment of new technologies and expertise on manpower development facilities	* construction of road, bridges, ports and telecommunication facilities	1. West Leyte Road Improvement 2. Philippine-Japan Friendship Highway- 3. Samar Integrated Rural Development Project 4. Copper and Melter, Isabel, Leyte 5. Phosphatic Fertilizer, Isabele, Leyte 6. Tongonan Geothermal Power Project 7. Leyte-Samar Project 8. National Irrigation Systems Improvement Project I

APPENDIX 9.1-2 (1) PROJECT LIST ON SELECTED ON GOING MAJOR PROJECTS
(AS OF DECEMBER 1982)

SECTOR / PROJECT NAME	REGION	PROJECT LOCATION	PROJECT COST (MILLION PESOS) ($1 = P7.50)	PROJECT DESCRIPTION
I INFRASTRUCTURE				
A. Road				
1. Philippine - Japan Highway Loan Project, Phase II	I and II	Laoag - Allacapan	363.35	Upgrading of selected portions of the Manila North Road (Road No. 3) beginning at Laoag City in Ilocos Sur North until Allacapan, Cagayan Province (Road No. 5)
2. Manila - North Road Improvement Project	I	Rosario - Laoag	544.913	Improvement of about 225 kms. from Rosario, Pangasinan to Laoag, Ilocos Norte.
3. West Leyte Road Improvement	VIII	West Leyte	18.109	Improvement of existing road sections of about 296 kms. to acceptable levels of service.
4. 3rd IBRD Highway Package	V, VI, VII and X	Not Specified	1,576.8	This project package includes 577 kms. of national roads and 230 kms. of minor roads.
5. Philippine - Japan Friendship Highway - Ferry Service Project	V, VIII and X	Sorsogon - Samar, Leyte - Surigao	247.47	It will serve as final link for the Daang Maharlika from Allacapan in Cagayan to Davao City.
B. Ports				
1. Fishing Port Package I Project	I, IV, V, VI, IX	Sual, Lucena,Camaligan and Zamboanga	854.297	The project involve the construction of fishing port complexes for efficient handling operations and improve shelter, maintenance and repair of fishing vessels.
C. Rail				
1. Main Line South Rehabilitation Project	V	Manila - Legaspi	476.9	Rehabilation of the tracks, bridges and communication system in the southern line of the Phil. National Railways (PNR) between Manila and Legaspi
D. Power and Electrification				
1. Magat River Multi - Purpose Project (Power Phase)	II	Ramon, Isabela	672.14	Construction and development of hydroelectric power plant at the Magat River multi-purpose Project with an initial capacity of 360 megawatts (MW), consisting of four (4) generating units at 90 MW each.
2. Kalayaan Pumped Storage Power Project (Stage I)	IV	Laguna	1,930.51	Construction of a pumped storage hydroelectric power plant with an aggregate installed capacity of 300 MW consisting of 2 generating capacity of 300 (MW) each. Basically operating as hydraulic accumulator system, the plant will supplement electric power in the Luzon Grid, specially during periods of off peak power demand.

APPENDIX 9.1 - 2 (2) PROJECT LIST ON SELECTED ON GOING MAJOR PROJECTS
(AS OF DECEMBER 1982)

SECTOR / PROJECT NAME	REGION	PROJECT LOCATION	PROJECT COST (MILLION PESOS)	PROJECT DESCRIPTION
3. Makiling - Banahaw Geothermal Power Project (Units 5 and 6)	IV	Calauan, Laguna	993.04	Involves the exploration and exploitation of geothermal resources in the Makiling - Banahaw areas in the Southern Tagalog region and the construction of power generation facilities for the third Mak - Ban Geothermal Power Plant including the supply and erection of the electromechanicalequipment.
4. Tiwi Geothermal Power Project (Units 5 and 6)	V	Tiwi, Albay	790.32	Construction of power generation facilities with a total capacity of 110 (MW), consisting of 2 generating units at 55 MW each.
5. Tongonan Geothermal Power Project	VIII	Tongonan, Leyte	490.99	Involves the generation of electric power, estimated to have a total generating capacity of 112.5 (MW), utilizing the geothermal resource potential of the Tongonan and Bunawen Geothermal Field.
6. Leyte - Samar Circuit	VIII	Leyte and Samar	254.62	Involves the installation of transmission lines (192 kms. of 138 KV and 45.5 Kms. of 69 KV) and construction of two substation facilities.
E. Irrigation and Related Water Resources Project				
1. Chico River Irrigation Project	II	Cagayan and Kalinga - Apayao	548.0	Upgrading and rehabilation of existing irrigation system in the project area and extend irrigation to about 19,700 has. of rainfed rice land.
2. Magat River Multi - Purpose Project	II	Isabela	681.206	The project seeks to accelerate the development of the Cagayan Valley through irrigation, flood control and provision of electric power. It is also aims to establish adequate system of domestic water supply, recreation and fish conservation.
3. National Irrigation Systems Improvement Project I	I, II, and VIII IV, V, VI, IX, X, XI, and XII	Not Specified	1,844.010	Rehabilitation of existing irrigation and drainage system as well as constructing new irrigation facilities to allow year - round cultivation.
4. Central Luzon Ground - water Irrigation Project	III	Not Specified	221.351	The project involves the installation of 240 deep wells and related equipment to supplement water supply for irrigating an additional 12,000 has. in areas where surface water is inadequate.

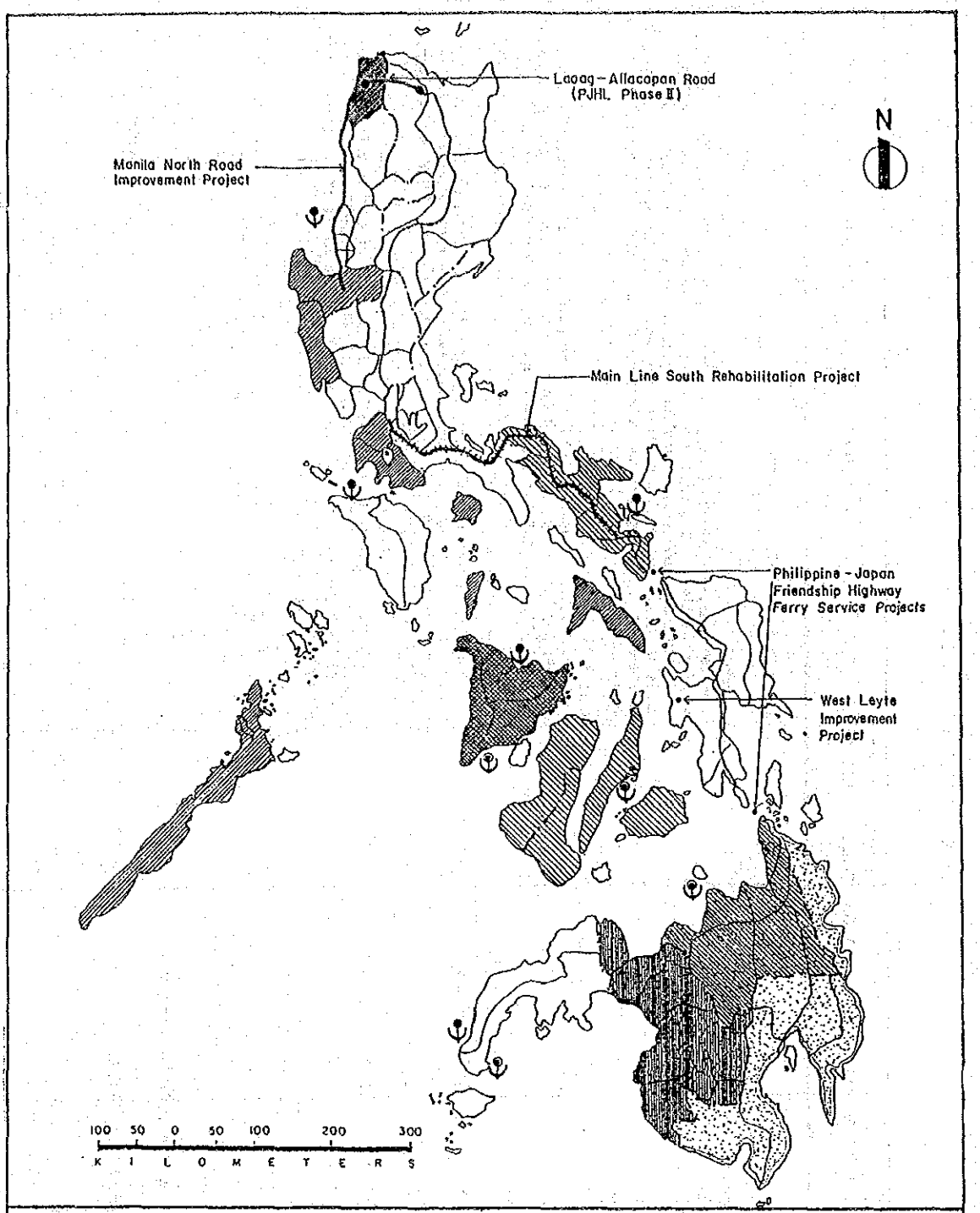
APPENDIX 9.1-2(3) PROJECT LIST ON SELECTED ON GOING MAJOR PROJECTS
(AS OF DECEMBER 1982)

SECTOR / PROJECT NAME	REGION	PROJECT LOCATION	PROJECT COST (MILLION PESOS)	PROJECT DESCRIPTION
II Integrated Area Development Project				
1. Libmanan Cabusao Integrated Area Development Project	V	Libamanan and Cabusao, Camarines Sur	78.91	Involves the construction of irrigation and drainage facilities, flood and salinity control structures, roads and social/institutional services in around 3,927 hectares.
2. Bicol Secondary and Feeder Roads Project	V	Camarines Sur and Albay	404.0	Involves the construction of 189.96 kms. of secondary roads, 252.34 kms. of feeder roads and 61 bridges.
3. Bicol River Basin Irrigation Development Project	V	Naga, Calabanga and Rinconada, Camarines Sur	612.6	Involves the implementation of 2 integrated area development projects, namely; Naga - Calabanga and Reconada IDA's. It has 6 components irrigation and irrigation and related works, flood control; agricultural and institutional development; farm to market roads; rural waterworks development and watershed development.
4. Rinconada - Buhi/Lao	V	Buhi, Baao, Nabua and Iriga City, Camarines Sur	75.26	Rehabilation and extension of the existing Lalo Irrigation system to about 1,000 hectares; development of Lake Buhi as water source of irrigation, construct 2'1 Km. of service roads, develop watershed/agroforestation in 1,350 has. farmed by 900 small scale upland farmers.
5. Integrated Health, Nutrition and Population Project	V	Camarines Sur, and Albay	58.4	Involved the provision of health facilities to 400 barangays in Camarines Sur and Albay, upgrading of the laboratory facilities of the 2 provincial hospitals; training of health aides and construction of health stations.
6. Bula - Minalabac	V	Camarines Sur	69.0	Covers 2,423 hectares with 1,230 farmers as beneficiaries; it will provide farm lots of manageable sizes ranging from 500 to 2,000 square meter complete with irrigation and road facilities and the provision of settlement facilities to barangays in the area.
7. Cagayan Integrated Agricultural Development Project	II	Cagayan Province	501.98	Targeted to complete in 1983, the project includes agricultural development, provision of irrigation, electricfication, construction of barangays roads and flood control facilities and other developmental projects.
8. Philippine Rural Infrastructure Project (PRIP)	I, II, VI, VII	Abra, Kalinga - Apayao, Aklan, Antique, Capiz and Bohol.	531.0	Construction and rehabilitation of 51 communal irrigation facilities; 1,172 kms. of barangays roads and access roads; 3 ports in Panay; 60 barangay health stations and provision of 418 wells for residents water supply.

APPENDIX 9.1-2 (4) PROJECT LIST ON SELECTED ON GOING MAJOR PROJECTS
(AS OF DECEMBER 1982)

SECTOR / PROJECT NAME	REGION	PROJECT LOCATION	PROJECT COST (MILLION PESOS)	PROJECT DESCRIPTION
9. Samar Integrated Rural Development Project.	VIII	Samar Island	599.69	IBRD Improvement of about 230 kms. of national roads in Eastern Samar; rehabilation of Port Catbalogan; construction and improvement of about 2,000 wells and 100 spring in small rural communities throughout the island; construction of 3 schistosomiasis control field laboratories and a mass chemotheraphy campaign and provision of consulting services to assist in carrying out F/S for Catubig Valley in Northern Samar. ADAB Construction of approx. 160 kms. of national secondary roads and around 80 bridges; 260 kms. of agricultural feeder roads, water supply systems, development of power distribution system (240 kms.) and agricultural development.
III Industry				
1. Copper Smelter	VIII	Isabela, Leyte	$343 M.	Establishment of a copper smelting and refining facilities designed to process locally manufactured copper concentrates into refined copper; the plant targeted to operate in mid-1983 have a production capacity of 138,000 MTPY copper cathodes; 442,000 MTPY sulfuric acid.
2. Phosphatic Fertilizer	VIII	Isabela, Leyte	$484 M.	Targeted to operate during mid-1984 the project, with an annual production capacity of 153,000 MT ammonium sulfate; 253,000 MT of NP/NPK; 512,000 MT of DAP and 170,000 MT of MAP, will utilize the sulfuric acid output of the copper smelter project.

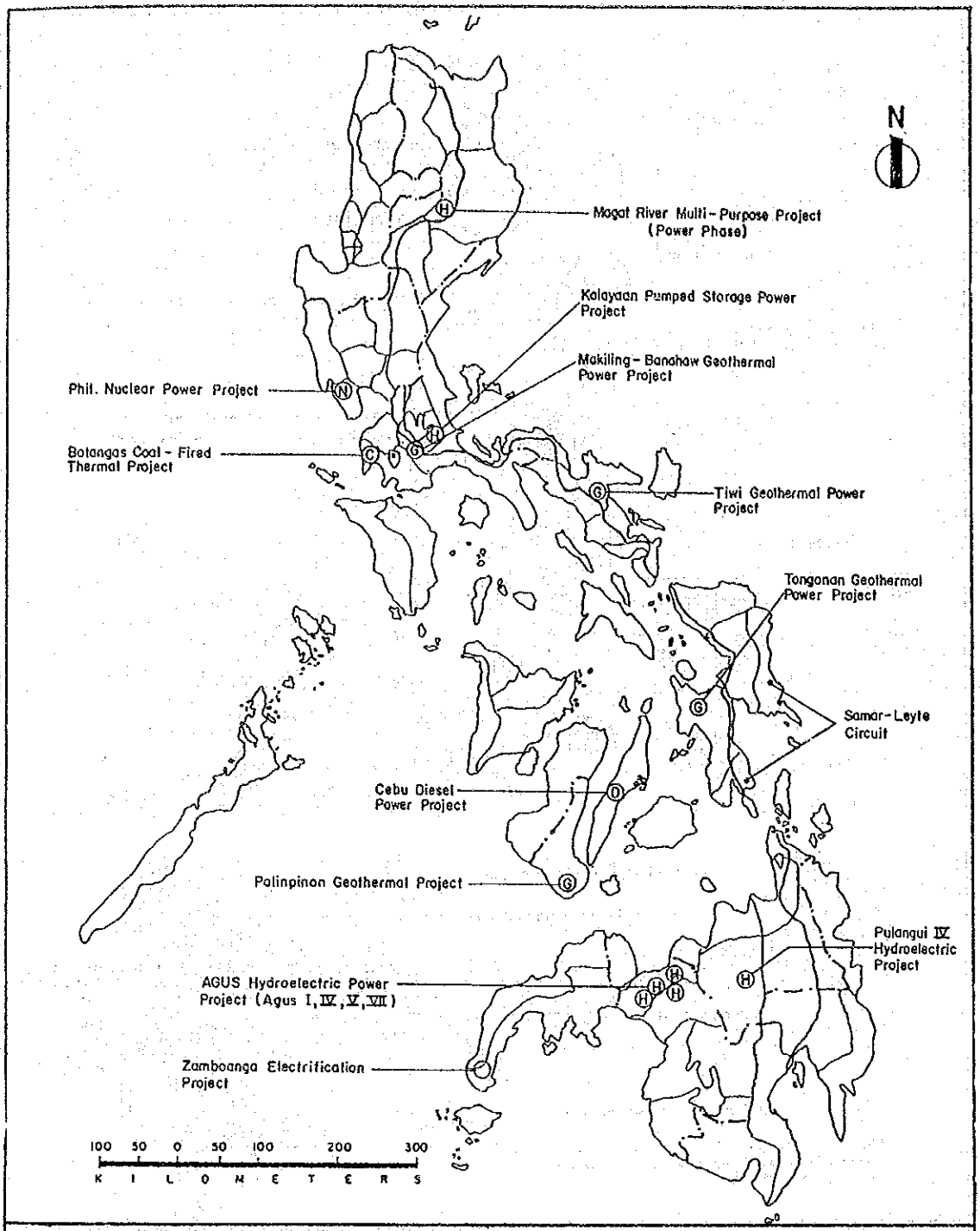
SOURCE: 1. Profiles of Major On-going Foreign Assisted Projects as of 31 December 1982 NEDA, March 1983
2. Five-year Phil. Development Plan, 1983-87 NEDA



APPENDIX 9.1-3
MAJOR ON-GOING PROJECTS (ROADS, PORTS & RAILWAYS)

LEGEND :

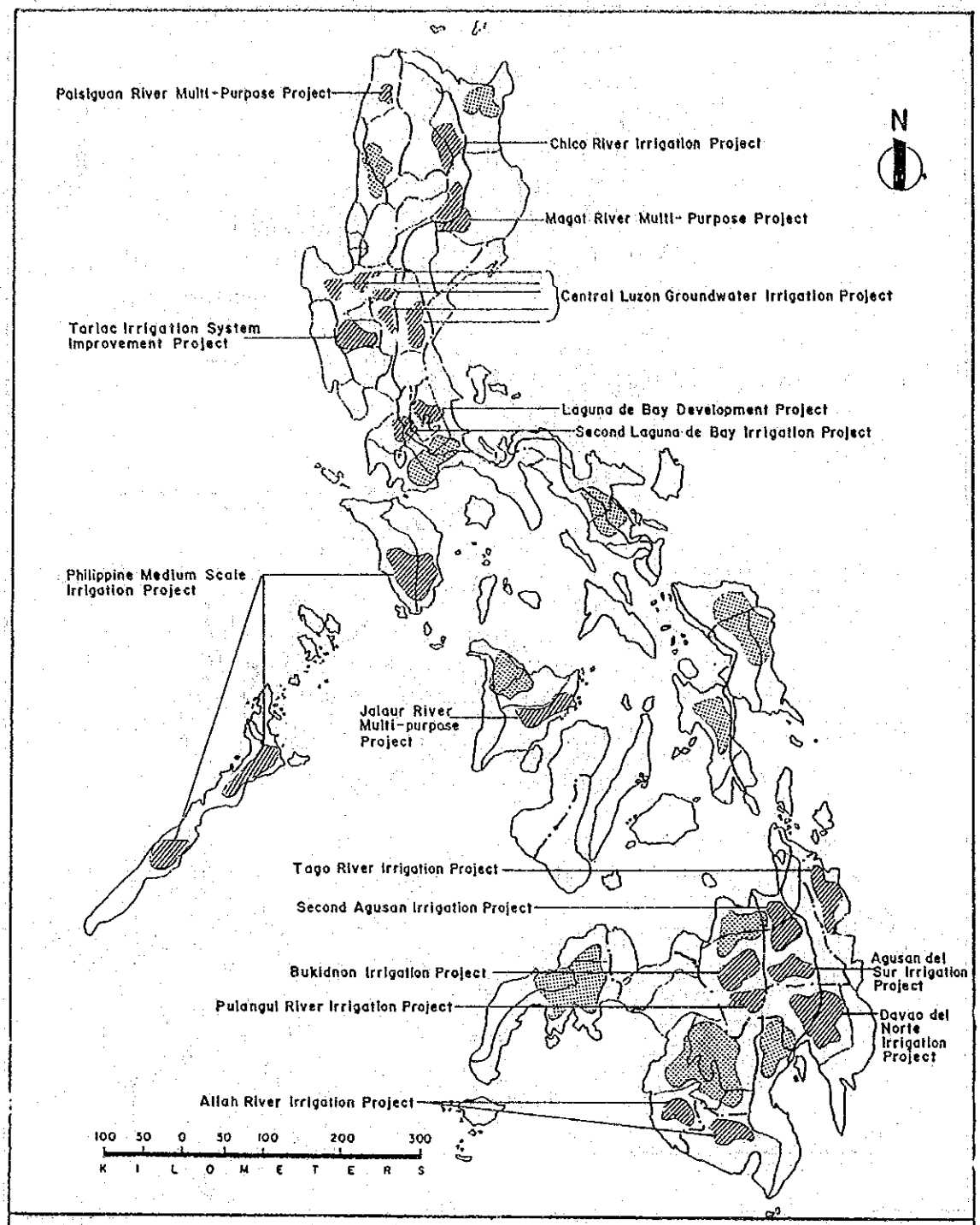
Second ADB Improvement Project (Philippine Islands Road Improvement).	Mindanao Secondary & Feeder Roads Project
Third IBRD Highway Package	First OPEC - Assisted Road Project
Luzon Road Improvement Project	Fishing Ports Package I Project
Ilocos Norte Rural Road Improvement Project	Third IBRD Ports Package



APPENDIX 9.1-4

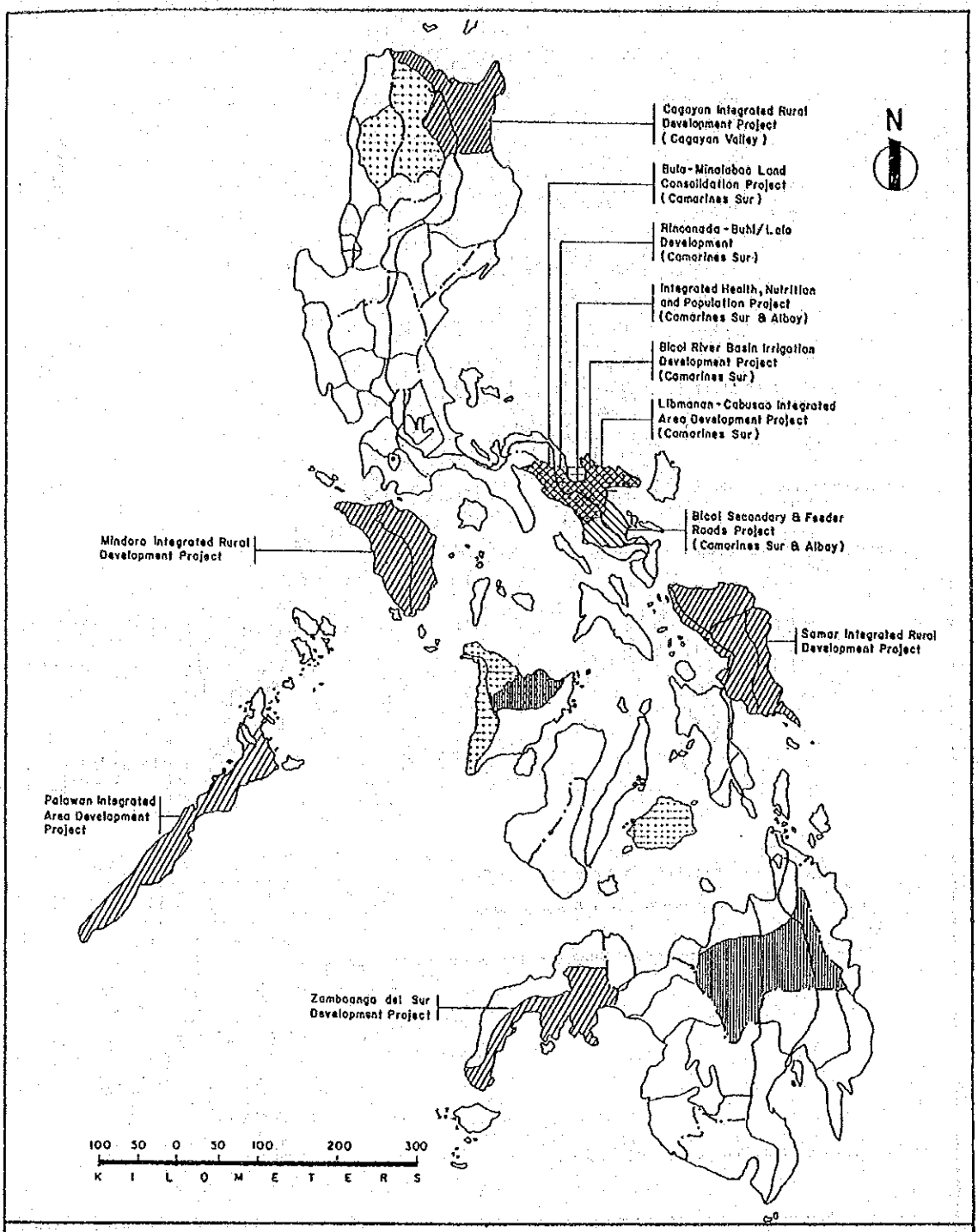
MAJOR ON-GOING PROJECTS (POWER & ELECTRIFICATION)

Legend:	
Ⓝ Nuclear	
Ⓗ Hydrothermal	
Ⓖ Geothermal	
Ⓒ Coal	



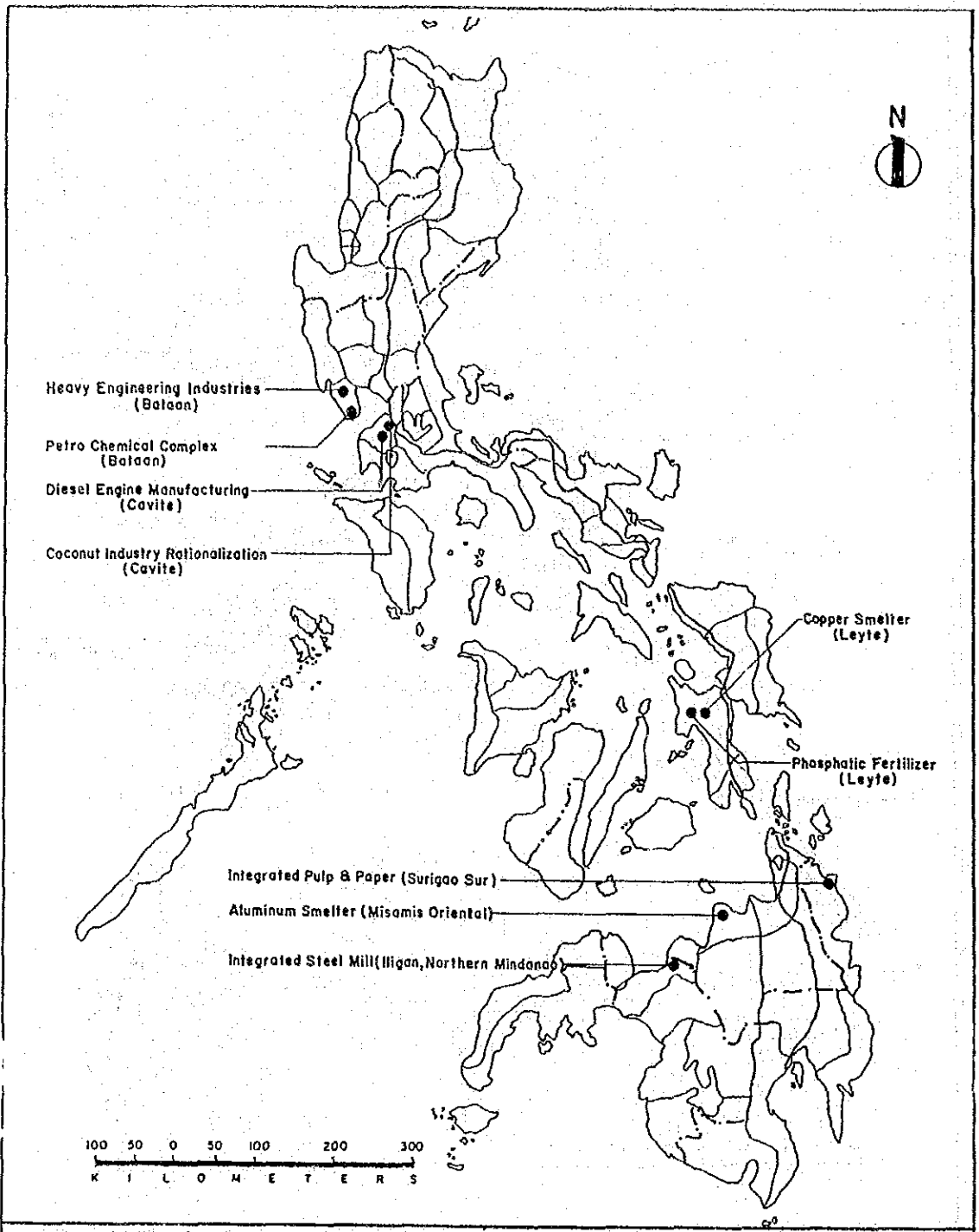
APPENDIX 9.1-5 MAJOR ON-GOING PROJECTS (IRRIGATION)

LEGEND: ▨ NATIONAL IRRIGATION SYSTEM IMPROVEMENT PROJECT I & II	



APPENDIX 9.1-6 ON-GOING AREA INTEGRATED DEVELOPMENT PROJECT

LEGEND:	
PHILIPPINE RURAL INFRASTRUCTURE PROJECT (PRIP)	
SECOND RURAL DEVELOPMENT LAND SETTLEMENT PROJECT	



APPENDIX 9.1-7 MAJOR INDUSTRIAL PROJECTS

SOURCE: 1983-87 Dev. Plan, NEDA

APPENDIX 9-2 Future Planning Framework

APPENDIX 9.2-1 POPULATION IN THE PROJECT AREA BY PROVINCE

	Population				Growth-Rates		
	1980	1990	2000	2010	1980-1990	1990-2000	2000-2010
Region I	3,540,893	4,086,000	4,422,000	4,659,000	1.4	0.8	0.5
Abra	160,198	181,000	195,000	205,000	1.2	0.8	0.5
Benguet	354,751	455,000	538,000	566,000	2.5	1.7	0.5
Ilocos Norte	390,666	434,000	451,000	475,000	1.1	0.4	0.5
Ilocos Sur	443,591	501,000	536,000	565,000	1.2	0.7	0.5
La Union	452,578	536,000	591,000	624,000	1.7	1.0	1.2
Mt. Province	103,052	120,000	132,000	139,000	1.5	1.0	0.5
Pangasinan	1,636,057	1,859,000	1,979,000	2,085,000	1.3	0.6	0.5
Region II	2,215,522	2,786,000	3,273,000	3,740,000	2.3	1.6	1.3
Batanes	12,091	14,000	16,000	19,000	1.5	1.3	1.7
Cagayan	711,476	873,000	1,003,000	1,146,000	2.1	1.4	1.3
Ifugao	111,368	136,000	156,000	178,000	2.0	1.4	1.3
Isabela	670,604	1,093,000	1,284,000	1,467,000	2.3	1.6	1.3
Kalinga-Apayao	185,063	238,000	285,000	326,000	2.6	1.8	1.3
Nueva Vizcaya	241,690	315,000	382,000	437,000	2.7	2.0	1.3
Quirino	83,250	115,000	147,000	167,000	3.3	2.5	1.3
Region III	4,802,793	5,988,000	6,964,000	7,875,000	2.2	1.5	1.2
Bataan	323,254	446,000	564,000	639,000	3.3	2.4	1.3
Bulacan	1,096,046	1,394,000	1,633,000	1,846,000	2.4	1.6	1.2
Nueva Ecija	1,069,409	1,317,000	1,512,000	1,710,000	2.1	1.4	1.2
Pampanga	1,181,590	1,442,000	1,667,000	1,884,000	2.0	1.5	1.2
Tarlac	688,457	836,000	950,000	1,075,000	2.0	1.3	1.2
Zambales	444,037	553,000	638,000	721,000	2.2	1.4	1.2
Region VIII	2,799,534	3,358,000	3,763,000	4,054,000	1.8	1.2	0.7
Eastern Samar	320,637	405,000	479,000	516,000	2.4	1.7	0.7
Leyte	1,302,648	1,541,000	1,690,000	1,821,000	1.7	0.9	0.7
Northern Samar	378,516	465,000	537,000	578,000	2.1	1.5	0.7
Southern Leyte	296,294	356,000	397,000	428,000	1.9	1.1	0.7
Western Samar	501,439	591,000	660,000	711,000	1.7	1.1	0.7

APPENDIX 9.2-2 EXPECTED GROWTH OF AGRICULTURAL OUTPUT BY REGION, 1982-87

	Philippines	REGION I	II	VIII
Food Crop	4.9	-	-	-
Palay	3.6	4.8	6.3	1.3
Corn	11.9	4.8	6.0	1.3
Vegetables	-	4.8	16.4	-
Fruits	-	4.8	5.5	-
Commercial Crop				
Tobacco	-	4.8	5.5	-
Sugar	5.6	-	7.1	1.2
Coconut (Copra)	0.9	-	4.1	6.9
Fish	6.2	4.7	5.4	4.5
Meat	7.3	4.8	4.6	1.3
Forestry	1.7	5.3	2.2	
Mining	10.1	11.7	-	-
G R D P	6.3	7.2	7.4	7.6

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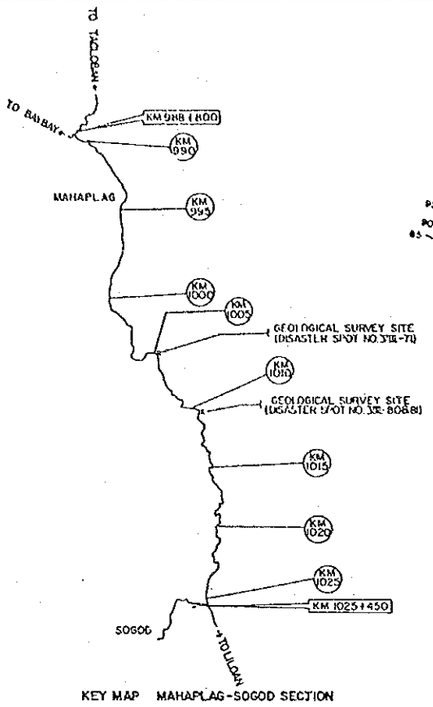
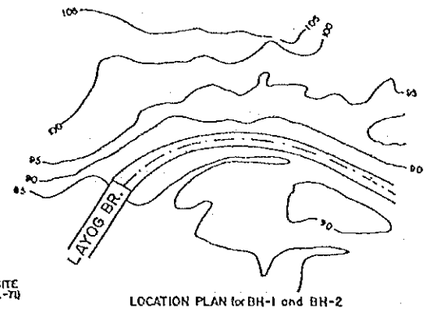
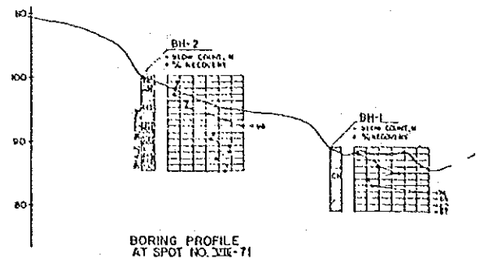


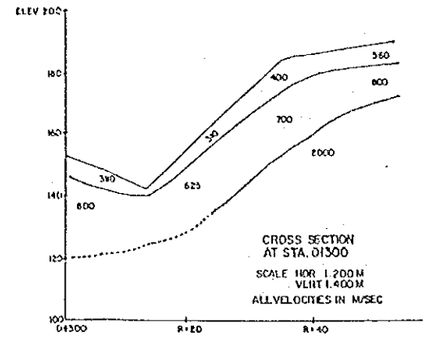
KEY MAP MAHAPLAG-SOGOD SECTION

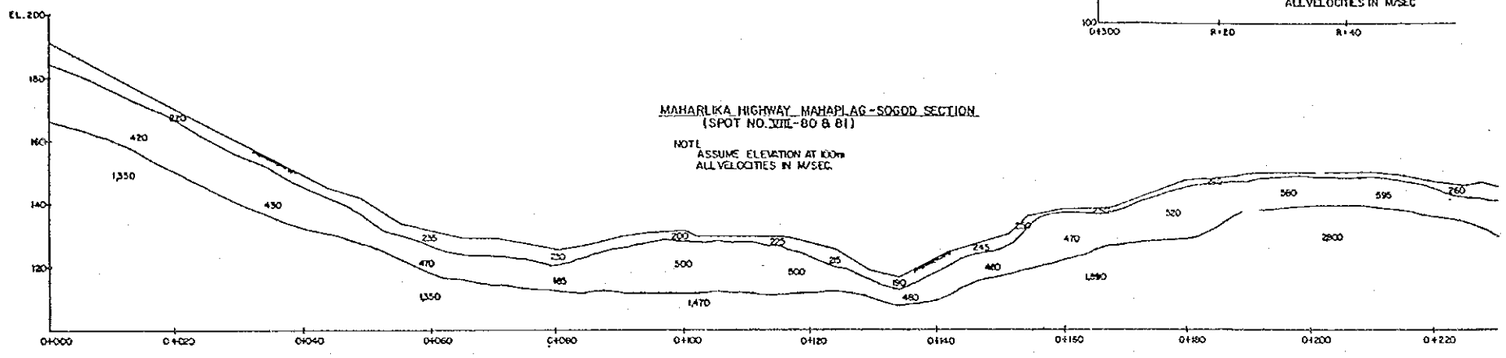


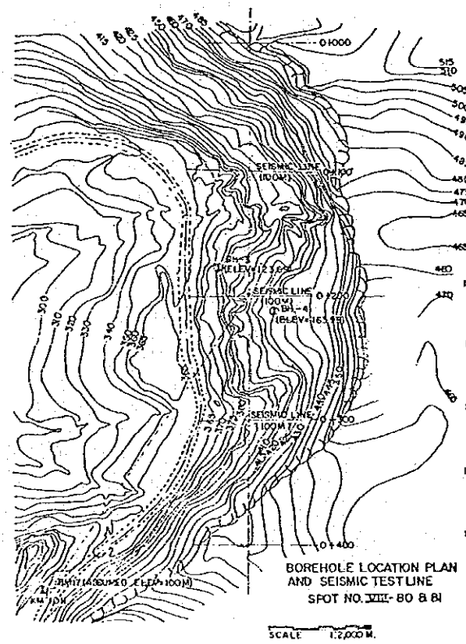
LOCATION PLAN for BH-1 and BH-2
SPOT NO. VIII - 71
Scale 1:1000



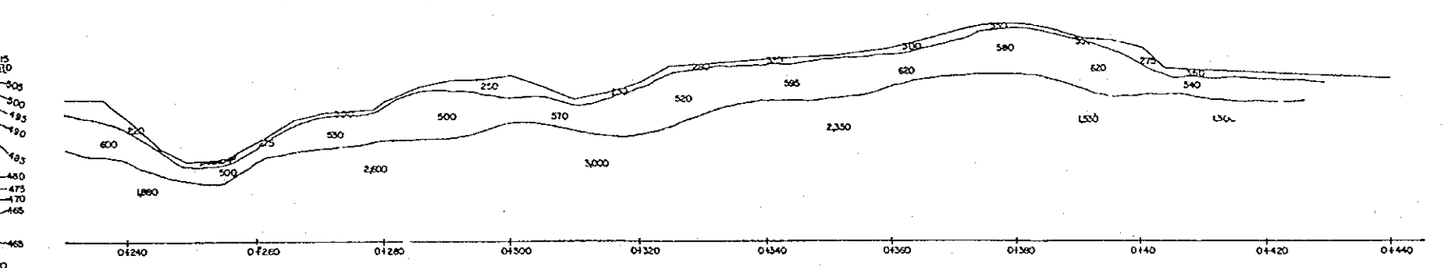
BORING PROFILE AT SPOT NO. VIII-71

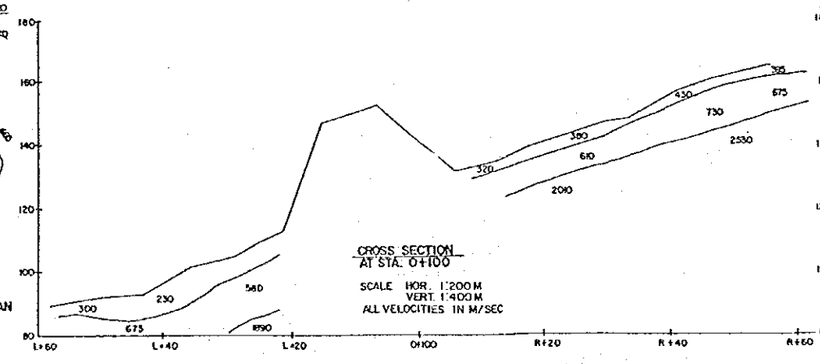


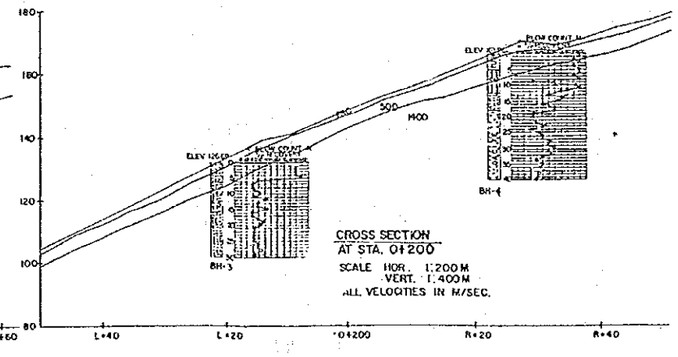




BOREHOLE LOCATION PLAN AND SEISMIC TEST LINE
SPOT NO. VIII- 80 & 81







APPENDIX 10.1-1 SUMMARY OF SEISMIC EXPLORATION AND BORINGS IN MAHAPLAG-SOGOD SECTION

B O R I N G L O G

PROJECT ROAD DISASTER PREVENTION PROJ. BORE HOLE NO. BH-1
LOCATION Maharlika Hi-way Sogod-Mahaplag Rd. DATE STARTED 11-17-83 DATE COMPLETED 11-18-83
GROUND WATER ELEV. -0.80 m GROUND SURFACE ELEV.
DRILLING METHOD washboring and coring SAMPLERS USED 5.0 cm OD-SS
WT. OF HAMMER 63.6 kg HAMMER FALL 76.2 cm

DEPTH IN M.	GRAPH	DESCRIPTION	CONSISTENCY	NMC (PL — O — LL)	P.I.	BLOW COUNT, N / % RECOVERY	OTHER TEST DATA
0		Very moist dark gray with brown mottling silty CLAY with traces of sand and shell fragments	SOFT	20 40 60 80 100	99	20 40 60 80 100	
			STIFF		86		
			VERY STIFF		65		
			HARD		58		
			VERY STIFF		56		
					55		
5	CH				60		
			STIFF		57		
					55		
			VERY STIFF		61		
					57		
			HARD		56		
					58		
					62		
					62		
					62		
					58		
10					56		
					55		
		END OF BORING AT 10.00 M.					

B O R I N G L O G

PROJECT ROAD DISASTER PREVENTION PROJ. BORE HOLE NO. BH-2
LOCATION Maharlika Hi-way Sogod-Mahaplag Rd. DATE STARTED 11-19-83 DATE COMPLETED 11-22-83
GROUND WATER ELEV. -7.20 m GROUND SURFACE ELEV.
DRILLING METHOD washboring and coring SAMPLERS USED 5.0 cm OD-SS
WT. OF HAMMER 63.6 kg HAMMER FALL 76.2 cm

DEPTH IN M.	GRAPH	DESCRIPTION	CONSISTENCY	NMC (PL — O — LL)	P.I.	BLOW COUNT, N / % RECOVERY	OTHER TEST DATA
0	MH	Moist light brown clayey SILT	SOFT	20 40 60 80 100	47	20 40 60 80 100	
	ML SW	Moist to very moist brown clayey silty SAND	LOOSE		14		
					16		
			FIRM		10		
			STIFF		17		
			VERY STIFF		32		
5	CH	Very moist brown silty CLAY with traces of sand			55		
			STIFF		29		
			VERY STIFF		27		
					31		
					26		
					24		
					28		
	MH	Moist dark gray clayey SILT	HARD		37		
					37		
		Gray slightly fractured SILTSTONE			22		
10					30	50/5	
		Dark gray slightly weathered plastic SHALE					
15		END OF BORING AT 15.00 M.					

BORING LOGS (MAHAPLAG-SOGOD SECTION) (2)

B O R I N G L O G

PROJECT ROAD DISASTER PREVENTION PROJ. — BORE HOLE NO. BH-3
LOCATION Maharlika Hiway Sogod, Southern Leyte — DATE STARTED 12-3-83 — DATE COMPLETED 12-8-83
GROUND WATER ELEV. below 30.00 m. — GROUND SURFACE ELEV.
DRILLING METHOD washboring and coring — SAMPLERS USED 5.0 cm OD-SS
WT. OF HAMMER 63.6 kg. — HAMMER FALL 76.2 cm.

DEPTH IN M.	GRAPH	DESCRIPTION	CONSISTENCY	NMC PL—O—LL (20 40 60 80 100)	P.I.	○ BLOW COUNT, N ● % RECOVERY (20 40 60 80 100)	OTHER TEST DATA
0		Light gray highly weathered and fractured ANDESITE with black flints and orange streak	VERY DENSE				
25		Light gray to dirty white highly weathered and altered ANDESITE	VERY DENSE				
30		END OF BORING AT 30.00 M.					

B O R I N G L O G

PROJECT ROAD DISASTER PREVENTION PROJ. — BORE HOLE NO. BH-3
LOCATION Maharlika Hiway Sogod, Southern Leyte — DATE STARTED 12-3-83 — DATE COMPLETED 12-8-83
GROUND WATER ELEV. below 30.00 m. — GROUND SURFACE ELEV.
DRILLING METHOD washboring and coring — SAMPLERS USED 5.0 cm OD-SS
WT. OF HAMMER 63.6 kg. — HAMMER FALL 76.2 cm.

BORING LOGS (MAHAPLAG-SOGOD SECTION) (3)

B O R I N G L O G

PROJECT ROAD DISASTER PREVENTION PROJ.
LOCATION Maharlika Hiway Sogod, Southern Leyte
DATE STARTED 11-30-83 DATE COMPLETED 12-7-83
GROUND WATER ELEV. below 40.00 m. GROUND SURFACE ELEV.
DRILLING METHOD washboring and coring SAMPLERS USED 5.0 cm. OD-SS
WT. OF HAMMER 63.6 kg. HAMMER FALL 76.2 cm.
BORE HOLE NO. BH-4

DEPTH IN M.	GRAPH	DESCRIPTION	CONSISTENCY	NMC PL—O—LL	P.I.	BLOW COUNT, N / % RECOVERY	OTHER TEST DATA
0	TUFF	Brownish gray sandy TUFF with traces of weathered andesite gravel					
5	SM	Grayish brown silty SAND with traces of weathered andesite gravel					
10	SM	Grayish brown sandy SILT with traces of weathered andesite gravel	VERY DENSE				
15		Reddish gray to gray weathered and fractured ANDESITE					
20	DACITE	Dark gray weathered and fractured DACITE					
25							

B O R I N G L O G

PROJECT ROAD DISASTER PREVENTION PROJ.
LOCATION Maharlika Hiway Sogod, Southern Leyte
DATE STARTED 11-30-83 DATE COMPLETED 12-7-83
GROUND WATER ELEV. below 40.00 m. GROUND SURFACE ELEV.
DRILLING METHOD washboring and coring SAMPLERS USED 5.0 cm. OD-SS
WT. OF HAMMER 63.6 kg. HAMMER FALL 76.2 cm.
BORE HOLE NO. BH-4

DEPTH IN M.	GRAPH	DESCRIPTION	CONSISTENCY	NMC PL—O—LL	P.I.	BLOW COUNT, N / % RECOVERY	OTHER TEST DATA
25	DACITE	Dark to light gray weathered and fractured DACITE	VERY DENSE				
30							
35							
40		END OF BORING AT 40.00 M.					

APPENDIX 10.1-3 SUMMARY OF LABORATORY TEST RESULTS (MAHAPLAG-SOGOD SECTION)

PROJECT: ROAD DISASTER PREVENTION PROJECT
LOCATION: Sugod-Mahaplag Road, Maharlika Hi-way

SUMMARY OF LABORATORY TEST RESULTS

BORE-HOLE NO.	SAM-PLE NO.	DEPTH (M)	NMC	ATTERBERG LIMIT			SIEVE ANALYSIS, (% FINER) PASSING SIEVE NO.										REMAR
				LL	PL	PI	1	3/4	3/8	4	10	30	40	60	140	200	
BH-1																	
	1	0.00-0.45	59	112	43	69											
	2	0.55-1.00	49	107	41	66											
	3	1.00-1.45	44	105	40	65											
	4	1.55-2.00	49	97	39	58											
	5	2.00-2.45	47	95	39	56											
	6	2.55-3.00	42	93	38	55											
	7	3.00-3.45	51	100	40	60											
	8	3.55-4.00	42	97	40	57											
	9	4.00-4.45	48	93	38	55											
	10	4.55-5.00	47	95	38	57											
	11	5.00-5.45	50	102	41	61											
	12	5.55-6.00	43	97	40	57											
	13	6.00-6.45	40	94	38	56											
	14	6.55-7.00	40	96	38	58											
	15	7.00-7.45	42	102	40	62											
	16	7.55-8.00	32	103	41	62											
	17	8.00-8.45	42	103	41	62											
	18	8.55-9.00	46	97	39	58											
	19	9.00-9.45	45	92	36	56											
	20	9.55-10.00	45	92	37	55											

PROJECT: ROAD DISASTER PREVENTION PROJECT
LOCATION: Sugod-Mahaplag Road, Maharlika Hi-way

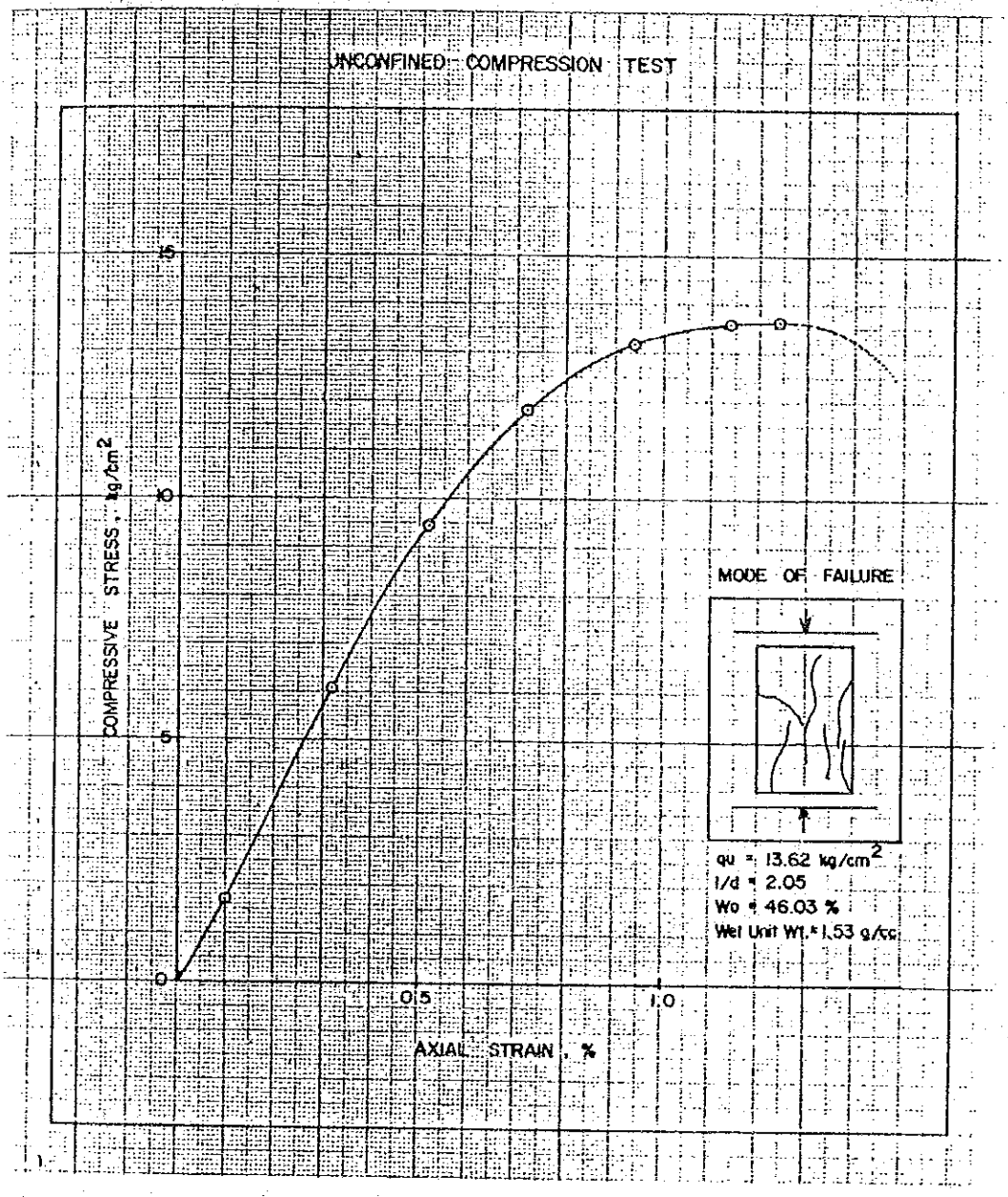
SUMMARY OF LABORATORY TEST RESULTS

BORE-HOLE NO.	SAM-PLE NO.	DEPTH (M)	NMC	ATTERBERG LIMIT			SIEVE ANALYSIS, (% FINER) PASSING SIEVE NO.										REMARK
				LL	PL	PI	1	3/4	3/8	4	10	30	40	60	140	200	
BH-2					-												
	1	0.00-0.45	65	83	36	47											
	2	0.55-1.00	30	43	29	14						85	72	53	46	38	
	3	1.00-1.45	26	45	29	16								80	50	23	
	4	1.55-2.00	23	42	32	10						86	72	62	42	21	
	5	2.00-2.45	56	47	30	17						91	87	72	52	35	
	6	2.55-3.00	56	64	26	38											
	7	3.00-3.45	56	95	40	55											
	8	3.55-4.00	38	57	29	28											
	9	4.00-4.45	50	55	28	27											
	10	4.55-5.00	49	89	38	51											
	11	5.00-5.45	40	63	27	36											
	12	5.55-6.00	26	51	27	24							78	68	52	45	
	13	6.00-6.45	37	56	28	28											
	14	6.55-7.00	35	61	24	37							76	64	60	49	
	15	7.00-7.45	36	63	26	37							75	68	54	49	
	16	7.55-8.00	22	52	30	22							93	84	75	46	
	17	8.00-8.35	25	63	33	30											

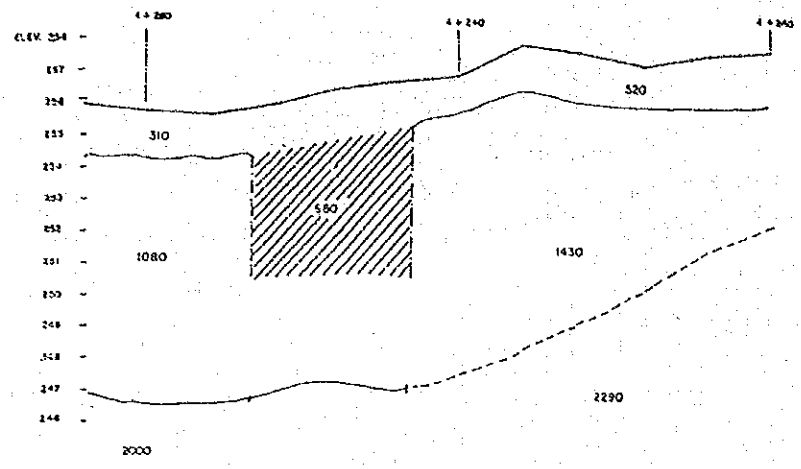
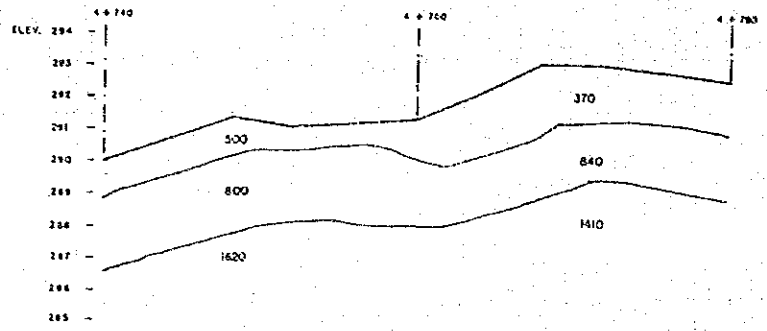
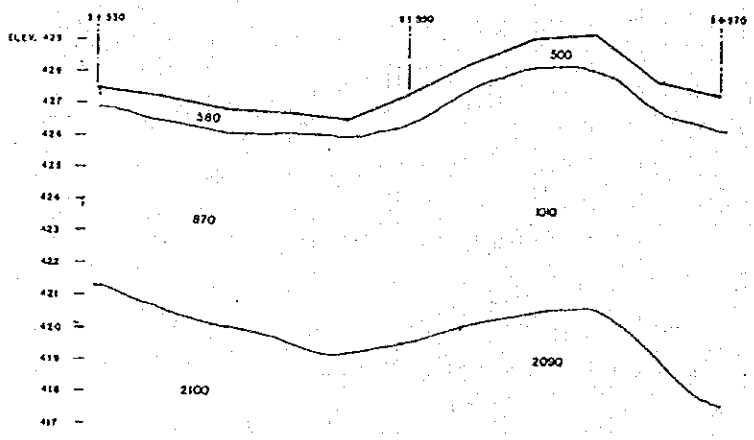
APPENDIX 10.1-4 UNCOFINED COMPRESSION TEST

PROJECT : ROAD DISASTER PREVENTION PROJECT
LOCATION : SOGOD - MAHAPLAG ROAD MAHARLIKA HIGHWAY
BOREHOLE NO. : BH-2 SAMPLE NO. : C-4

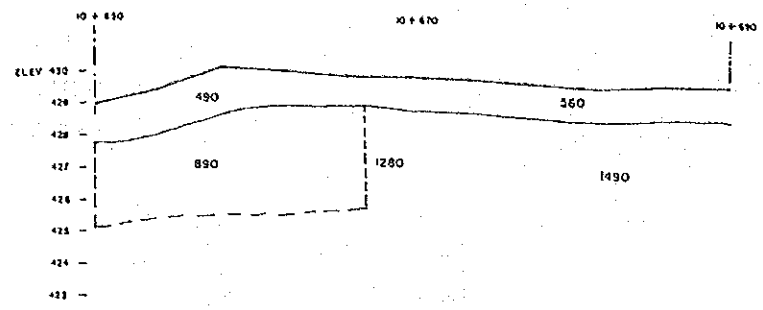
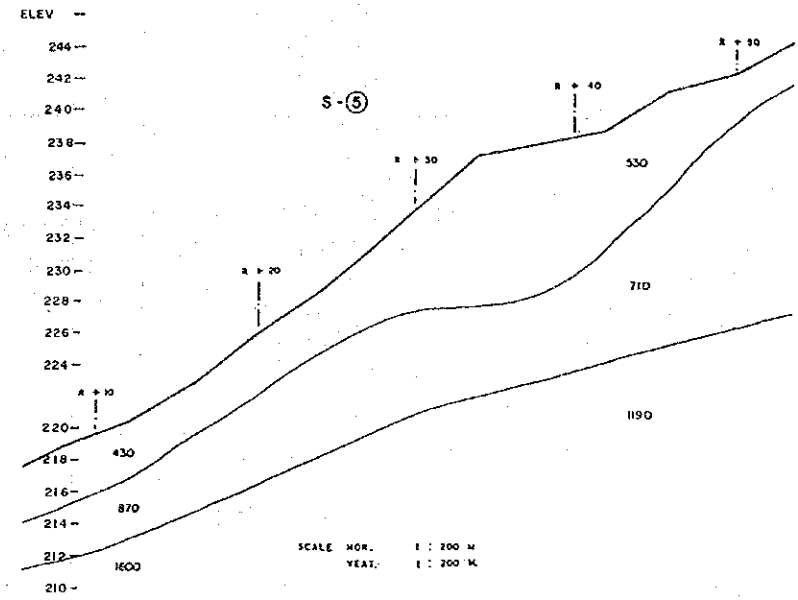
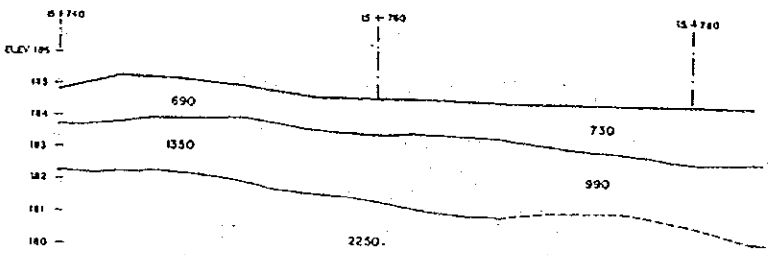
DATE : 12-21-83
DEPTH : 10.00-10.50 M.



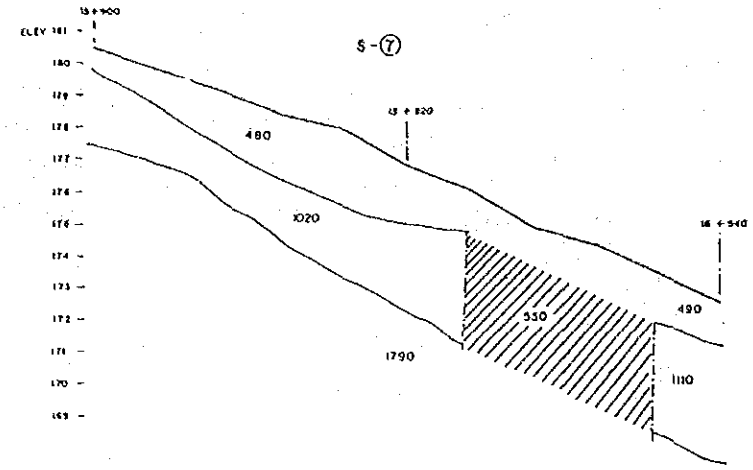
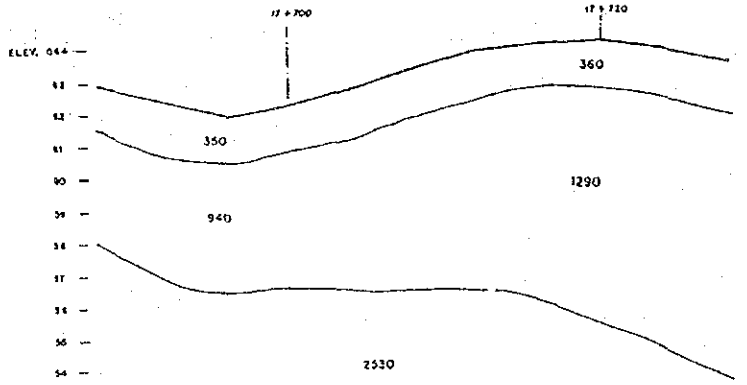
APPENDIX 10.1-5 SUMMARY OF SEISMIC REFRACTION (MAHAPLAG-SOGOD SECTION) (1)

SPOT NO.	Results of seismic refraction Scale Hor. 1:200 m Vert. 1:100 m All velocities in M/sec.	Description
VIII-75		Montle soil covering and highly to moderately weathered and fractured ANDESITE
VIII-77		Same as VIII-75 however, overburden thickness is smaller in VIII-75
VIII-87		Reddish brown soil cover underlain by moderately to highly weathered AGGLOMERATES

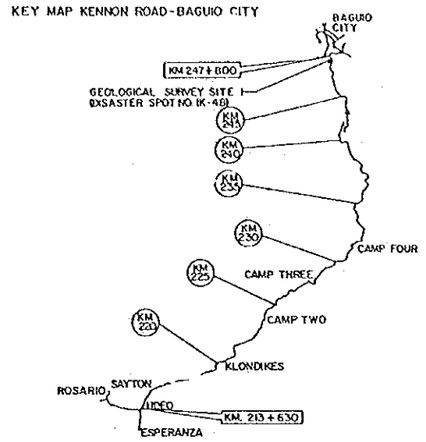
SUMMARY OF SEISMIC REFRACTION (MAHAPLAG - SOGOD SECTION) (2)

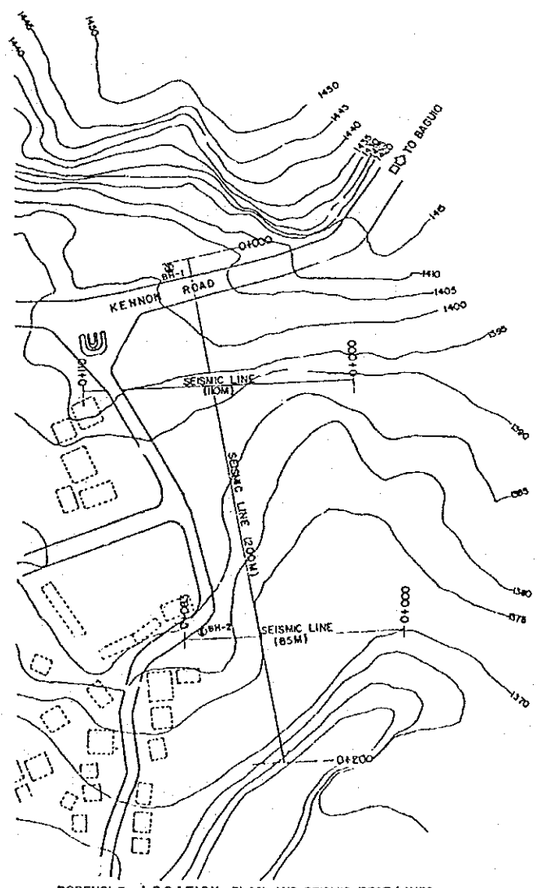
SPOT NO.	Results of seismic refraction survey Scale Hor. 1:200m Vert. 1:100m All velocities in M/sec	Description
VIII-90		Brownish soils cover underlain by highly to moderately weathered AGGLOMERATES
VIII-100		Topsoil is underlain by ANDESITES of various weathering grades
VIII-103		Same as VIII-100, but jointing and weathering is more intense

SUMMARY OF SEISMIC REFRACTION (MAHAPLAG-SOGOD SECTION) (3)

SPOT NO.	Results of seismic refraction survey Scale Hor. 1:200m Vert. 1:100m All velocities in M/sec	Description
VIII-104		Totally weathered ANDESITE
VIII-107		Totally weathered AGGLOMERATES with highly jointed section

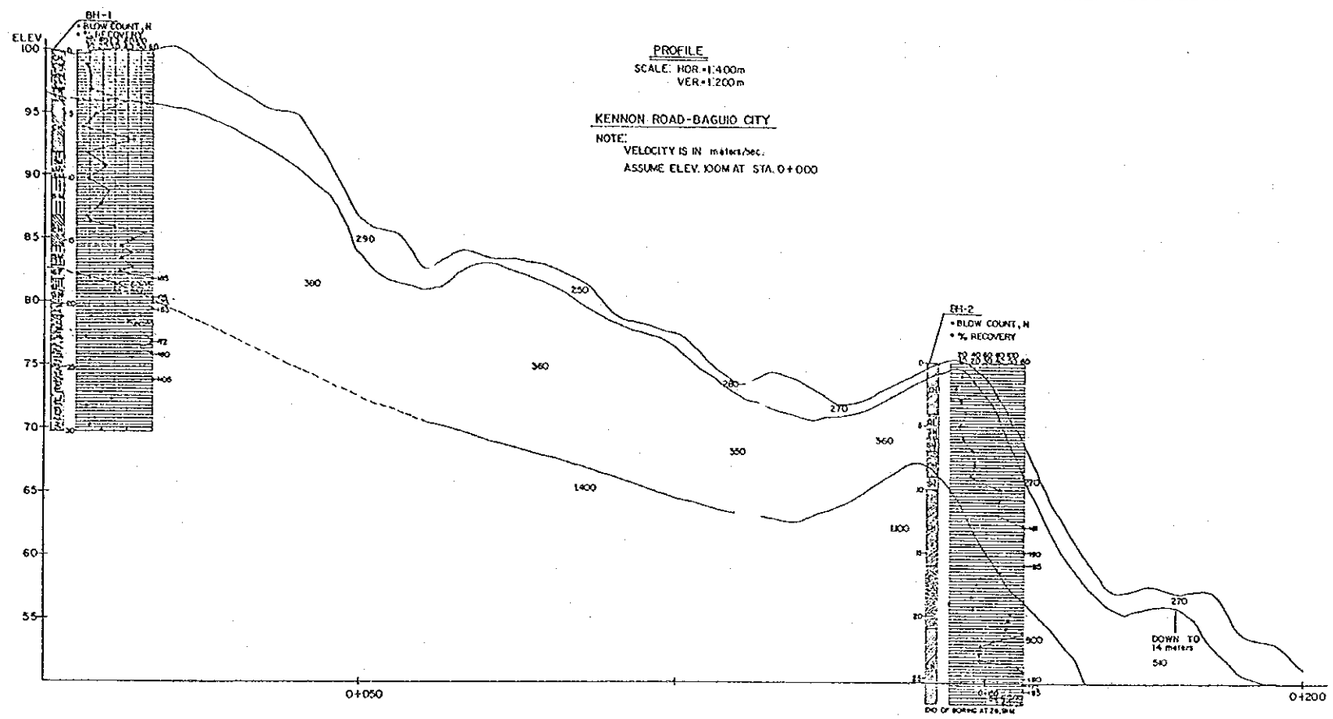
HALF REDUCED COPY

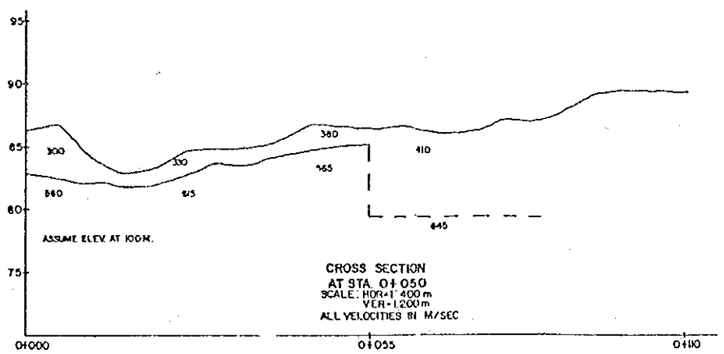




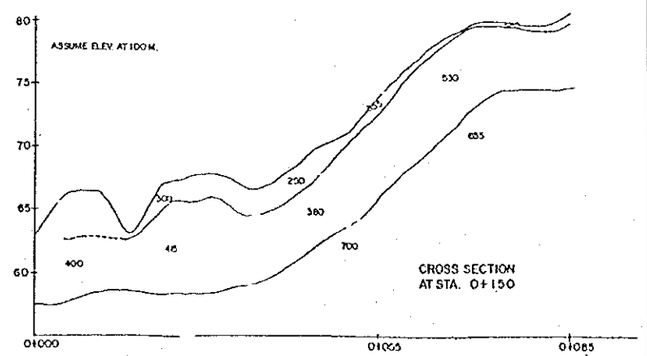
BOREHOLE LOCATION PLAN AND SEISMIC TEST LINES

SCALE 1:800 M.





CROSS SECTION
AT STA. 01+050
SCALE: HOR=1:400m
VER=1:200m
ALL VELOCITIES IN M/SEC



CROSS SECTION
AT STA. 01+150

APPENDIX 10.1-6 SUMMARY OF SEISMIC EXPLORATION AND BORINGS IN KENNON ROAD

APPENDIX 10.1-7 BORING LOGS (KENNON ROAD) (1)

BORING LOG

PROJECT ROAD DISASTER PREVENTION PROJ. — BORE HOLE NO. BH-1
LOCATION Kennon Rd. Baguio City — DATE STARTED 10-26-83 DATE COMPLETED 10-31-83
GROUND WATER ELEV. 25.6 m. — GROUND SURFACE ELEV.
DRILLING METHOD washboring and coring — SAMPLERS USED 5.0 cm. OD-SS
WT. OF HAMMER 63.6 kg. — HAMMER FALL 76.2 cm.

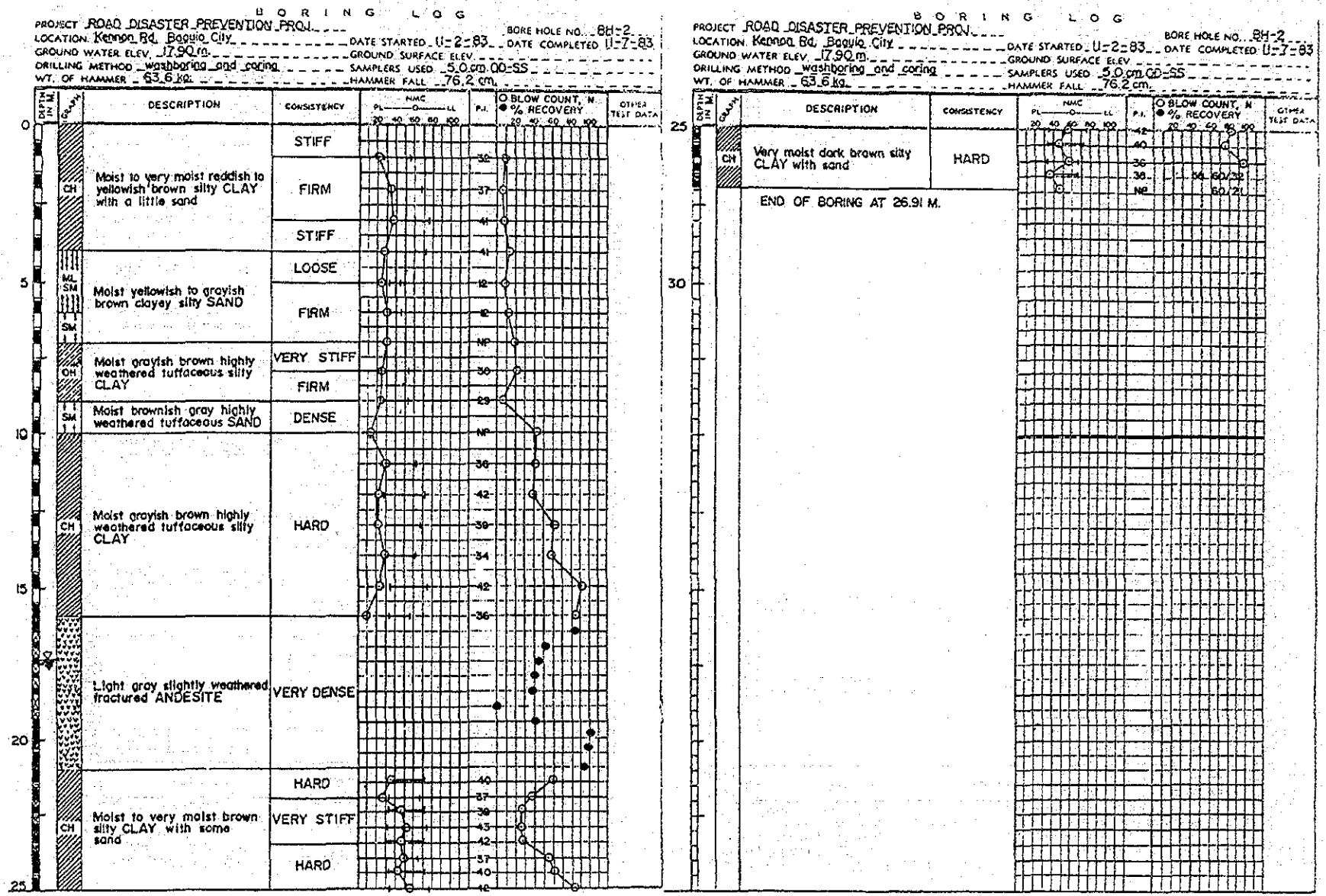
DEPTH IN M.	GRAPH	DESCRIPTION	CONSISTENCY	NMC / PL / LL	P.I.	BLOW COUNT, N / % RECOVERY
0	CH	Very moist reddish brown sandy silty CLAY	STIFF		40	
	CH CL SC	Very moist brown sandy silty CLAY	FIRM		34	
	CH SC		DENSE		20	
5	CH	Very moist orange to reddish brown silty CLAY with sand	STIFF		29	
			FIRM		44	
			STIFF		34	
	SM	Very moist to moist greyish brown silty SAND with a little gravel	FIRM		42	
	SM		LOOSE		43	
10	SM		FIRM		NP	
			LOOSE		30	
	CH	Very moist reddish brown sandy silty CLAY	STIFF		NP	
			HARD		NP	
15	SM	Moist greyish to reddish brown silty SAND	DENSE		NP	
	SP	Moist to dry gravelly SAND	VERY DENSE		25	
	ML SM	Moist dry brownish to light gray clayey silty SAND			31	
					42	
	TUFF BRECCIA	Brownish to gray highly weathered TUFF to volcanic BRECCIA			32	
					NP	
					NP	
					NP	
					NP	
					NP	
					NP	
					12	35-60/15
					14	35-60/15
					12	
					NP	
					NP	
					NP	60/10
					NP	
					NP	
					NP	
					NP	
25					NP	

BORING LOG

PROJECT ROAD DISASTER PREVENTION PROJ. — BORE HOLE NO. BH-1
LOCATION Kennon Rd. Baguio City — DATE STARTED 10-26-83 DATE COMPLETED 10-31-83
GROUND WATER ELEV. 25.6 m. — GROUND SURFACE ELEV.
DRILLING METHOD washboring and coring — SAMPLERS USED 5.0 cm. OD-SS
WT. OF HAMMER 63.6 kg. — HAMMER FALL 76.2 cm.

DEPTH IN M.	GRAPH	DESCRIPTION	CONSISTENCY	NMC / PL / LL	P.I.	BLOW COUNT, N / % RECOVERY
25	BRECCIA	Light gray highly weathered andesitic BRECCIA	VERY DENSE			
30		END OF BORING AT 30.00 M.				

BORING LOGS (KENNON ROAD) (2)



APPENDIX 10.1-6 SUMMARY OF LABORATORY TEST RESULTS (KENNON ROAD)

PROJECT: ROAD DISASTER PREVENTION PROJECT
LOCATION: KENNON ROAD, BAGUIO CITY

SUMMARY OF LABORATORY TEST RESULTS

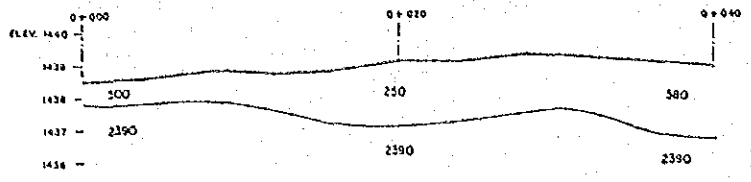
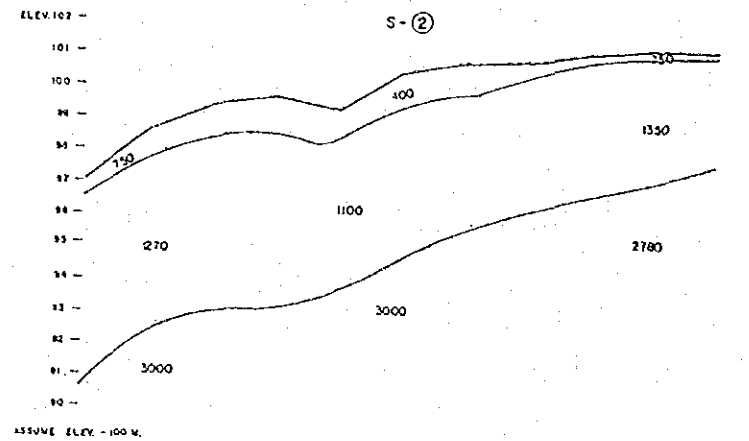
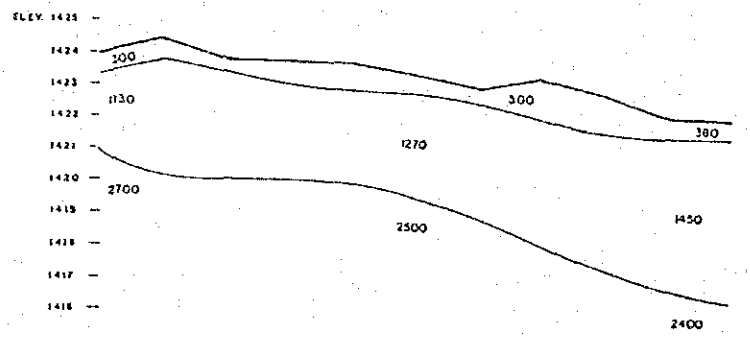
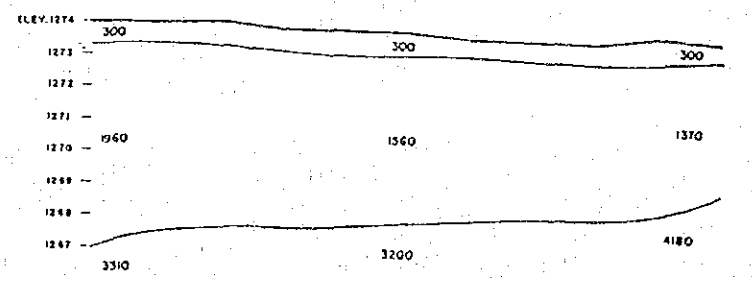
BORE-HOLE NO.	SAMPLE NO.	DEPTH (M)	NMC	ATTERBERG LIMIT			SIEVE ANALYSIS, (% FINER) PASSING SIEVE NO.										REMA
				LL	PL	PI	1	3/4	3/8	4	10	20	40	60	140	200	
BR-1																	
	1	0.55-1.00	41	73	33	40				100	96	89	81	72	65	58	
	2	1.55-2.00	43	60	26	34				100	94	81	65	56	50	40	
	3	2.55-3.00	33	48	28	20				100	94	82	66	56	45	40	
	4	3.55-4.00	37	53	24	29				100	86	68	52	41	37	30	
	5	4.55-5.00	48	74	32	44				100	93	86	74	62	54	51	
	6	5.55-6.00	44	61	27	34			100	96	90	80	68	62	53	50	
	7	6.55-7.00	50	72	30	42				100	99	95	90	79	74	69	
	8	7.55-8.00	51	73	30	43			100	99	99	96	91	79	77	69	
	9	8.55-9.00	16						100	87	71	50	38	34	28	21	
	10	9.55-10.00	28	62	32	30		100	97	94	89	79	65	61	59	47	
	11	10.55-11.00	32							100	88	71	58	54	42	33	
	12	11.55-12.00	24							100	77	54	41	36	27	24	
	13	12.55-13.00	20						100	88	71	55	44	36	32	28	
	14	13.00-13.45	46	52	27	25				100	99	95	90	80	71	69	
	15	14.00-14.45	32	57	26	31				100	99	93	82	73	65	59	
	16	14.45-14.90	34	74	32	42				100	92	89	87	71	62	61	
	17	15.00-15.45	30	62	30	32				100	94	81	64	51	41	32	
	18	15.55-16.00	17						100	88	74	54	40	27	17	14	
	19	16.00-16.45	9						100	97	83	62	44	24	15	13	
	20	16.55-17.00	10						100	96	86	68	53	45	34	31	
	21	17.00-17.45	3					100	67	53	40	26	17	9	8	5	
	22	17.55-18.00	11							100	60	42	37	30	14	10	
	23	18.00-18.45	21	45	33	12				100	99	96	82	53	34	32	
	24	18.55-19.00	21	46	32	14			100	90	86	83	72	53	27	26	
	25	19.00-19.45	6	44	32	12		100	95	91	82	65	54	48	36	30	
	26	19.55-20.00	11					100	93	83	71	59	49	39	32	32	
	27	20.00-20.45	3					100	93	91	79	65	45	37	29	25	
	28	21.00-21.45	6						100	86	54	41	22	20	16	9	
	29	21.45-21.55	10						100	84	68	57	42	38	31	21	
	30	22.55-23.00	7					100	82	71	54	45	33	26	22	19	
	31	23.00-23.45	10						100	94	58	53	48	43	33	28	
	32	23.55-24.00	13						100	91	62	56	43	40	33	25	
	33	24.55-25.00	11						100	90	79	58	43	34	27	23	
	34	25.55-26.00	12						100	89	76	59	48	36	28	25	

PROJECT: ROAD DISASTER PREVENTION PROJECT
LOCATION: KENNON ROAD, BAGUIO CITY

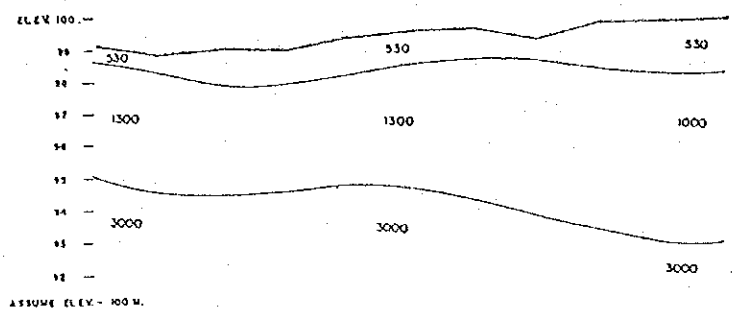
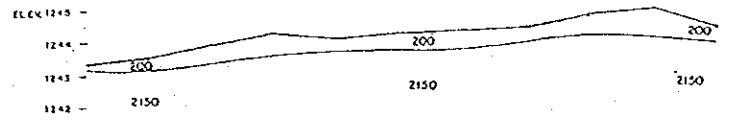
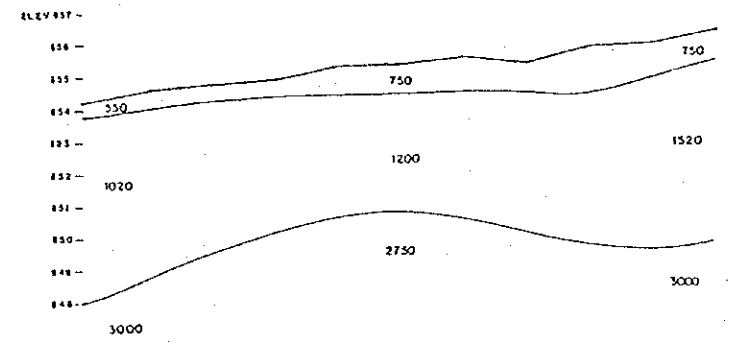
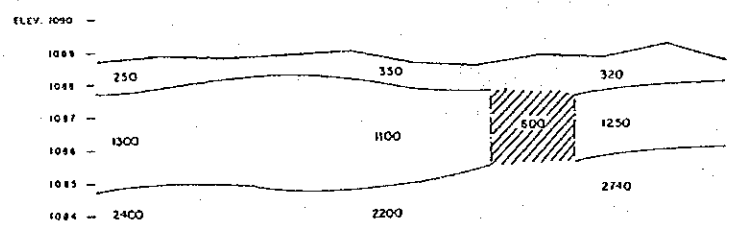
SUMMARY OF LABORATORY TEST RESULTS

BORE-HOLE NO.	SAMPLE NO.	DEPTH (M)	NMC	ATTERBERG LIMIT			SIEVE ANALYSIS, (% FINER) PASSING SIEVE NO.										REMARKS
				LL	PL	PI	1	3/4	3/8	4	10	20	40	60	140	200	
BH-2																	
	1	0.55-1.00	21	57	25	32				100	97	93	87	81	76	70	
	2	1.55-2.00	33	69	32	37					100	98	95	88	80	77	
	3	2.55-3.00	37	75	34	41				100	99	97	91	86	78	72	
	4	3.55-4.00	28	71	30	41			100	95	92	87	76	68	60	51	
	5	4.55-5.00	25	45	33	12		100	92	89	80	67	51	46	32	28	
	6	5.55-6.00	30	46	34	12			100	95	87	70	55	49	45	40	
	7	6.55-7.00	30						100	92	79	62	45	38	27	25	
	8	7.55-8.00	25	54	24	30					100	95	66	48	36	33	
	9	8.55-9.00	24	54	25	29			100	91	84	76	68	51	42	34	
	10	9.55-10.00	13					100	85	76	59	47	37	36	29	23	
	11	10.55-11.00	30	64	28	36			100	96	93	82	69	61	53	48	
	12	11.55-12.00	22	71	29	42			100	94	83	72	63	55	49	43	
	13	12.55-13.00	22	69	30	39			100	92	83	72	61	52	44	39	
	14	13.55-14.00	29	61	27	34			100	99	87	68	53	46	38	32	
	15	14.55-15.00	22	74	32	42					100	94	78	61	56	53	
	16	15.55-16.00	9	67	31	36			100	95	92	84	69	59	48	45	
	17	21.00-21.45	36	72	32	40					100	97	87	81	79	76	
	18	21.55-22.00	27	69	32	37					100	95	82	61	50	43	
	19	22.00-22.45	47	71	32	39					100	96	86	78	68	63	
	20	22.55-23.00	51	75	32	43							100	88	78	72	
	21	23.00-23.45	47	72	30	42					100	97	91	71	58	51	
	22	23.55-24.00	49	67	30	37					100	93	82	74	68	53	
	23	24.00-24.45	42	72	32	40						100	93	84	74	68	
	24	24.55-25.00	56	77	35	42						100	95	83	73	71	
	25	25.00-25.45	47	73	33	40						100	91	87	80	72	
	26	25.55-26.00	56	67	31	36					100	97	93	81	74	66	
	27	26.00-26.45	36	68	30	38					100	81	68	66	57	49	
	28	26.55-26.91	46					100	86	84	66	47	36	32	18	11	

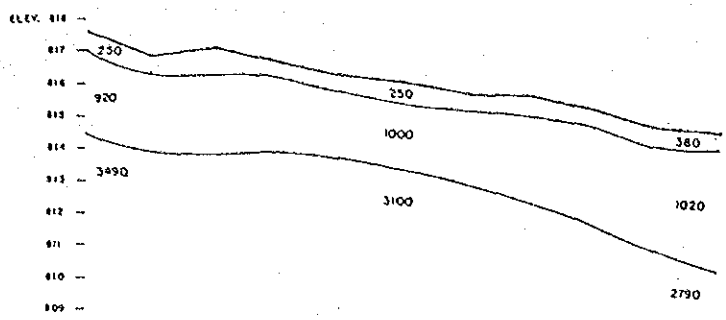
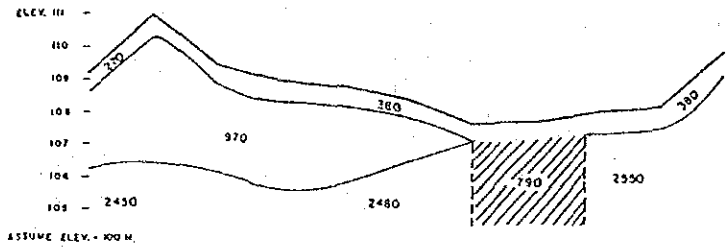
APPENDIX 10.1-9 SUMMARY OF SEISMIC REFRACTION (KENNON ROAD) (1)

SPOT NO.	Results of seismic refraction survey Scale Hor. 1:200m Vert. 1:100m All velocities in M/sec	Description
IK-6		Slightly weathered and fractured Conglomeratic, Metavolcanics, Limestones, Diorites and Andesites
IK-10		Moderately to highly weathered fossiliferous LIMESTONE
IK-12		Moderately to highly weathered ANDESITE
IK-19		Moderately weathered, slightly jointed ANDESITE

SUMMARY OF SEISMIC REFRACTION (KENNON ROAD) (2)

SPOT NO.	Results of seismic refraction survey Scale Hor. 1:200 m Vert. 1:100 m All velocities in M/sec.	Description
IK-21		Moderately weathered, highly jointed, a livegray DIORITE
IK-23		Slighly to moderately weathered DIORITE
IK-29		Highly weathered, highly jointed ANDESITE
IK-34		Highly to moderately weathered, highly jointed ANDESITE

SUMMARY OF SEISMIC REFRACTION (KENNON ROAD) (3)

SPOT NO.	Results of seismic refraction survey Scale Hor. 1:200 m Vert. 1:100 m All velocities in M/sec	Description
IK-38		Highly jointed, slightly weathered Sedimentary Facies
IK-41		Slightly weathered to moderately weathered ANDESITE

Appendix 10-2 Realignment of Critical Sections

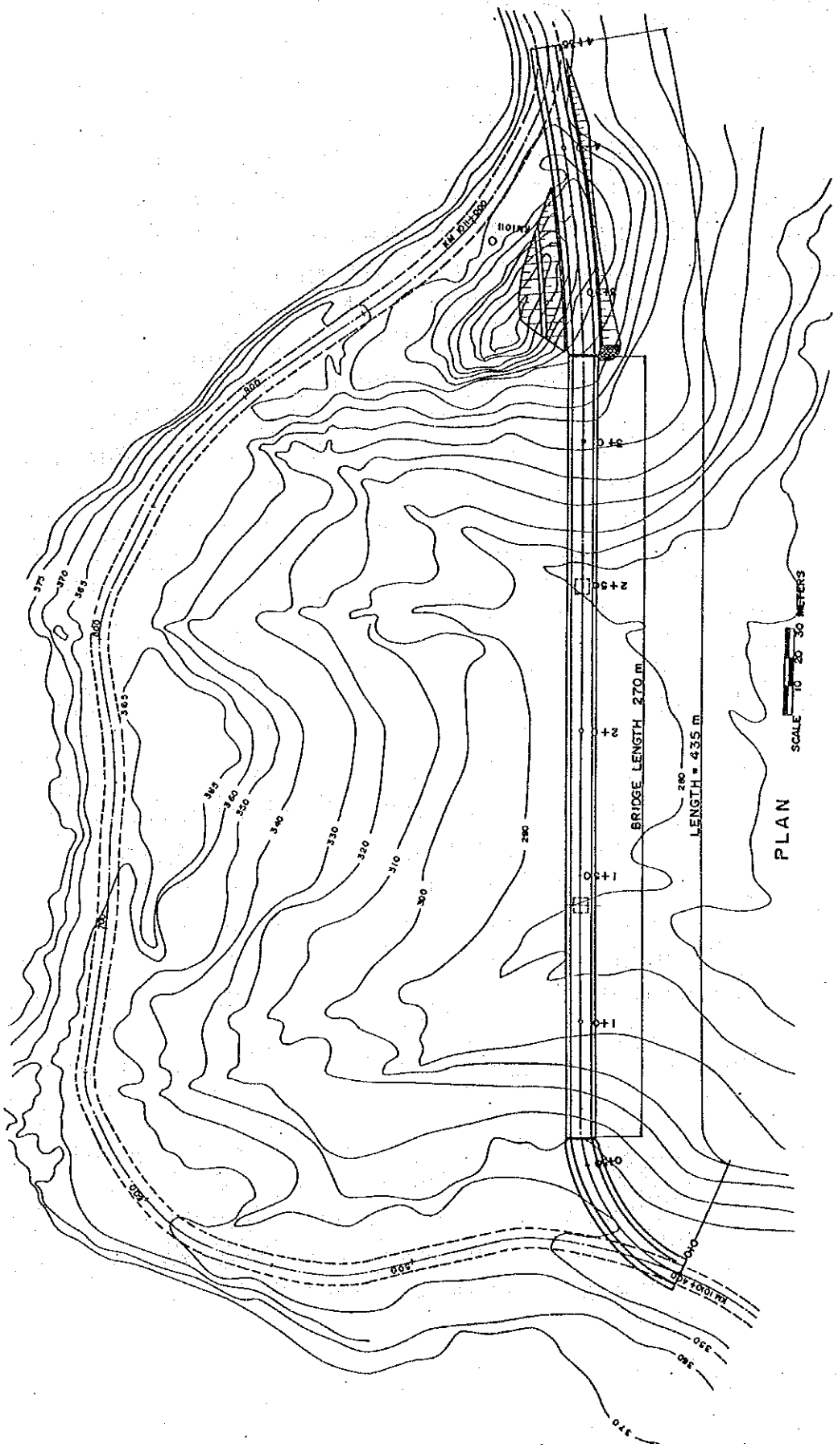
1. Km. 1,010 + 700 in Mahaplag-Sogod Section, Mahalika Highway

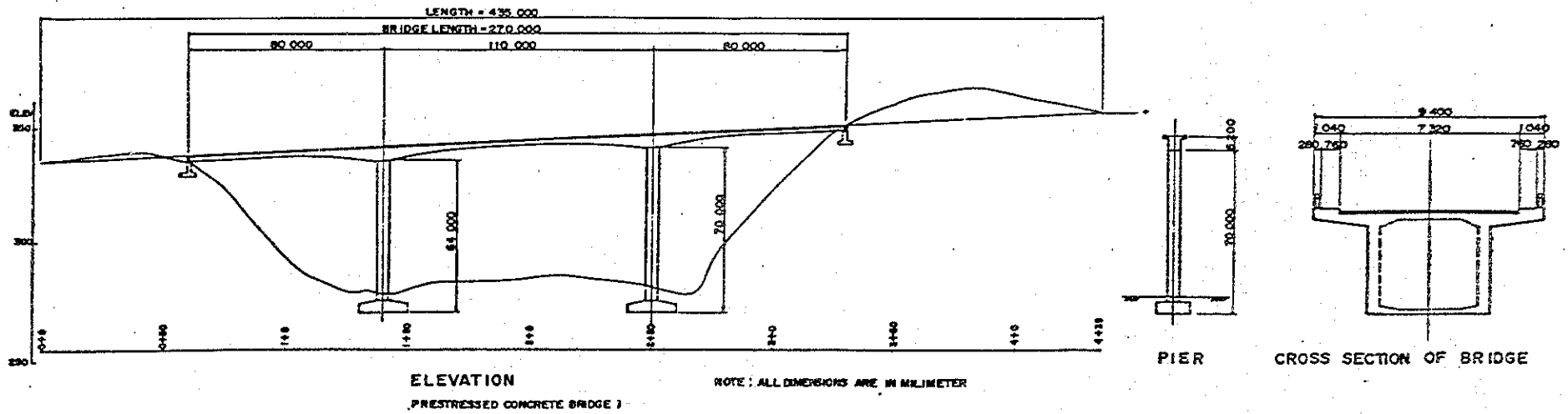
A short section at Km. 1,010 + 700 (spots VIII-80 and 81) in Mahaplag-Sogod Section is subjected to the largest scale of cut slope failure and embankment slope failure. Two (2) alternative plans were studied to come up with the optimum solution on this special section: one is to provide slope protection work on the existing slopes, thus increasing stability of the existing slopes and the other is to realign a road center line to avoid disaster potential spots. In the latter plan, the road center line was shifted towards valley side and the valley was spanned by a bridge (see Figure on next page). Rough construction costs of two plans were estimated as follows;

Unit : Million Pesos

Plan-1 Slope Protection of Existing Slopes		Plan-2 Realignment	
Embankment	8.8	Superstructure	38.0
Vegetation on embankment slopes	0.8	Substructure	15.0
Re-cutting (gravel)	7.1	Approach	1.2
Re-cutting (soft rock)	5.7		
Vegetation on cut slopes	1.1		
Underground drainage	1.4		
Others	2.2		
Total	27.1		54.2

As Plan-2 requires a bridge of 270 meters in length with piers of 70 meters in height, construction cost of Plan-2 is more expensive by about double than Plan-1. Plan-1 which is slope protection of existing slopes was recommended for adoption to the preliminary design.


BRIDGE LENGTH 270 m
LENGTH = 435 m
PLAN
SCALE 10 20 30 METERS



ELEVATION

PRESTRESSED CONCRETE BRIDGE)

NOTE : ALL DIMENSIONS ARE IN MILIMETER

PIER

CROSS SECTION OF BRIDGE

2. Section between Km. 239 + 830 and Km. 240 + 240, Kennon Road

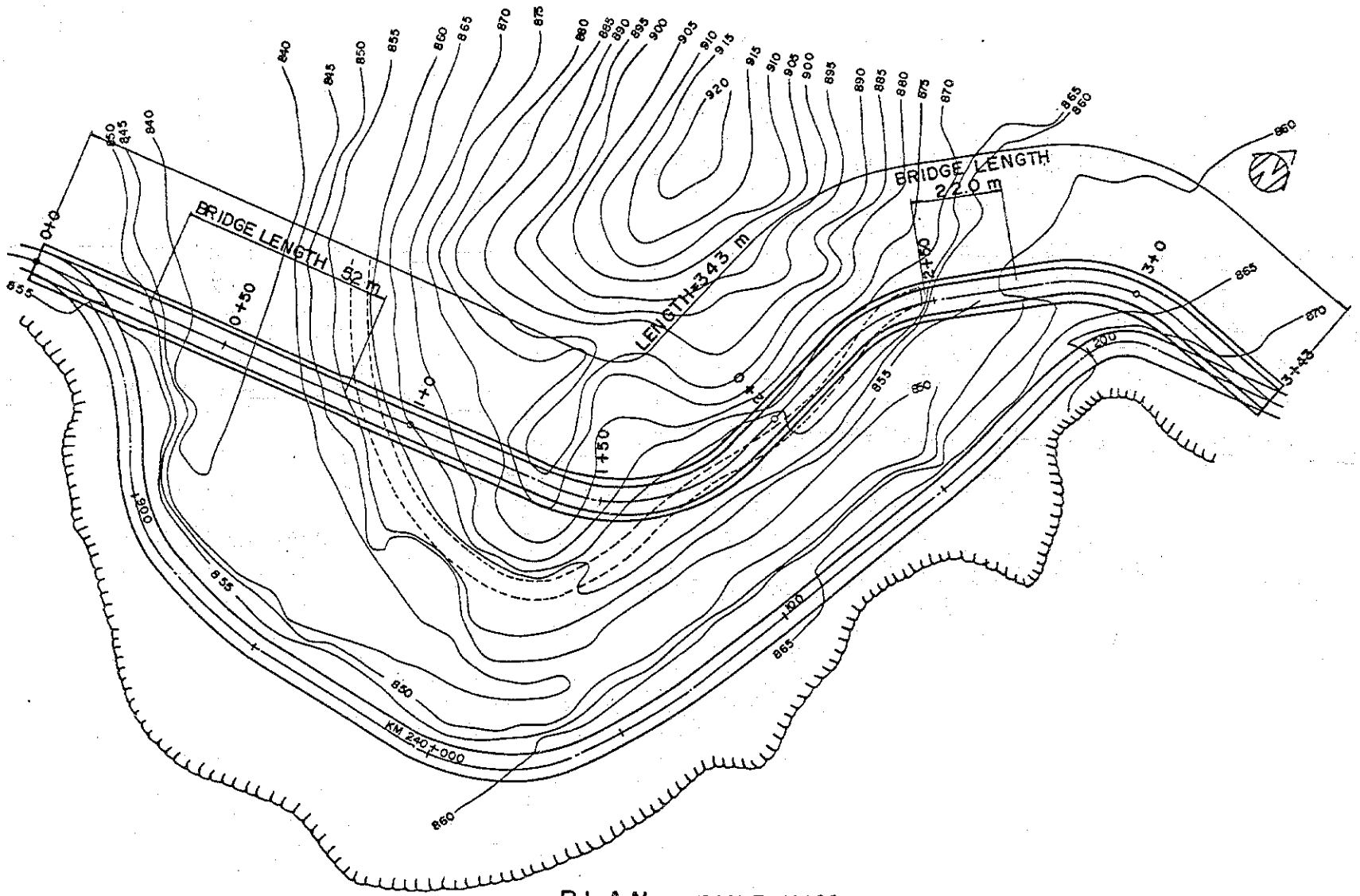
Quite steep and high cut slopes continue along this section which contains four (4) disaster spots of IK-39, 40, 41 and 42. In addition to a plan to provide slope protection works on the existing slopes, a route realignment plan was considered. New alignment was selected on the opposite side of the Bued River. New alignment has length of 343 meters which is shorter by about 70 meters than the existing route, however, new alignment has to cross the Bued River twice requiring two bridges. It also requires high cut slopes of about 25 meters in height (see Figure on next page).

Construction costs of two plans were roughly estimated as follows;

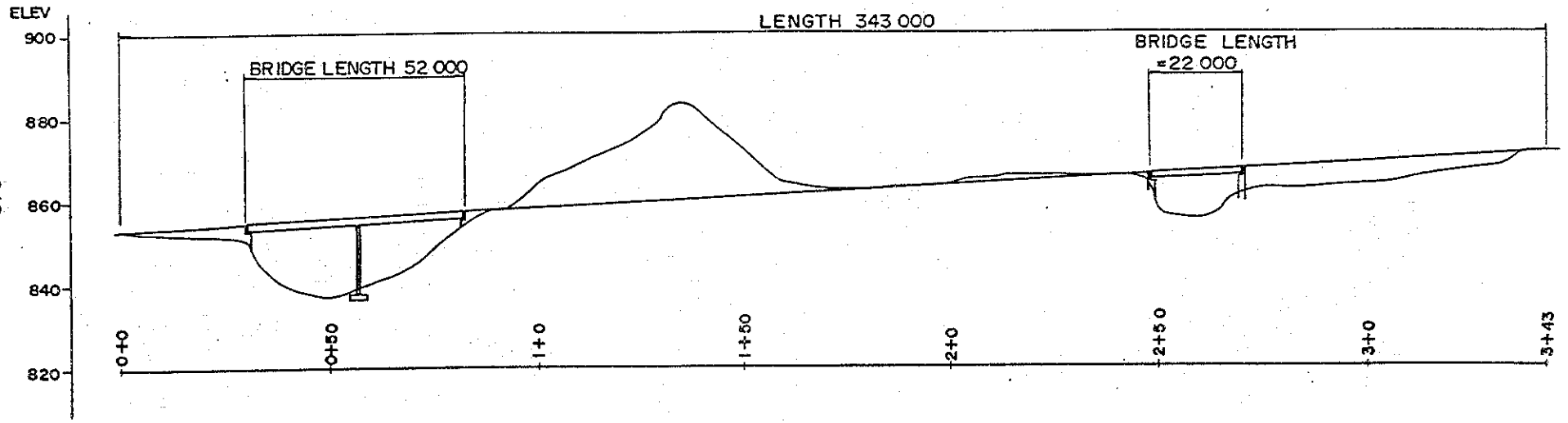
Unit : Million Pesos

Plan-1 Slope Protection of Existing Slopes		Plan-2 Realignment	
IK-39	1.0	Two bridges (L = 74 meters)	
IK-40	0.3	Superstructure	3.5
IK-41	0.8	Substructure	1.8
IK-42	0.2	New road (L = 269 meters)	1.9
Total	2.3		7.2

Plan-2, realignment plan is more expensive by about 3 times than Plan-1. Plan-1, slope protection of existing slopes was recommended.



PLAN SCALE 1:100



ELEVATION

NOTE : ALL DIHENSIONS ARE IN MILIMETER

APPENDIX 10-3

STABILITY CALCULATIONS

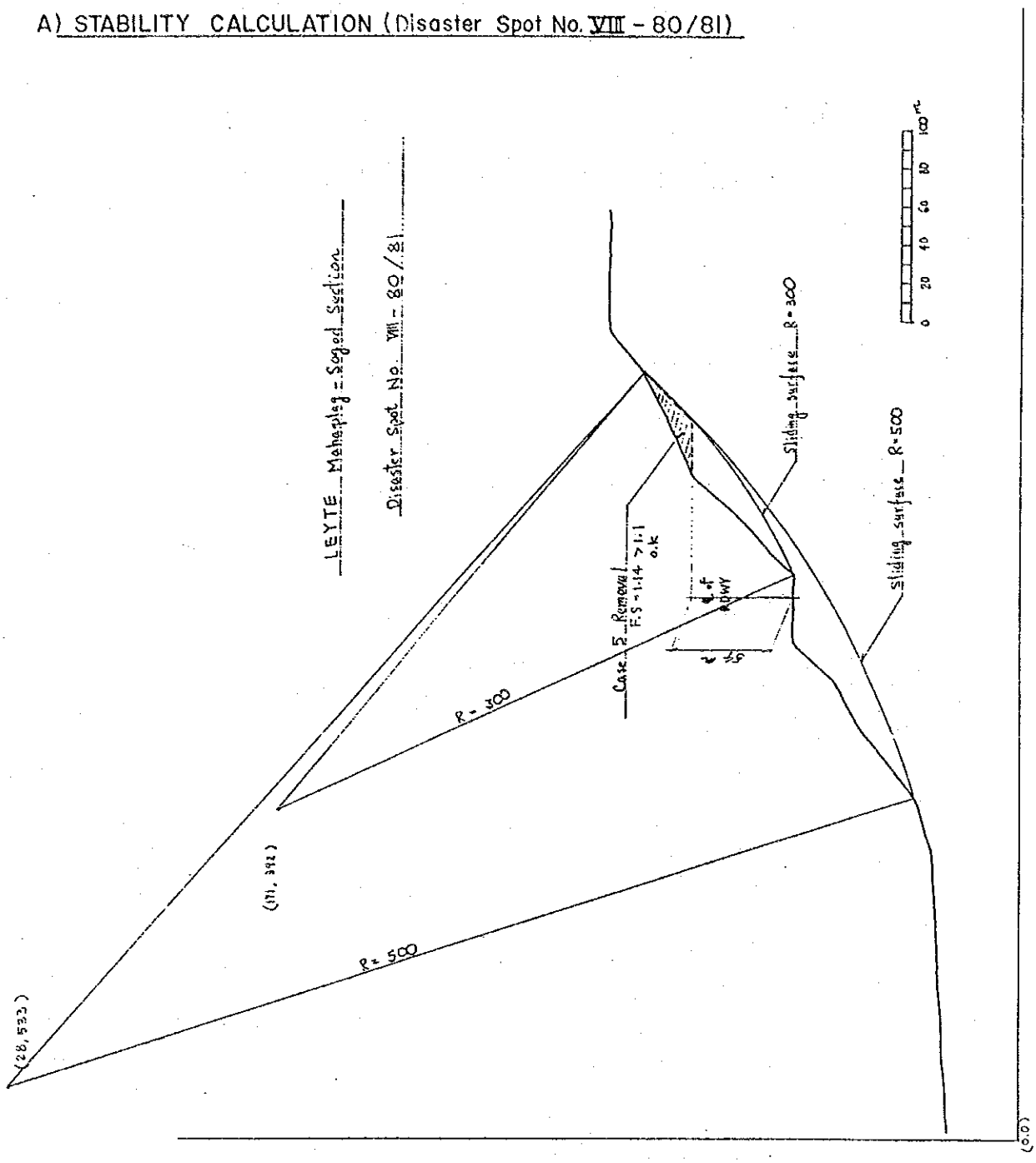
A) Stability Calculation for Slope failure at Disaster Spot No. VIII - 80/81 (Mahaplag - Sogod Section Leyte)

Computed by Micro-Computer

B) Stability Calculation for Landslide at Disaster Spot No. IK- 48 (Kennon Road)

1. Dimension of Slope
2. Computation of Stability
3. Acting Force on Pile
4 Design of Pile

A) STABILITY CALCULATION (Disaster Spot No. VIII - 80/81)



1 Case 1

R = 500

F.S = 1.0 ⟶ $\tan \phi$ = 1.41 and C = 0.0 t/m^2 or

$\tan \phi$ = 0.00 and = 13.16 t/m^2

2 Case 2

R = 500

$\tan \phi$ = 0.87, c = 5.00 t/m^2 ⟶ F.S = 1.0

3 Case 3

R = 300

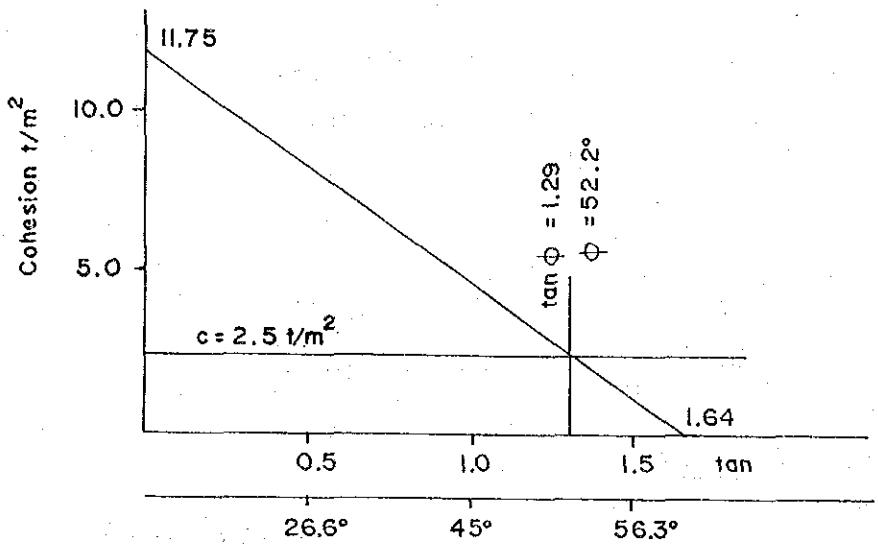
$\tan \phi$ = 0.87, c = 5.00 t/m^2 ⟶ F.S = 0.95

4 Case 4

R = 300

F.S = 1 ⟶ $\tan \phi$ = 1.64 and c = 0.00 t/m

$\tan \phi$ = 0.00 and c = 11.75 t/m^2



4 Case 5

R R = 300

After Removal

$\tan \phi$ = 1.29, c = 2.5 t/m^2 ⟶ F.S = 1.14 > 1.1

TITLE:LEYTE CASE - 1

WATEER LEVEL 1

-------FAILURE CIRCLE-----			----------FORCES----------			------FACTOR OF SAFETY------		
X0 (M)	Y0 (M)	RADIUS (M)	COHESION (T*M)	FRICTION (T*M)	DRIVING (T*M)	SAFETY	TAN(F)	C (T/M**2)
28.00	533.00	500.00	0.00	X1918586.00	X1918586.00	1.00	1.41	0.00
28.00	533.00	500.00	X1918586.00	0.00	X1918586.00	1.00	0.00	13.16

TITLE:LEYTE CASE - 2

CORDNETES OF GRAND SURFACE
(100.0, 0.0) (151.0, 48.0) (178.0, 57.0) (214.0, 86.0) (237.0, 98.0)
(258.0, 122.0) (294.0, 120.0) (302.0, 132.0) (321.0, 148.0) (344.0, 174.0)
(400.0, 200.0) (550.0, 200.0)

CORDINETES OF LAYER BOUNDARY DEN(T/M**3) COH(T/M**2) FRI(DEG)
(0.0, X-100.0) (550.0, X-100.0) 1.80 5.00 0.87

GRAND OF WATEER LEVEL 1

-------FAILURE CIRCLE-----			----------FORCES----------			------FACTOR OF SAFETY
X0 (M)	Y0 (M)	RADIUS (M)	COHESION (T*M)	FRICTION (T*M)	DRIVING (T*M)	
28.00	533.00	500.00	729041.30	X1182859.00	X1918586.00	1.00

TITLE:LEYTE CASE - 3

CORDNETES OF GRAND SURFACE
(100.0, 0.0) (294.0, 120.0) (302.0, 132.0) (321.0, 148.0) (344.0, 174.0)
(400.0, 200.0) (550.0, 200.0)

CORDINETES OF LAYER BOUNDARY DEN(T/M**3) COH(T/M**2) FRI(DEG)
(0.0, X-100.0) (550.0, X-100.0) 1.80 5.00 0.87

GRAND OF WATEER LEVEL 1

-------FAILURE CIRCLE-----			----------FORCES----------			------FACTOR OF SAFETY
X0 (M)	Y0 (M)	RADIUS (M)	COHESION (T*M)	FRICTION (T*M)	DRIVING (T*M)	
171.00	392.00	298.00	195161.80	242850.50	458663.20	0.95

TITLE:LEYTE CASE 4

WATEER LEVEL 1

-------FAILURE CIRCLE-----			----------FORCES----------			------FACTOR OF SAFETY------		
X0 (M)	Y0 (M)	RADIUS (M)	COHESION (T*M)	FRICTION (T*M)	DRIVING (T*M)	SAFETY	TAN(F)	C (T/M**2)
171.00	392.00	298.00	0.00	458663.20	458663.20	1.00	1.64	0.00
171.00	392.00	298.00	458663.20	0.00	458663.20	1.00	0.00	11.75

TITLE:LEYTE S/80/81 CASE 5

CORDNETES OF GRAND SURFACE
(100.0, 0.0) (294.0, 120.0) (302.0, 132.0) (321.0, 148.0) (344.0, 174.0)
(374.0, 174.0) (400.0, 200.0) (550.0, 200.0)

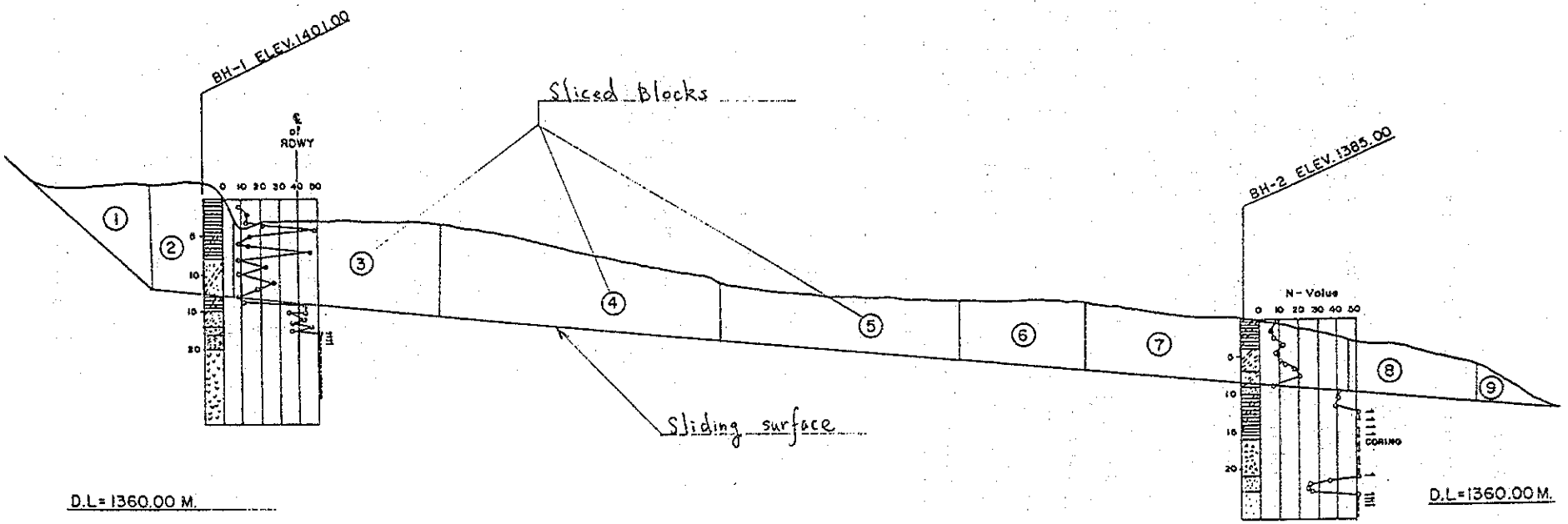
CORDINETES OF LAYER BOUNDARY DEN(T/M**3) COH(T/M**2) FRI(DEG)
(0.0, X-100.0) (550.0, X-100.0) 1.80 2.50 1.29

GRAND OF WATEER LEVEL 1

-------FAILURE CIRCLE-----			----------FORCES----------			------FACTOR OF SAFETY
X0 (M)	Y0 (M)	RADIUS (M)	COHESION (T*M)	FRICTION (T*M)	DRIVING (T*M)	
171.00	392.00	298.00	89557.37	272872.20	318703.50	1.14

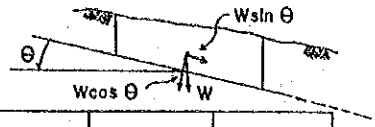
B) STABILITY CALCULATION (Disaster Spot No. IK-48)

Dimension of Slope



2. Computation of Stability

Computation Table of Stability Check



Slice No.	Area of Trapezium A (m^2)	Unit Weight of soil γ_3 (t/m^3)	Weight of Slices W (t/m)	Degree θ	W·Sin θ (t/m)	W·Cos θ (t/m)	ℓ (m)
1	1/2 (0.0+14.0) X15.0	1.7	178.5	47.5	131.6	120.6	20.5
2	1/2X(14.0+14.5)X9.5	1.7	230.1	5.0°	20.1	229.2	9.54
3	1/2X(10.0+13.5)X28.5	1.7	569.3	5.0°	49.6	567.1	28.6
4	1/2X(13.5+7.8)X36.5	1.7	660.8	5.0	57.6	658.3	36.6
5	1/2X(7.8+8.0)X31.5	1.7	423.0	5.0°	36.9	421.4	31.6
6	1/2X(8.0+9.0)X16.5	1.7	238.4	5.0°	20.8	239.5	16.6
7	1/2X(9.0+7.0)X34.0	1.7	462.4	5.0°	40.3	460.6	34.1
8	1/2X(7.0+5.2)X16.5	1.7	171.1	5.0°	14.9	170.4	16.6
9	1/2X(5.2+0.0)X10.5	1.7	46.4	5.0°	4.0	46.2	10.5
Total					375.8	2911.3	204.9

If Factor of Safety = 1.0

$$F.S = \frac{C \times \Sigma\ell + \tan\phi \times W\cdot\cos\theta}{W\cdot\sin\theta}$$

C: Cohesion of Soil (t/m^2)

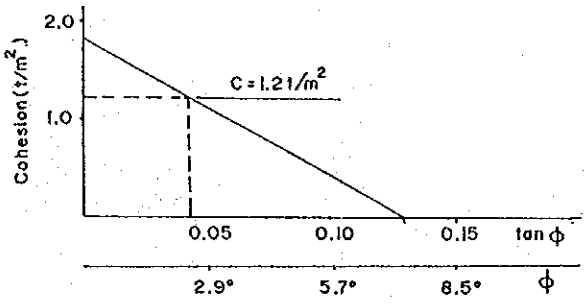
ϕ: Angle of Internal friction (degree)

F.S = 1

$$1 = \frac{C \times 204.9 + \tan\phi \times 2911.3}{375.8}$$

$C = 0 \longrightarrow \tan\phi = 0.129 \quad (\phi = 7.4°)$

$\tan\phi = 0 \longrightarrow C = 1.834\ t/m^2$



$C = 1.20\ t/m^2 \longrightarrow \tan\phi_1 = 0.045 \quad (\phi = 2.56°)$

3 Acting Force on Pile

$$F.S_{(p)} = \frac{C \times \Sigma \ell + \tan\phi \times W \cdot \cos\theta + P}{W \cdot \sin\theta}$$

P; Acting Force on Pile (t/m)

$F.S_{(p)}$; Proposed Factor of Safety (1.1)

$C = 1.1\ t/m^2$

$\tan\phi = 0.045$

$\Sigma\ell$ = Slices ① + ② + ③ = 58.94

$W \cdot \cos\theta$ = Slices ① + ② + ③ = 916.9

$W \cdot \sin\theta$ = Slices ① + ② + ③ = 201.3

$$1.1 = \frac{1.20 \times 58.94 + 0.045 \times 916.9 + P}{201.3}$$

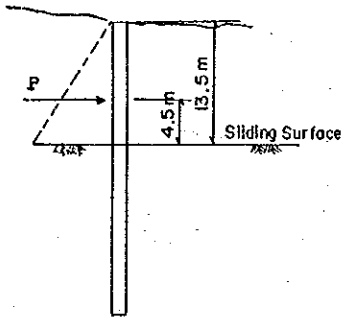
$P = 129.6\ t/m$

Interval of Piles 4.0 meters

$P = 129.6\ t/m \times 4m = 518.3\ t/1\text{-pile}$

P; Acting Force on One Pile

4 Design of Pile



Acting Force on Pile

P = 518.3 ton

Use Chang's Formula

Co-efficient of Horizontal Subgrade reaction Kh

$Kh = \alpha \cdot Eo \cdot D^{-\frac{3}{4}}$

α; Constance (= 0.2)

$Eo = 28 \cdot N\ (kg/cm^2)$

N; No. of Blows by S.P.T. (= 40)

D; Diameter of Pile (240 cm)

$Kh = 0.2 \times 28 \times 40 \times 240^{-\frac{3}{4}} = 3.7\ kg/cm^3$

E; Young Modulus of Pile $2.8 \times 10^5\ kg/cm^2$

I; Inertia of Pile

$$I = \frac{1}{64} \times \pi \times D^4 = \frac{1}{64} \times \pi \times 240^4 = 1.63 \times 10^8\ cm^4$$

$$B = \sqrt[4]{\frac{K \cdot D}{4EI}}$$

$$= \sqrt[4]{\frac{3.7 \times 240}{4 \times 2.8 \times 10 \times 1.63 \times 10}} = 0.001485^{cm^{-1}}$$

Embedment lenght under Sliding Suface

$$\ell \geq 2.5/\beta$$

$$= 2.5/0.001485 = 1684\text{cm} = 16.8\text{m}$$

Total pile lenght $13.5 + 16.8 \fallingdotseq 30$meter

Sectional force due to Acting force on pile

$$Mmax = \frac{\sqrt{(1+2\beta ho)^2+1}}{2\beta ho} \exp\left[-\tan^{-1}\frac{1}{1+2\beta ho}\right] \times Mo$$

Mmax ; Max. Moment

Mo ; Bending Moment at Sliding Surface

ho ; Height from Sliding Surface to point of Acting Force

Mo = 518.3 ton X 4.5 meters = 2332.4 t·m

M max = 2958 t·m

S = 518.3 ton

S ; Shearing Force

Computation of Sectional Stresses

Diameter of Pile 240cm

Covering of Reinforcement 15 cm

Steel Reinforcement Used

As = 3-D32- @ 15cm

$= 3 \times 7.942 \times 44 = 1048.3\ \text{cm}^2$

$(n = Es/Ec = 15)$

$$np = n \times \frac{As}{\pi \cdot \gamma^2} = 15 \times \frac{1048.3}{\pi \times 240^2} = 0.09$$

→ S = 6.5, C = 2.5, Z = 0.43 } Refer to Reinforced Concrete homogram

$$\sigma c = \frac{M}{\gamma^3} \times C$$

$$= \frac{2958 \times 10^5}{240^3} \times 2.5 = 53\ \text{kg/cm}^2 < 70\ \text{kg/cm}^2 \times 1.5 = 105\ \text{kg/cm}^2$$

$$\sigma s = \frac{M}{\gamma^3} \times S \times n$$

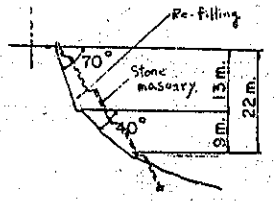
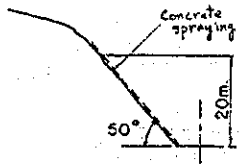
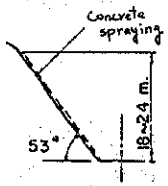
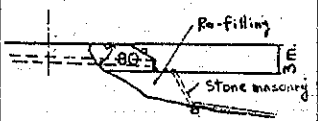
$$= \frac{2958 \times 10^5}{240^3} \times 6.5 \times 15 = 2086\ \text{kg/cm}^2 < 1800 \times 1.5 = 2700\ \text{kg/cm}^2$$

$$\tau = \frac{S}{\gamma^2} \times Z$$

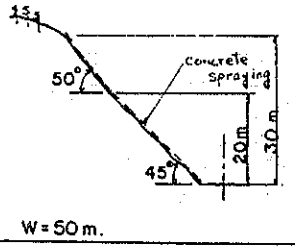
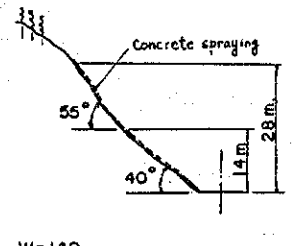
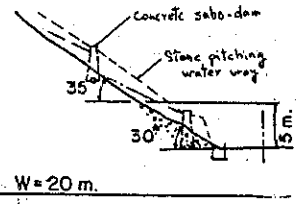
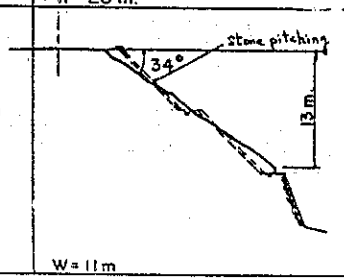
$$= \frac{518.3}{240^2} \times 0.43 = 3.9\ \text{kg/cm}^2 < 6.0 \times 1.5 = 9.0\ \text{kg/cm}^2$$

APPENDIX 10-4 Condition of Disaster and Selected Counermeasures

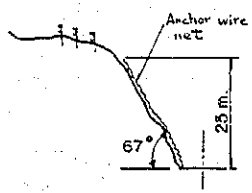
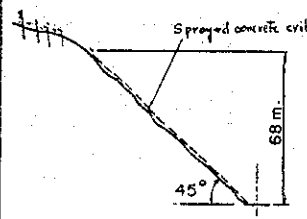
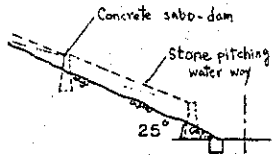
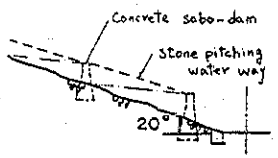
DALTON PASS SECTION (1)

No.	Disaster Spot No.	Km Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks
1	III-4(a)	167+300 E-DF	 W = 50 m.	·Embankment material	·Concentration of road surface water	·Re-filling should be done ·Surface water flows on the slope. ·Slope is steep and new side ditch should be placed.	·Re-filling ·Stone masonry ·Side ditch	·Existing stone masonry was destroyed due to road surface water.
2	III-4(b)	167+400 C-F	 W = 280 m.	·Diorite ·Slightly weathered. ·Developed crack	·No surface water concentration.	·Some detached rocks exist on the slope. ·Cracked rocks. ·Progress of weathering is anticipated.	·Removal ·Concrete spraying (t = 10)	
3	III-4(c)	167+600 C-F	 W = 180 m.	·Diorite ·Slightly weathered ·Highly developed cracks	·No surface water concentration	·Detached rocks exist on the slope. ·Progress of weathering is anticipated. ·Many cracks and joints ·More developed cracks than the cracks of spot III-4(b).	·Removal ·Concrete spraying (t = 15)	
4	III-5	167+850 E-DF	 W = 20 m.	·Embankment material	·Existing pipe culvert.	·Apron, headwall and wingwall of pipe culvert outlet were destroyed. ·No restoration work was implemented.	Re-filling of Pipe culvert Apron for culvert Stone masonry Vertical ditch	Only a half lane of the roadway is passable.

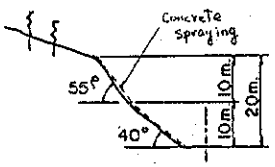
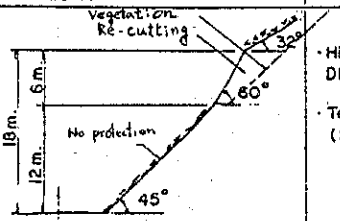
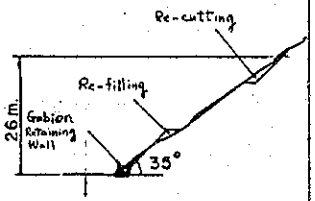
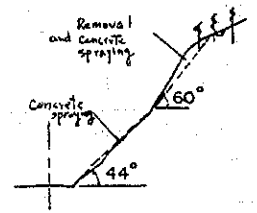
CONDITION OF DISASTER AND SELECTED COUNTERMEASURES — DALTON PASS SECTION (2)

No.	Disaster Spot No.	Km Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks
5	III-6	167+900 C-S.F		·Diorite ·Highly and totally weathered in some parts of the slope Highly developed crack	·Slope surface water flows on the slope and a little concentration of surface water exists.	·Some unstable materials shall be removed due to total weathering in some parts of the slope. ·Slope gradient is not so steep. ·Scouring of slope surface water and progress of weathering is anticipated.	Removal ·Concrete spraying (t=15 cm.)	·The bottom of the slope is in the toe of the ridge. ·It is useless to provide top slope ditch.
6	III-7	168+100 C-S.F		·Andesite ·Highly to moderately weathered rock. ·Highly developed cracks	·Slope surface water flows on the slope.	·Some totally weathered rocks should be removed. ·Slope gradient is nearly optimum. ·Scouring of surface water and progress of weathering is anticipated	·Removal ·Concrete spraying (t=10 cm)	
7	III-10	170+400 D.F		·Standstone ·Slightly weathered	·Water from hinterland runs at a hollow on the slope.	·The amount of debris is less than 50 cu.m. ·Debris flows out from the hollow of the slope during rainy days.	·Small Sabo-dam ·Waterway	
8	III-11	170+700 E-D.F		·Embankment materials	·Concentration of road surface water ·Road surface water saturates into the embankment materials	·Embankment slope shall be protected by the structures. ·Poor drainage facilities on the roadway	·Re-filling ·Stone pitching ·Side ditch	·Grouted riprap was destroyed due to road surface water.

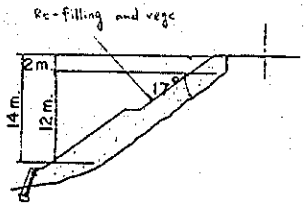
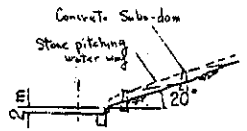
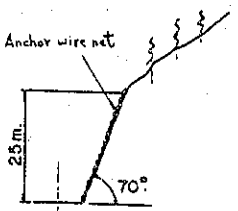
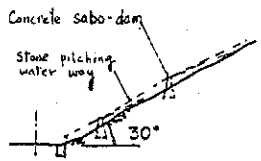
CONDITION OF DISASTER AND SELECTED COUNTERMEASURES — DALTON PASS SECTION (3)

No.	Disaster Spot No.	Km Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks
9	III-12	170+750 C-F	 W = 158 m.	·Andesite ·Moderately weathered ·Many jointed and cracked rocks	·A little influence of slope surface water on the spot.	·Some detached rocks exist on the slope. ·Size of falling rocks is like a cobble stone. ·A little progress of weathering is due to the small influence of surface water.	·Removal ·Anchor wire net	·Catch fence can not be applied due to an anticipated big falling rocks.
10	III-14	171+200 C-S.F	 W = 119 m.	·Schist/Andesite ·Highly and totally weathered in some parts of the slope ·Highly cracked	·Some seepage of water occurs when surface water flows on the slope.	·Some unstable materials exist on the slope. ·Progress of weathering is anticipated due to slope surface water. ·Scouring is caused by slope surface water.	·Removal ·Sprayed concrete crib with boulder and with concrete wall.	
11	III-15	172+500 D.F	 W = 20m. + 10m.	·Andesite ·Moderately weathered	·Water from hinterland runs at the two hollows on the slope. ·Slope surface water concentrates at upper part of the two hollows	·Some debris flows out from two hollows during rainy days.	·Small Sabo-Dam ·Water way ·Pipe culvert	
12	III-18	173+450 D.F	 W = 10m.	·Volcaniclastics	·Slope surface water concentrates at one hollow on the slope.	·Some debris composed of gravel and sand flows out during rainy days. ·Amount of debris flow is about 100 cu.m.	·Small Sabo-Dam ·Water way	

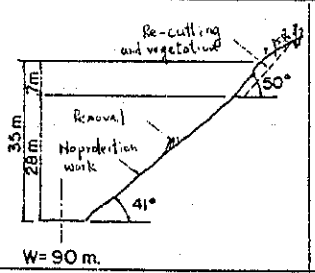
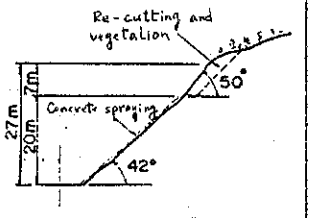
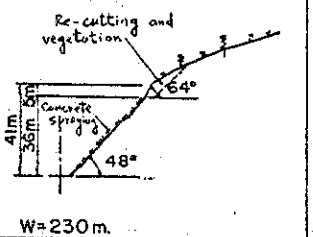
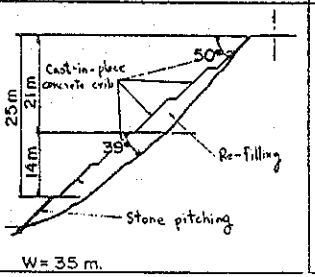
CONDITION OF DISASTER AND SELECTED COUNTERMEASURES — DALTON PASS SECTION (4)

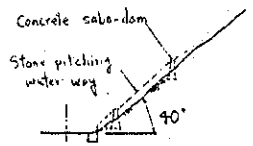
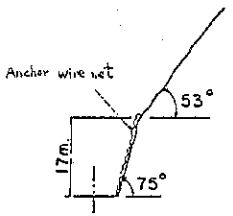
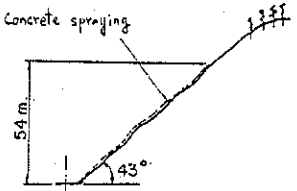
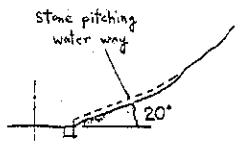
No.	Disaster Spot No.	Km Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks
13	III-19	173+650 C-S.F	 W = 20 m.	· Volcaniclastics · Moderately weathered	· A little influence exists due to slope surface water.	· Progress of weathering is anticipated. · Slope surface failure occurs due to some unstable materials on the slope.	· Removal. · Concrete spraying. (t=10 cm)	
14	III-22(a)	185+450 C-S.F	 W = 40 m.	· Highly weathered DIORITE. · Terrace Deposit (Sand and gravel)	· Water from hinterland flows on the slope and a concentration of slope surface water occurs.	· Upper layer of the slope is Terrace deposit. · No drainage facilities on the slope.	· Re-cutting. · Berm and Vertical ditch. · Vegetation.	
15	III-22(b)	185+500 C-S.F	 W = 75 m.	· Totally weathered DIORITE (Nearly soil)	· Water from hinterland flows on the slope. · Slope surface water saturates into the slope. · The ground water level is high.	· No existing slope protection. · No drainage facility on the slope · Nearly soil · High ground level	· Re-cutting and Re-filling. · Vegetation · Berm and vertical ditch · Gabion Retaining wall	
16	III-23	185+900 C-S.F	 W = 40 m.	· Moderately to highly weathered DIORITE rocks with developed cracks.	· Slope surface water flows on the slope and a concentration of slope surface water occurs.	· Some unstable materials exist on the slope. · Progress of weathering is anticipated due to slope surface water	· Removal · Concrete spraying (t=10m) · Top slope ditch	

CONDITION OF DISASTER AND SELECTED COUNTERMEASURES — DALTON PASS SECTION (5)

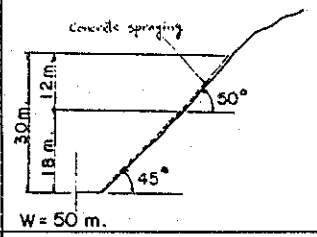
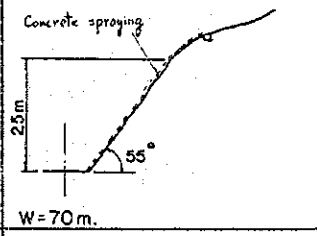
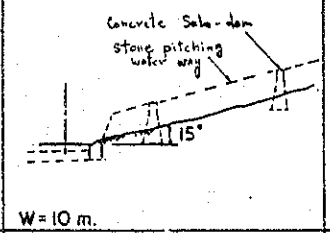
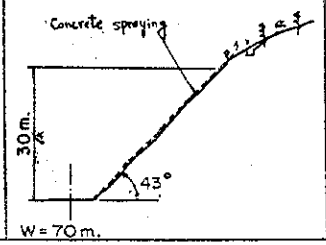
No.	Disaster Spot No.	Km Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks
17	III-24	186+400 E-D.F	 W = 70 m.	· Embankment materials	· Concentration of slope surface water exist · Road surface water also saturates into the embankment materials.	· No slope protection nor drainage facilities on the slope. · No side ditch on the roadway. · Slope gradient is very steep.	· Re-filling · Vegetation · Stone masonry · Berm ditch · Side ditch	
18	III-25(a)	186+400 D-F	 W=10 m.	· Highly weathered DIORITE	· Water from hinterland flows at one hollow on the slope.	· Some debris are overlying on the hollow.	· Concrete sabo dam · Water way	
19	III-25(b)	186+400 C-F	 W=50 m.	· Slightly to moderately weathered DACITE rock with regular cracks.	· There is a little influence of slope surface water on the spot.	· No protection for falling rocks on the slope. · Some detached rocks exist on the slope.	· Removal · Anchor wire net	
20	III-26	186+600 D.F	 W=30 m.	· Slightly weathered DIORITE.	· Water from hinterland flows at one hollow on the slope.	· The slope is covered by grasses and trees. · Some debris are overlying on the hollow.	· Concrete sabo dam · Water way	

CONDITION OF DISASTER AND SELECTED COUNTERMEASURES — DALTON PASS SECTION (6)

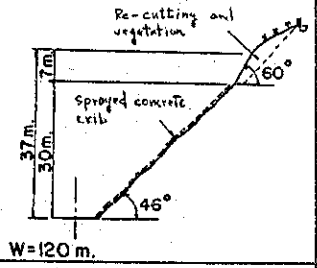
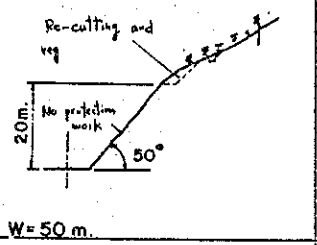
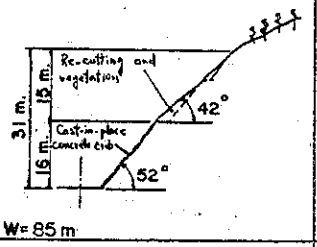
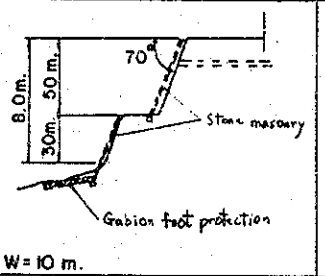
No.	Disaster Spot No.	Km Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks
21	III-28	187+300 C-S F		· Slightly weathered DACITE rocks with sparse cracks	· Slope surface water flows on the slope.	· Some unstable materials on the slope. · No progress of weathering is anticipated for hard stable rocks. · Soils overlie on the rocks at the top of the slope.	· Removal · Berm ditch · Re-cutting · Vegetation · Top slope ditch	· No slope protection required for the rock.
22	III-30	187+800 C-S.F		· Moderately weathered DACITE rocks with developed cracks.	· Slope surface water flowson the slope and a little concentration of slope surface water occurs.	· Progress of weathering is anticipated. · Some unstable materials exist on the slope.	· Removal · Concrete spraying (t=10 cm) · Berm ditch · Re-cutting · Vegetation	
23	III-31	188+000 C-S.F		· Moderately to highly weathered DIORITE rocks with highly developed cracks.	· A little concentration of surface water exist.	· Weaker rocks than the rocks of spot III-30	· Removal · Concrete spraying (t=15 cm) · Berm ditch · Re-cutting · Vegetation	
24	III-32	188+100 E-D.F		· Embankment materials	· Concentration of road surface water exists. · Road surface water saturates into the embankment materials.	· Poor drainage facilities exist. · No existing slope protection. · Too steep and high slope	· Re-filling · Cast-in place concrete crib with grass · Stone pitching · Gabion foot protection	

No.	Disaster Spot No.	Km Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks
25	III-36	188+700 D.F	 W=10 m.	·Slightly weathered DIORITE.	·Water from hinterland flows at a hollow on the slope.	·Some debris exist in the hollow.	·Concrete Saba-Dam. ·Waterway.	
26	III-37	189+900 C-F	 W=117 m.	·Moderately weathered DIORITE with highly developed cracks.	·A little influence of slope surface water exists.	·Slope is steep with stable rocks. ·Only falling rocks are anticipated.	·Anchored wire net.	
27	III-38(a)	190+000 C-S.F	 W=67 m.	·Highly weathered DIORITE rocks with highly developed cracks.	·Slope surface water flows on the slope and a concentration of slope surface water occurs.	·A little unstable soil is on the slope. ·A little progress of weathering occurs.	·Concrete spraying (t=10 cm.)	
28	III-38(b)	190+050 D.F	 W=10 m.	·Slightly weathered DIORITE.	·Concentration of slope surface water exists. ·Water from hinterland flows at a hollow on the slope.	·Slope is stable and covered by trees and grasses.	·Waterway.	

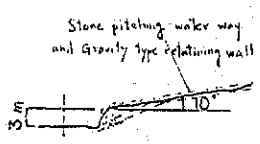
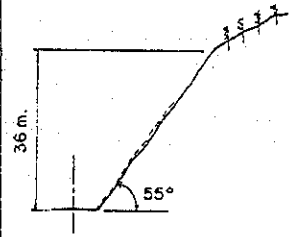
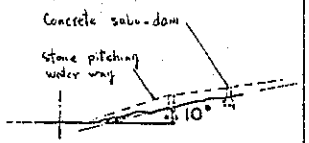
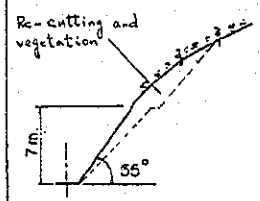
CONDITION OF DISASTER AND SELECTED COUNTERMEASURES — DALTON PASS SECTION (8)

No.	Disaster Spot No.	Km Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks
29	III-39	190+400 C-S.F		·Highly weathered DIORITE rocks with regular cracks.	·A little concentration of slope surface water exists.	·A little progress of weathering is anticipated. ·Some unstable soils exist on the slope.	·Removal ·Concrete spraying (t = 10 cm.)	
30	III-41	190+750 C-S.F		·Highly weathered DIORITE rocks with highly developed cracks	·Water from hinterland flows at two hollows on the slope. ·There is much concentration of slope surface water.	·Slope gradient is gentle with very weak, soft rock.	·Removal ·Concrete spraying. (t = 15 cm.) ·Top slope and Vertical ditch	
31	III-42	190+850 D.F		·DIORITE	·Water from hinterland flows at a hollow on the slope.	·Some debris exist on the hollow. ·No drainage structure crosses the roadway.	·Concrete Sabo-Dam ·Water way ·Box culvert	
32	III-43	190+900 C-S.F		·Highly weathered DIORITE rocks with highly developed cracks	·Water from hinterland flows on the slope.	·Progress of weathering is anticipated for weak soft rock.	·Concrete spraying. (t = 15 cm.) ·Top slope and vertical ditch	

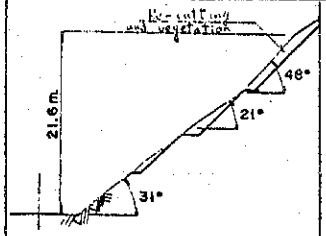
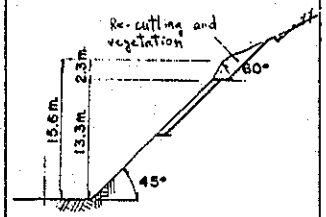
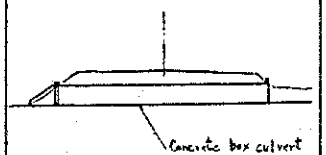
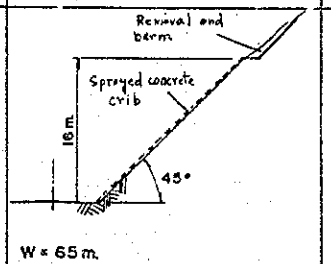
CONDITION OF DISASTER AND SELECTED COUNTERMEASURES — DALTON PASS SECTION (9)

No.	Disaster Spot No.	Km Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks
33	III-46	192+700 C-S.F		·Highly weathered DACITE rocks with highly developed cracks and fractures.	·Water from hinterland flows on the slope.	·Much progress of weathering is due to surface water. ·Slope is a little bit steeper than the optimum gradient.	·Removal ·Sprayed concrete crib with concrete wall. ·Re-cutting ·Vegetation ·Top slope ditch.	
34	III-47(a)	192+850 C-S.F		·Slightly weathered DACITE rocks with developed cracks.	·Water from interland flows on the slope.	·Slope is very gentle and stable. ·A little progress of weathering is due to surface water.	·Removal ·Top slope ditch. ·Re-cutting ·Vegetation	·No slope protection is required for rocks on the slope.
35	III-47(b)	193+000 C-S.F		·Highly weathered DACITE rocks with highly developed cracks and fractures.	·A little concentration of slope surface water exists.	·Slope is a little bit steeper than the optimum gradient. ·Much progress of weathering is anticipated.	·Removal ·Sprayed concrete crib with concrete wall. ·Berm ditch. ·Re-cutting ·Vegetation	
36	III-48	193+300 E-D.F		·Embankment materials.	·Scouring is caused by water coming from the outlet of pipe culvert. ·River was scoured at the toe of the slope.	·No apron and wingwall at the outlet of the pipe culvert. ·Scouring by the river current needs protection.	·Stone masonry. ·Gabion foot protection.	

CONDITION OF DISASTER AND SELECTED COUNTERMEASURES — DALTON PASS SECTION (10)

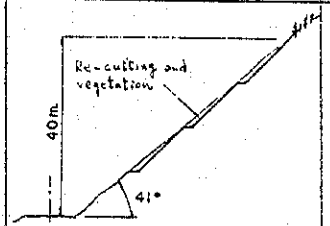
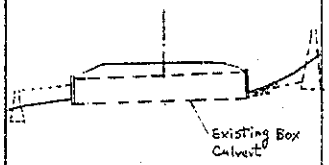
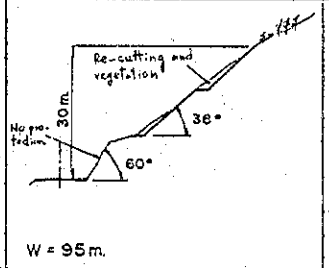
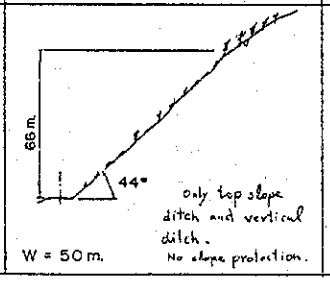
No.	Disaster Spot No.	Km Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks
37	III-50	194+400 D.F	 W=100 m.	· Colluvial soil (Debris)	· Water from hinterland flows at several hollows on the slope.	· No drainage facilities on the slope. · The slope is covered by trees and grasses and can be seen stable.	· Water way · Gravity type retaining wall.	
38	III-51	195+600 C-F	 W=80 m.	· Moderately to highly weathered DACITE rocks with highly developed cracks.	· A little influence exist due to slope surface water.	· Progress of weathering is anticipated. · Slope is just an optimum gradient. · Some detached rocks exist on the slope.	· Removal · Concrete spraying (t = 15 cm.)	
39	III-53	195+850 D.F	 W=20 m.	· Slightly weathered DIORITE.	· Water from hinterland flows at a hollow on the slope.	· Some debris exist on the slope. · No drainage structure crosses the roadway.	· Concrete Sabo-Dam. · Water way · Concrete box culvert.	
40	III-54	195+900 C-S.F	 W=50 m.	· Totally weathered DIORITE (nearly soil)	· Slope surface water saturate into the ground.	· Slope gradient is steeper than the optimum. · No drainage on the slope.	· Re-cutting. · Vegetation. · Berm ditch.	

CONDITION OF DISASTER AND SELECTED COUNTERMEASURES — DALTON PASS SECTION (II)

No.	Disaster Spot No.	Km Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks *
41	III-55	196+050 C-S.F	 W = 100 m.	•Totally weathered DIORITE (Nearly soil)	•Water from hinterland flows on the slope and a little concentration of water occurs.	•Slope gradient is not optimum. •Slope failure exist due to the absence of slope protection.	•Re-cutting •Vegetation •Top slope ditch and berm ditch.	
42	III-56	196+100 C-D.F	 W = 120 m.	•Totally weathered DIORITE (Nearly Soil)	•Concentration of slope surface water exists.	•Slope gradient is a little bit steeper than the optimum •Slope deep failure exists due to the concentration of surface water.	•Re-cutting •Vegetation •Top slope ditch and vertical ditch	
43	III-61	197+700 0.F		•Embankment materials	•Water from hinterland concentrates at this place.	•Lack of drainage facilities causes the water to cross over the roadway.	•Concrete Box culvert (double barrel)	
44	III-65	203+450 C-S.F	 W = 65 m.	•Highly weathered ANDESITE •Fractured and highly developed cracks	•Surface water flows on the slope and a little seepage of water occurs.	•Very weak soft rock •Much progress of weathering occurs due to surface water and seepage of water.	•Removal •Sprayed concrete crib with boulders •Berm ditch	•The proposed Dalton Pass Tunnel Project starts from this spot •Same countermeasures shown in left column

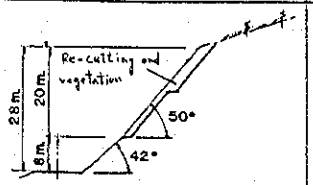
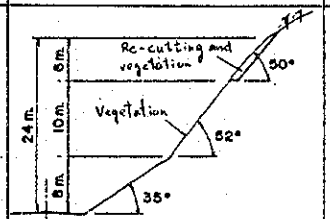
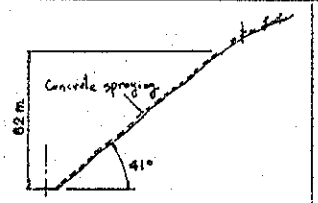
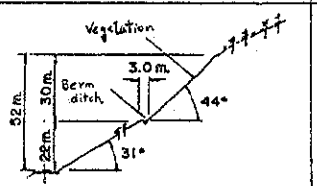
* Countermeasures shown in Remarks are to be considered as countermeasures in long term.

CONDITION OF DISASTER AND SELECTED COUNTERMEASURES — DALTON PASS SECTION (12)

No.	Disaster Spot No.	Km Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks*
45	III-66(a)	203+550 C-S.F		• Highly and totally weathered ANDESITE with developed cracks in some parts of the slope. (Nearly soil)	• A little concentration of slope surface water exists.	• Sloped gradient is almost optimum, but no berm ditch exists on the slope. • Vegetation should be applied on these soft rocks.	• Re-cutting • Vegetation • Berm ditch	• Re-cutting • Concrete spraying (t=10 cm) • Berm ditch
46	III-66(b)	203+850 D.F		• River deposit	• Small creek is approximately about 5.0 meters in width.	• Some debris exist on the creeck bed. • Scouring on the bed of the creek is anticipated.	• Water way • Concrete sabo dam	• Same countermeasures shown in left column
47	III-68	204+250 C-D.F		• Highly to totally weathered DIABASE rocks in some parts of the slope (Nearly soil)	• Concentration of slope surface water exists.	• Slope is too steep • Vegetation is needed	• Re-cutting • Vegetation • Berm ditch	• Re-cutting • Concrete spraying (t= 10cm) • Berm ditch
48	III-70	204+400 C-S.F		• The slope is covered by soil with highly weathered DIABASE rocks.	• Water from hinterland flows at a hollow on the slope.	• The slope is covered by trees and grasses and can be seen stable. • Scouring is caused by the concentration of surface water.	• Top slope ditch • Vertical ditch	• Re-cutting • Vegetation • Berm ditch

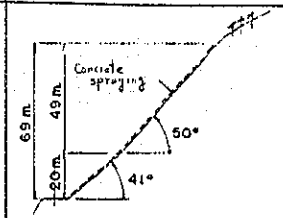
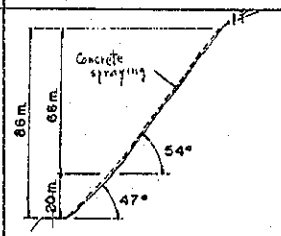
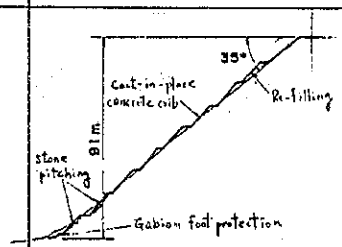
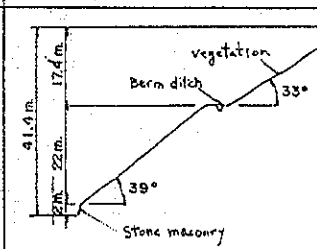
* Countermeasures shown in remarks are to be considered as countermeasures in long term.

CONDITION OF DISASTER AND SELECTED COUNTERMEASURES — DALTON PASS SECTION (13)

No.	Disaster Spot No.	Km Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks *
49	III-72	204+800 C-S.F	 W = 70 m.	• Highly to totally weathered DIABASE rocks in some parts of the slope. (Nearly soil)	• A little concentration of slope surface water exists.	• Steep slope • Totally weathered rocks are considered as soils.	• Re-cutting • Vegetation • Berm ditch	• Re-cutting • Concrete spraying (t=10cm) • Berm ditch
50	III-73	205+000 C-S.F	 W = 50 m.	• Highly and totally weathered ANDESITE rocks exist in some parts of the slope	• A little concentration of slope surface water.	• Slope gradient is gentle. • Very weak rocks covered the slope. (nearly soil)	• Re-cutting • Vegetation • Berm ditch	• Re-cutting • Concrete spraying (t=10cm) • Berm ditch
51	III-75	205+900 C-D.F	 W = 90 m.	• Highly weathered DIABASE • Highly jointed and developed cracks	• A little influence due to surface water	• Slope gradient is optimum • Progress of weathering is anticipated.	• Concrete spraying (t = 10 cm)	• Concrete spraying (t = 15 cm)
52	III-76	206+000 C-D.F	 W = 160 m.	• Highly to totally weathered DIABASE	• Water from hinterland flows on the slope.	• Berms exist on the slope but no ditches on the berm. • Cut slope gradient is optimum • No slope protection	• Vegetation • Berm ditch • Stone masonry	• Concrete spraying (t = 10cm) • Berm ditch • Stone masonry

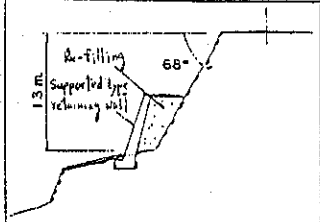
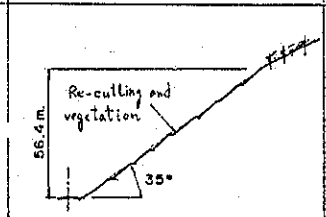
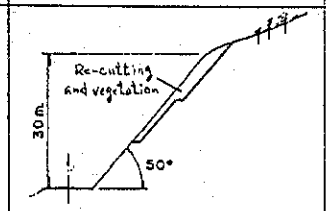
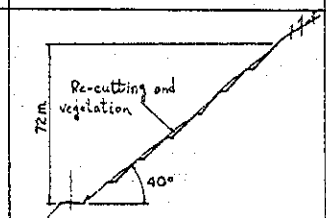
* Countermeasures shown in Remarks are to be considered as countermeasures in long term.

CONDITION OF DISASTER AND SELECTED COUNTERMEASURES — DALTON PASS SECTION (14)

No.	Disaster Spot No.	Km Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks *
53	III-77	206+250 C-D.F		• Moderately to highly weathered DIABASE with highly developed cracks.	• A little concentration of slope surface water exists.	• Slope gradient is a little bit steeper than the optimum. • Progress of weathering is anticipated. • Height of slope is very high.	• Removal • Concrete spraying (t = 15 cm)	• Removal • Cast in place concrete crib
54	III-78	206+350 C-S.F		• Moderately to highly weathered DIABASE with highly developed cracks.	• A little concentration of slope surface water exists.	• Same notes as spot No. III-77	• Removal • Concrete spraying (t=15cm)	• Removal • Cast-in-place concrete crib
55	III-79	206+600 E-D.F		• Embankment materials and highly weathered DIABASE	• Much concentration of road surface water causes the road surface water to saturate into the ground.	• Poor drainage facilities on the roadway. • The slope is very high and a little bit steeper than the optimum slope.	• Re-filling • Cast-in-place concrete crib with grass • Stone pitching • Gabion foot protection • Berm ditch and vertical ditch	• Same countermeasures shown in left column
56	III-80	206+600 C-S.F		• Highly weathered DIABASE • Highly developed cracks and fractured in some parts of the slope	• Water from hinterland flows on the slope and a little concentration of water occurs.	• Berms exist on the slope but no ditches on the berm. • No trees and grasses on the slope. • Slope gradient is optimum and stable.	• Vegetation • Berm ditch and vertical ditch • Stone masonry	• Concrete Spraying • Berm ditch and vertical ditch • Stone masonry

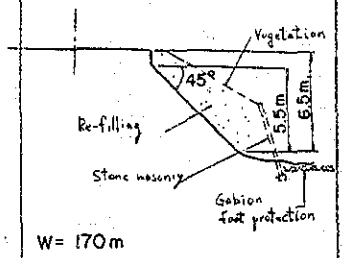
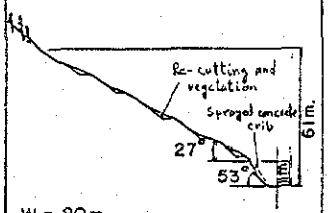
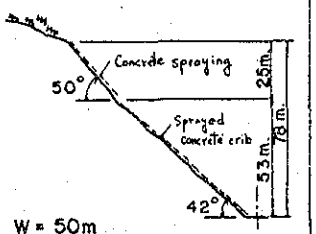
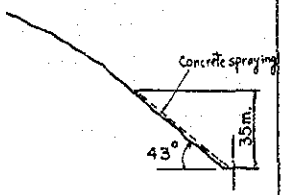
* Countermeasures shown in Remarks are to be considered as countermeasures in long term

CONDITION OF DISASTER AND SELECTED COUNTERMEASURES — DALTON PASS SECTION (15)

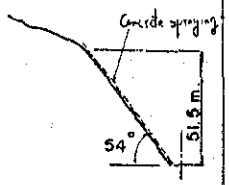
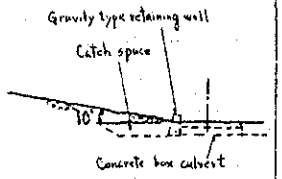
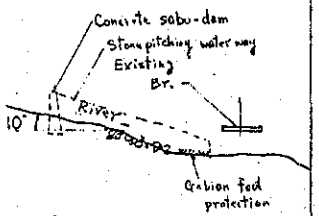
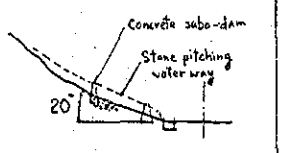
No.	Disaster Spot No.	Km Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks *
57	III-81	206+800 E-D.F	 W = 18m. + 20m. + 45m.	•Embankment materials	•Concentrated road surface water saturates into the ground.	•Poor drainage facilities on the roadway and on the slope. •Slope is very steep.	•Re-filling •Supported type Retaining wall •Vertical ditch •Stone pitching	•Same countermeasures shown in left column
58	III-82	207+150 C-S.F	 W = 96 m.	•Highly and totally weathered DIABASE in some parts of the slope. (Nearly soil)	•Concentration of the slope surface water exists.	•Slope has a very long length but gradient is not so steep. •Some unstable materials exist on the slope.	•Re-cutting •Vegetation •Berm ditch and Vertical ditch	•Re-cutting •Concrete spraying (t=10cm) •Berm ditch and Vertical ditch
59	III-83	207+300 C-S.F	 W = 65 m.	•Highly and totally weathered DIABASE in some parts of the slope (Nearly soil)	•A little concentration of slope surface water exists.	•Slope gradient is steeper than the optimum. •Vegetation should be applied	•Re-cutting. •Vegetation •Berm ditch	•Re-cutting •Concrete spraying (t=10cm) •Berm ditch
60	III-84	207+550 C-S.F	 W = 120 m.	•Highly and totally weathered DIABASE in some parts of the slope. (Nearly soil)	•Concentration of slope surface water exists.	•Slope gradient is just optimum, but some unstable materials exist on the slope.	•Re-cutting •Vegetation •Berm ditch and vertical ditch	•The proposed Dalton Pass Tunnel Project ends up to this spot. •Re-cutting •Concrete Spraying (t=10cm) •Berm ditch and vertical ditch.

* Countermeasures shown in Remarks are to be considered as countermeasures in long term

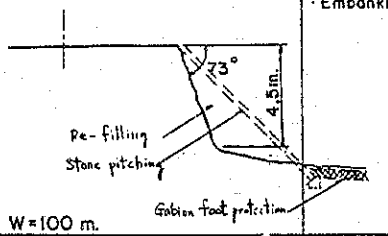
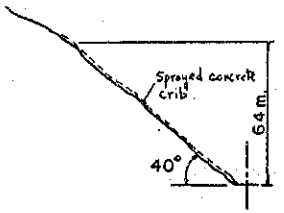
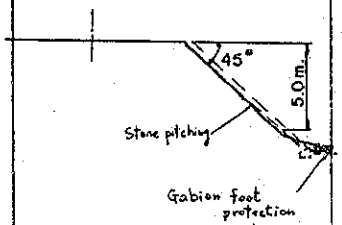
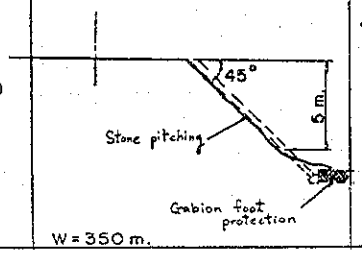
CONDITION OF DISASTER AND SELECTED COUNTERMEASURES — DALTON PASS SECTION (16)

No.	Disaster Spot No.	Km Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks
61	II-4	216+900 E-D.F	 W= 170m	· Embankment material	· Scouring is caused by high velocity of river current. · Concentration of road surface water exist.	· Embankment slope is not so high. · No protection facilities for scouring caused by the river current.	· Re-filling · Stone pitching · Vegetation · Gabion foot protection	
62	II-5	217+350 C-D.F	 W = 80m	· Highly to totally weathered DIABASE rocks with highly developed cracks and fractures.	· Water from hinterland flows on the slope and a concentration of slope surface water occurs.	· Slope is not steep but rocks are very weak. · Progress of weathering is anticipated. · Erosion by slope surface water is anticipated.	· Re-cutting Sprayed concrete crib with grass. · Vegetation · Top slope ditch and berm ditch.	
63	II-7	219+500 C-S.F	 W = 50m	· Highly to totally weathered DIABASE. · Highly fractured rock.	· Concentration of slope surface water exists.	· Slope is very high. Re-cutting work cannot be applied. · Slope gradient is a little bit steeper than the optimum.	· Removal · Sprayed concrete crib with grass. · Concrete spraying (t=15cm.) · Top slope ditch.	
64	II-8	219+600 C-S.F	 W = 30m	· Moderately to highly weathered DIABASE rocks with highly developed cracks.	· A little concentration of slope surface water.	· Unstable and detached rocks. · Slope gradient is not so steep.	· Removal · Concrete spraying (t = 15cm)	

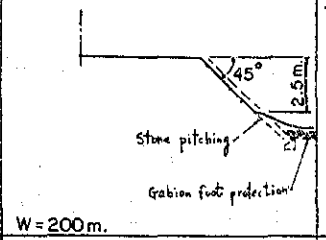
CONDITION OF DISASTER AND SELECTED COUNTERMEASURES — DALTON PASS SECTION (17)

No.	Disaster Spot No.	Km Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks
65	II-9	220+100 C-S.F	 W = 90 m.	· Highly weathered DIABASE rock with highly developed cracks.	· A little concentration of slope surface water exists.	· Much progress of weathering is due to slope surface water. · Slope is stable.	· Concrete spraying (t = 15cm.)	
66	II-11(a)	221+250 D.F	 W = 120 m.	· River deposite (Debris)	· During heavy rain, a big concentration of water from hinterland is anticipated.	· Very big amount of debris flow. · Only temporary counter measures are proposed. · Road disaster will be avoided only one time. Maintenance work and small restoration work will be required.	· Gravity type retaining wall. · Concrete box culvent. · Catch space. (Excavation)	· Generally speaking, Sabo Project will be required at this site.
67	II-11(b)	222+050 D.F	 W = 50 m.	· River deposite (Debris)	· Scouring of river bed is anticipated. · Current velocity of the river is very high during rainy season.	· Debris exist on the creek. · Scouring is caused by the river current.	· Concrete Sabo-Dam. · Waterway · Gabion foot protection.	
68	II-13	223+150 D.F	 W = 10 m.	: Slightly weathered DIABASE.	· Water from hinterland flows at a hollow on the slope.	· Some debris exist on the hollow. · Slope gradient is stable and the slope is covered by trees and grasses.	· Waterway · Concrete Sabo-Dam.	

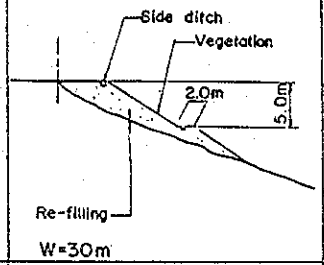
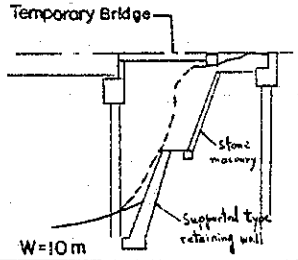
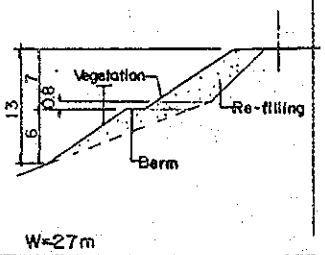
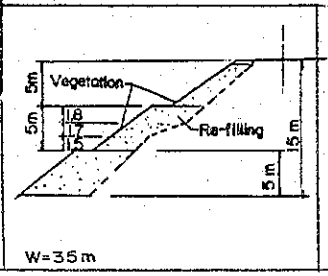
CONDITION OF DISASTER AND SELECTED COUNTERMEASURES — DALTON PASS SECTION (18)

No.	Disaster Spot No.	Km Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks
69	II-14	223+500 E-D.F		· Embankment material.	· Current velocity of the river is very high. · Road surface water concentration exist.	· Scouring caused by the river current made the slope very steep. · Road surface water also saturates into the ground.	· Re-filling. · Stone pitching. · Gabion retaining wall.	
70	II-15	223+600 C-D.F		· Highly to totally weathered DIORITE. · Fractured. · Very weak soft rock.	· Water from hinterland flows on the slope and concentrates at two hollows on the slope.	· Progress of weathering is due to surface water. · Rock is very weak and slope gradient is a little steeper than the optimum. · Slope is very high. Re-cutting work can not be applied.	· Removal. · Sprayed concrete crib with concrete wall. · Top slope ditch. · Vertical ditch.	
71	II-18(a)	224+400 E-D.F		· Embankment material.	· Current velocity of the river is very high.	· Road disaster occured due to scouring by the river. · River revetment is required.	· Re-filling. · Stone pitching. · Gabion foot protection.	
72	II-18(b)	225+000 E-D.F		· Embankment material.	· Current velocity of the river is very high.	· Road disaster occured due to the scouring by the river. · River revetment is required.	· Re-filling. · Stone pitching . · Gabion foot protection .	

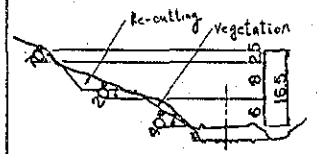
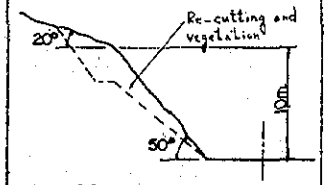
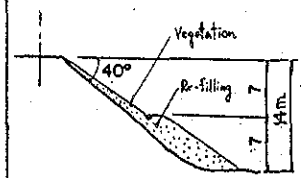
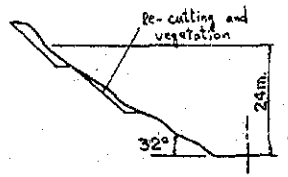
CONDITION OF DISASTER AND SELECTED COUNTERMEASURES — DALTON PASS SECTION (19)

No.	Disaster Spot No.	Km Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks
73	II-19	225+700 E-D.F	 W=200m.	· Embankment material.	· High velocity of river current. · Scouring by the river is anticipated.	· Existing grouted riprap is almost destroyed. · Scouring caused by the river current needs protection.	· Stone pitching. · Gabion foot protection.	

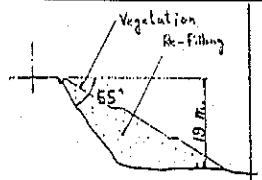
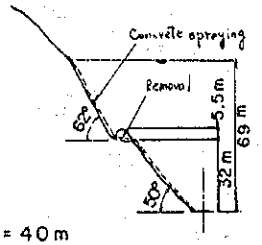
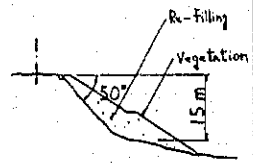
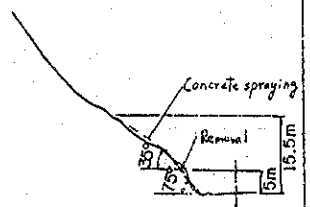
APPENDIX 10.3-2 CONDITION OF DISASTER AND SELECTED COUNTERMEASURES MAHAPLAG - SOGOD SECTION (I)

No.	Disaster Spot No.	Km Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks
1	VIII-6(a)	990+500 E-D.F		· Embankment material	· Concentration of road surface water	· Inadequate embankment · Poor drainage facilities exist on the roadway.	· Re-filling · Vegetation · Side ditch	A half lane of the existing concrete pavement was destroyed.
2	VIII-66	1000+730 E-D.F		· Sand and gravel · Filling material	· Bridge abutment was scoured by the river.	· 1st approach abutment encroached to the river	· Extension of bridge length · Revetment	Existing grouted riprap was destroyed. 
3	VIII-67	1002+350 E-D.F		· Embankment material	· Concentration of road surface water	· Inadequate embankment · Poor drainage facities exist on the roadway.	Re-filling Vegetation Side ditch	
4	VIII-68	1003+060 E-DF		· Embankment material	· Concentration of road surface water · Embankment material is saturated by road surface water.	· Poor drainage facilities exist on the roadway.	· Re-filling · Vegetation · Side ditch	

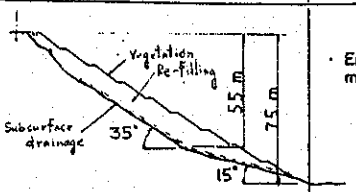
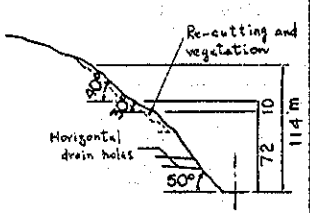
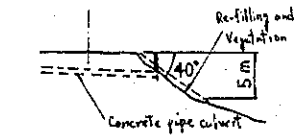
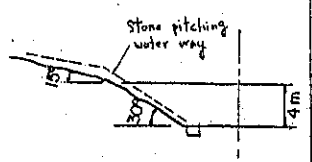
CONDITION OF DISASTER AND SELECTED COUNTERMEASURES — MAHAPLAG – SOGOD SECTION (2)

No.	Disaster Spot No.	Km Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks
5	VIII-71	1004+950 L.S	 W=120m'	· Highly weathered Sedimentary Rock (= Nearly Soil)	· Spring in the slope	· High groundwater level · Poor drainage facilities exist on the roadway · Not high nor steep slope	· Re-cutting · Horizontal drain holes · Vegetation · Gabion Retaining wall	
6	VIII-73	1006+580 C-S.F	 W= 60m	· Totally weathered · TUFF · Almost soil	· Concentration of surface water on the slope	· Slope gradient is not optimum (steeper) and slope is not high · Surface water concentration	· Re-cutting · Vegetation · Top slope ditch · Berm and vertical ditch	
7	VIII-74	1009+020 E-D.F	 W=20m	· Embankment material	· Concentration of road surface water	· Poor drainage facilities exist on the roadway.	· Re-filling · Vegetation · Vertical ditch · Side ditch	
8	VIII-75	1009+050 C-S.F	 W=35m	· Highly weathered TUFF Totally weathered in parts of slope	· Concentration of slope surface water · Water concentrated from hinterland	· No protection on the slope · Slope gradient is little bit steeper. · Surface water concentration	· Re-cutting · Vegetation · Vertical drain	

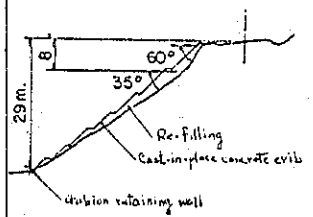
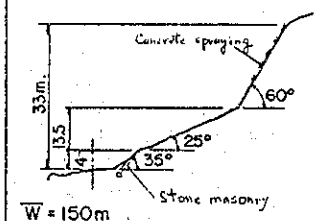
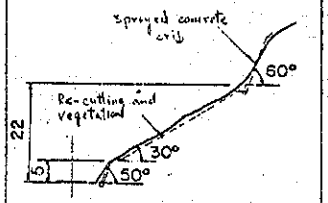
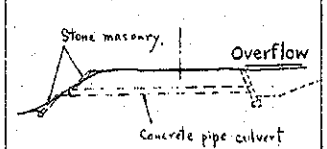
CONDITION OF DISASTER AND SELECTED COUNTERMEASURES — MAHAPLAG – SOGOD SECTION (3)

No.	Disaster Spot No.	Km / Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks
9	VIII-76	1009+680 E-D.F	 $\overline{W}$ = 15m	· Embankment material	· Concentration of road surface water	· Poor drainage facilities exist on the roadway. · Steep embankment slope	· Re-filling · Vegetation · Side ditch · Vertical ditch	
10	VIII-77	1009+700 C-S.F	 $\overline{W}$ = 40m	· TUFF · Slightly weathered and soft rock · High developed cracks	· Scoured by slope surface water	· No existing slope protection · Slope is steep and high	· Removal · Concrete spraying (t = 15 cm)	
11	VIII-78	1009+720 E-D.F	 $\overline{W}$ = 10 m	· Embankment material	· Concentration of road surface water	· Poor drainage facilities exist on the roadway. · Steep embankment slope	· Re-filling · Vegetation · Side ditch · Vertical ditch	
12	VIII-79	1010+200 C-S.F	 $\overline{W}$ = 65m	· Slightly weathered · TUFF · Soft rock · High developed cracks	· Scoured by slope surface water	· No existing slope protection · Slope is steep and high.	· Removal · Concrete spraying (t=15cm)	

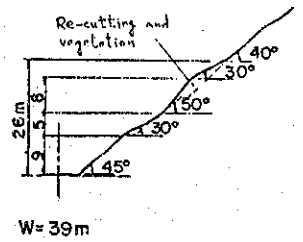
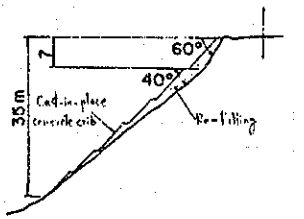
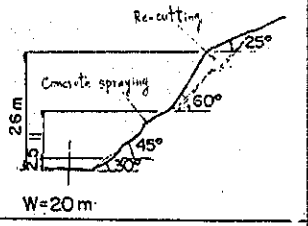
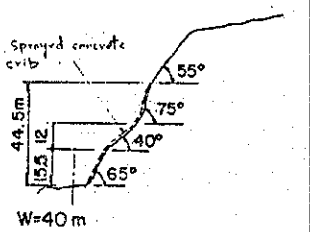
CONDITION OF DISASTER AND SELECTED COUNTERMEASURES — MAHAPLAG – SOGOD SECTION (4)

No.	Disaster Spot No.	Km Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks
13	VIII-80	1010+650 E-D.F	 $\overline{W}$ = 60m + 30m	· Embankment material	· Concentration of surface water	· No existing drainage facilities · Scoured by the slope surface water and road surface water · Slope is very high but not so steep	· Re-filling · Vegetation · Subsurface drainage · Side ditch	Opposite side of Spot No. VIII-81
14	VIII-81	1010+700 C-D.F	 $\overline{W}$ = 270m	· Tuffaceous SAND-STONE · Highly weathered · Totally weathered in some parts of the slope (almost sand and gravel)	· Concentration of slope surface water · Concentration of water from hinterland · Abundant seepage of water	· No existing slope protection · Progress of weathering is anticipated · Very long slope length	· Re-cutting · Vegetation · Berm and vertical ditch · Horizontal drain holes	The biggest slope failure in Mahaplag-Sogod Section.
15	VIII-83(b)	1012+040 E-D.F	 $\overline{W}$ = 7.0 m	· Embankment material	· Concentration of road surface water	· Poor drainage facilities exist on the roadway · Not so steep and high embankment	· Pipe culvert · Re-filling · Vegetation · Vertical drain	Outlet of pipe culvert, headwall and apron was washed out.
16	VIII-83(c)	1012+520 D.F	 $\overline{W}$ = 7.0 m	· Totally weathered · TUFF · Nearly soil	· Concentration of slope surface water	· No existing drainage facilities on the slope	· Waterway · Catch Basin	

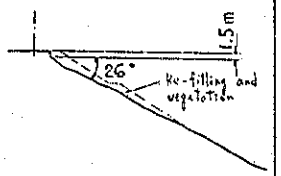
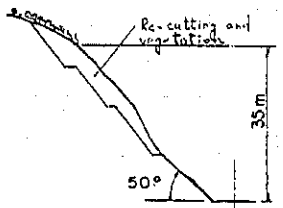
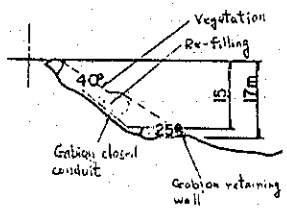
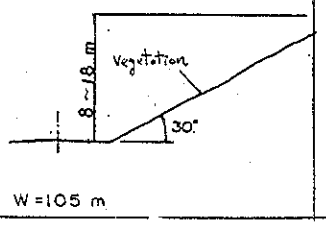
CONDITION OF DISASTER AND SELECTED COUNTERMEASURES — MAHAPLAG – SOGOD SECTION (5)

No.	Disaster Spot No.	Km Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks
17	VIII-85	1013+950 E-D.F	 W=49m	· Embankmenk material	· Concentration of road surface water	· Poor drainage facilities exist on the roadway. · No slope protection, high and steep slope	· Re-filling · Cast-in-place concrete crib with grass · Gabion retaining wall · Vertical ditch · Side ditch	
18	VIII-86	1013+980 C-S.F	 W=150m	· Highly weathered SANDSTONE · Totally weathered in some parts of the slope · High developed cracks	· Slope-surface water flows on the slope · Surface water from hinterland drops on the slope	· No existing slope protection · Scoured by slope surface water	· Re-cutting · Concrete spraying (thickness 15 cm) · Vertical drain · Stone masonry	
19	VIII-87(a)	1014+500 C-D.F	 W=20m	· Highly weathered ANDESITE · High developed cracks	· Concentration of slope surface water · A little seepage of water	· No existing slope protection · Weaker than the rock of VIII-86 · Surface water concentration · Scoured by surface water	· Re-cutting · Sprayed concrete crib with grass · Vegetation · Vertical drain · Stone masonry	
20	VIII-87(b)	1015+100 O:F	 W=100m	Embankment material	· Small creek crosses the roadway and water overflows on it.	· No structure crossing the roadway	· Pipe culvert · Stone masonry	

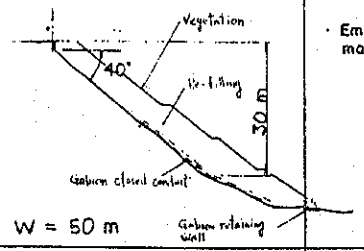
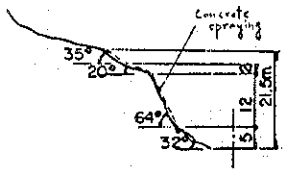
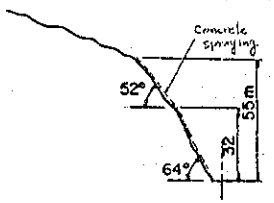
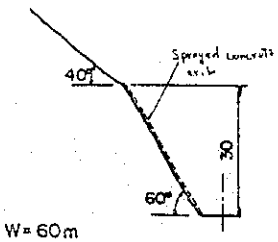
CONDITION OF DISASTER AND SELECTED COUNTERMEASURES — MAHAPLAG - SOGOD SECTION (6)

No.	Disaster Spot No.	Km Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks
21	VII-88	1015 + 150 C-D.F		· Totally weathered TUFF · Nearly soil · Loose soil	· Surface water from hinterland drops on the slope. · Scoured by concentration of slope surface water	· Progress weathering is fast. · Slope gradient is not so steep. · Vegetation should be applied. · Concentration of surface water	· Re-cutting · Vegetation · Vertical drain	
22	VIII-89	1015 + 560 E-D.F		· Embankment materials	· Concentration of road surface water · Existing culvert crosses the roadway.	· Poor drainage facilities exist on the roadway. · Slope is very high and not so steep. · No slope protection nor aprons of pipe culverts A little seepage of water occurs.	· Re-filling · Cast-in-place concrete crib with grass · Vertical ditch · Gabion closed conduit · Stone pitching · Gabion Retaining Wall	
23	VIII-90(a)	1015 + 510 C-S.F		· Highly weathered SANDSTONE · Highly developed cracks	· Concentration of slope surface water	· More stable than the rock of Spot No.VIII-90(b) · No drainage facilities exist on the slope.	· Re-cutting · Concrete spraying (thickness 10 cm) · Vertical drain	
24	VIII-90(b)	1015 + 560 C-S.F		· Highly weathered SANDSTONE · In some parts of the slope, hard SANSTONE exists. · Highly developed cracks	· Water from hinterland drops on the slope.	· Very weak rocks · Slope is steep and very high. · The berms exist on the slope, but there is no berm ditch. · Re-cutting can not be applied.	· Removal · Sprayed concrete crib with concrete wall · Rock Bolt · Anchor wire net	There are 2 kinds of Rock-hardness on the slope

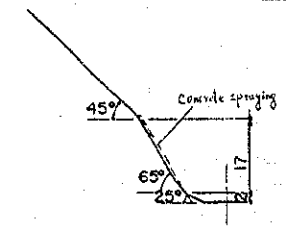
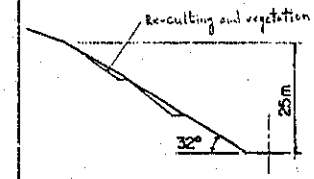
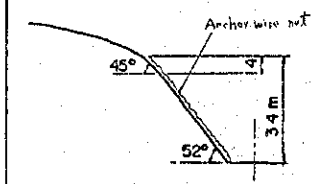
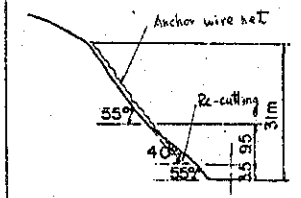
CONDITION OF DISASTER AND SELECTED COUNTERMEASURES — MAHAPLAG - SOGOD SECTION (7)

No.	Disaster Spot No.	Km Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks
25	VIII-91	1016 + 600 E-D.F	 W=15m	· Embankment materials	· Concentration of road surface water · Embankment material is saturated by the road surface water.	· Poor drainage facilities exist on the roadway. · Slope gradient is gentle.	· Re-filling · Vegetation · Side ditch · Gabion Retaining Wall	
26	VIII-92	1016 + 750 C-S.F	 W= 60 m	· VOLCANICLASTICS · Totally weathered (Nearly Soil) · Very loose	· Seepage of water occurs · Slope surface water flows on the slope	· No slope protection · No drainage facilities exist on the slope	· Re-cutting · Vegetation · Berm and vertical ditch	
27	VIII-93	1016 + 850 E-D.F	 $\overline{W}$ = 44.5m	· Embankment material	· Concentration of road surface water · Embankment material is saturated by the road surface water.	· Poor drainage facilities · Slope gradient is gentle. · A little seepage of water on the slope occurs.	· Re-filling · Vegetation · Gabion closed conduit · Vertical ditch · Side ditch · Gabion Retaining Wall	· Half lane of the concrete pavement was destroyed.
28	VIII-94	1017 + 400 C-D.F	 W = 105 m	· VOLCANICLASTICS · Totally weathered (Nearly Soil)	· Slope surface water flows on the slope. · A little seepage of water occurs.	· No protection on the slope · Slope gradient is very gentle.	· Removal · Vegetation · Top slope ditch	

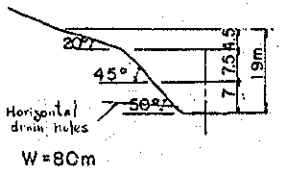
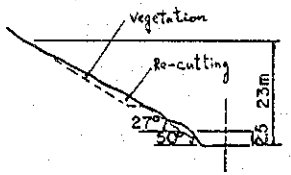
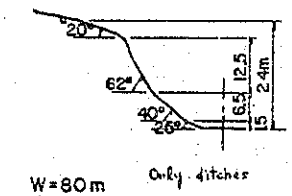
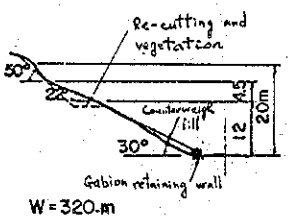
CONDITION OF DISASTER AND SELECTED COUNTERMEASURES — MAHAPLAG – SOGOD SECTION (8)

No.	Disaster Spot No.	Km Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks
29	VIII-96	1018+280 E-D.F		· Embankment materials	· Concentration of road surface water · Embankment material is saturated by the road surface water.	· Poor drainage facilities exist on the roadway. · A little seepage of water on the slope	· Re-filling · Vegetation · Gabion closed conduit · Vertical ditch · Side ditch · Gabion Retaining Wall.	· Concrete pavement was destroyed.
30	VIII-97	1018+800 C-S.F		· Highly weathered ANDESITE (Soft rock) · Highly jointed and developed cracks	· Slope surface water flows on the slope.	· No protection on the slope and the slope gradient is not optimum. · Progress of weathering is anticipated.	· Re-cutting · Concrete spraying (t = 10cm)	
31	VIII-99	1019+380		· ANDESITE · Slightly weathered · Developed cracks	· Slope surface water flows on the slope.	· No protection on the slope · Some detached soils exist on the slope. · Slope gradient is steep.	· Removal · Re-cutting · Concrete spraying (t = 15cm) · Vertical ditch · Top slope ditch	
32	VIII-100	1019+690 C-D.F		· ANDESITE · Highly weathered and developed cracks	· Concentration of slope surface water. · A little seepage of water occurs.	· Deep scouring due to concentration of slope surface water · Debris exist on the slope.	· Removal · Water way · Gravity type retaining wall · Concrete spraying (t = 10cm) · Vegetation	

CONDITION OF DISASTER AND SELECTED COUNTERMEASURES — MAHAPLAG – SOGOD SECTION (9)

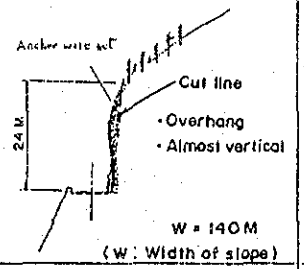
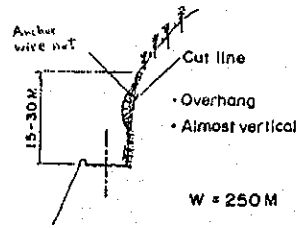
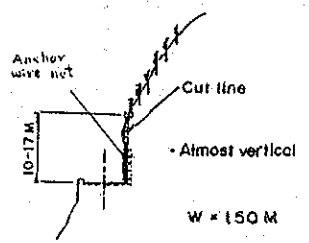
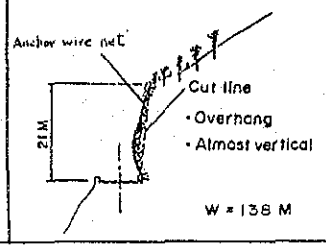
No.	Disaster Spot No.	Km / Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks
33	VIII-101	1019+890 C-S.F	 W=70 m	· Slightly weathered ANDESITE · Highly developed cracks	· Less concentration of slope surface water	· No slope protection was implemented. · Progress of weathering is anticipated.	· Removal · Concrete spraying (t =10 cm)	
34	VIII-102	1020+000 C-S.F	 W = 23 m	· Highly weathered ANDESITE · Totally weathered in some parts of the slope (Nearly soil)	· Concentration of slope surface water	· No slope protection was implemented · Scoured by concentration of slope surface water · Nearly soil	· Re-cutting · Vegetation · Vertical ditch	
35	VIII-103	1020+670 C-F	 W=20m	· Highly weathered ANDESITE · Hard Rock · Developed cracks	· Less damages due to slope surface water	· Progress of weathering is minimal. · Detached rocks exist on the slope.	· Removal · Anchor wire net	
36	VIII-104	1020+800 C-F	 W=90m	· Highly weathered ANDESITE · Hard Rock · Developed cracks	· Less damages due to slope water surface	· Soft rock and soils exist in some parts of the slope. · Progress of weathering is minimal. · Slope gradient is steeper than optimum gradient.	· Removal · Re-cutting · Anchor wire net	

CONDITION OF DISASTER AND SELECTED COUNTERMEASURES — MAHAPLAG – SOGOD SECTION (10)

No.	Disaster Spot No.	Km / Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks
37	VIII-105	1021+050 L.S		· Moderately weathered SEDIMENTARY ROCK	· High underground level · A little seepage of water occurs.	· The slope is covered by grasses and trees. · The slope gradient is not steep and the slope is unstable in dry season.	· Horizontal drain holes	
38	VIII-106	1022+260 C-S.F		· Slightly weathered TUFF · Bedding planes inclined towards slope surface	· Slope surface water flows on the slope and saturate to the ground.	· Translational slide is anticipated. · Structural weakness of slope such as bedding plane between firm bedrocks and overlaying detritus.	· Re cutting · Vegetation · Top slope ditch	
39	VIII-107	1022+550 C-S.F		· Moderately weathered TUFF · Developed cracks	· Water from hinterland runs at two hollows of the slope.	· The slope is covered by grasses and trees. · Concentration of slope surface water	· Vertical ditch · Top slope ditch	
40	VIII-108	1023+220 L.S		· Highly weathered SEDIMENTARY ROCK (Nearly Soil)	· Slope surface water saturates to the ground. · Ground water level is not so high.	· Slope gradient is not steep and height of slope is low. · Width of shoulder is more than 3.0meters.	· Re-cutting · Counter fill · Gabion Retaining Wall · Berm and vertical ditch · Vegetation	

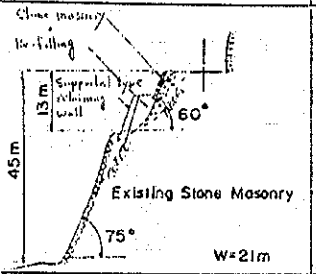
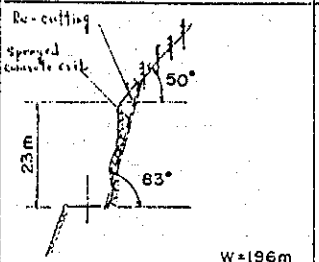
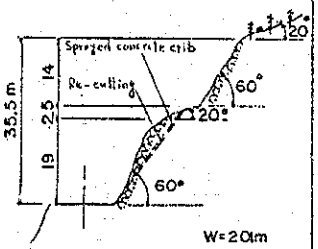
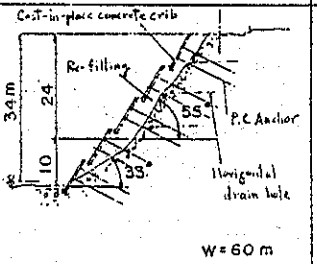
APPENDIX 10.3-3 CONDITION OF DISASTER AND SELECTED COUNTERMEASURES

KENNON ROAD (1)

No.	Disaster Spot No.	Km Type of Disaster	Existing Slope Condition			Factor for selection of countermeasure	Countermeasure	Remarks
			Dimension of slope	Geological Condition	Water Condition			
1	1K-3	216+000 C-F		·Conglomerate ·Hard and fresh rock with sparse cracks.	·Less concentration of slope surface water. ·A little seepage of water.	·Overhang formed ·Water from hinterland concentrated at one place and falls to road surface. ·Progress of weathering is minimal.	·Re-cutting ·Anchor wire net ·Vertical ditch	·Road widening towards river side is difficult due to deep valley.
2	1K-4	219+300 C-F		·Conglomerate ·Hard and fresh rock with sparse cracks.	·A little seepage of water. ·Water from hinterland runs at two hollows of the slope.	·Overhang formed ·Rock is stable though with slight cracks. ·Water from hinterland concentrated at two places and fall to road surface.	·Re-cutting ·Anchor wire net ·Vertical ditch	-do-
3	1K-6	223+200 C-F		·Conglomerate ·Fresh rock with regular cracks.	·No water seepage nor concentration of slope surface water.	·Overhang formed ·More stable than rock of 1K-4.	·Re-cutting ·Anchor wire net	-do-
4	1K-7(a)	224+850 C-F		·Conglomerate ·Slightly weathered rock with regular cracks.	·No concentration of slope surface water.	·Overhang formed ·Some joints exist. Less weak than rock of 1K-3,4 and 6.	·Re-cutting ·Anchor wire net	-do-

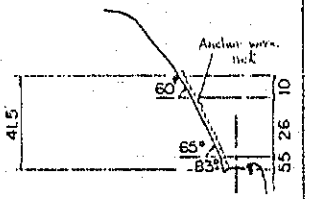
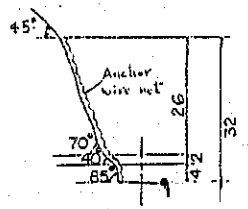
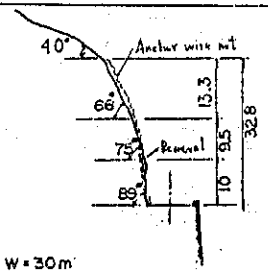
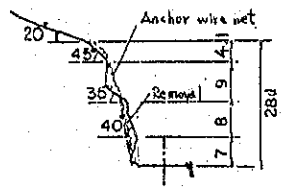
CONDITION OF DISASTER AND SELECTED COUNTERMEASURE

KENNON ROAD (2)

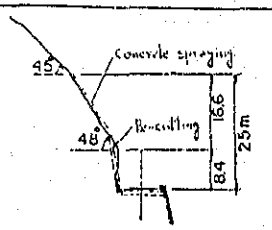
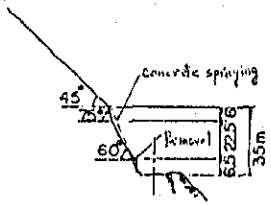
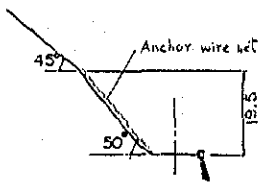
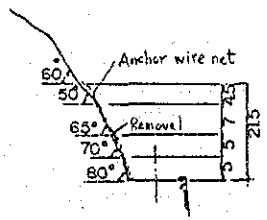
No.	Disaster Spot No.	Km Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks
5	IK-7(b)	224+850 E-D.F		・Embankment materials (sand and gravel) ・Hard CONGLOMERATE	・Concentration of road surface water exists. ・Embankment materials were saturated by road surface water.	・Existing grouted riprap was destroyed due to concentration of road surface water. ・Poor drainage facilities ・Slope gradient is steep but there are berms on the slope.	・Supported type retaining wall. ・Stone masonry retaining wall ・Side ditch.	
6	IK-9	226+100 C-F		・LIMESTONE ・Weathered rock with developed cracks.	・Less concentration of slope surface water. ・Slope surface water flows on the slope.	・Two types of disasters are present on the spot. One is the slope failure and the other is rock fall. ・Highly jointed rocks exist in some parts of the slope. ・The right side of the slope is stable.	・Removal ・Re-cutting ・Sprayed concrete crib with grass and with concrete wall	・Catch fence can not be applied due to the heavier weight of the falling rocks.
7	IK-10(a)	226+350 C-F		・LIMESTONE ・Weathered rock with developed cracks.	・A little influence due to the slope surface water.	・Rock fall is in block mass. ・The height of the slope is not so high. ・Two kinds of hardness in rocks exist on the slope.	・Re-cutting ・Sprayed concrete crib with grass and with concrete wall	・Very big slope failure occurs at the opposite side of the river.
β	IK-10(b)	227+250 E-D.F		・Embankment materials (sand and gravel)	・Seepage of water on the slope occurs. ・Road surface water saturates into the embankment materials.	・Subsurface drain is required. ・The slope is high and steep.	・Re-filling of common materials ・Horizontal drain hole ・Cast-in place concrete crib with concrete wall ・P.C. Anchor ・Concrete pavement	

CONDITION OF DISASTER AND SELECTED COUNTERMEASURES

KENNON ROAD (3)

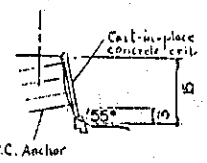
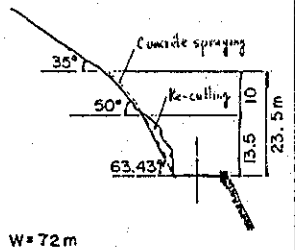
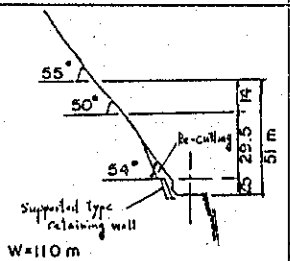
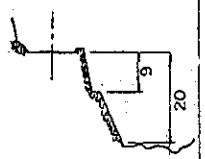
No.	Disaster Spot No.	Km Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks
9	IK-11	229+050 C – F	 W=39m	.Andesite rocks .Fresh rock with regular cracks.	.No water concentration exist on the slope.	.Rock fall .Progress of weathering is minimal.	.Removal .Anchor wire net	.There is a small creek between slope of IK-11 and IK-12.
10	IK-12	229+150 C – F	 W=24m	.Fresh ANDESITE .Regular cracks.	.No water concentration existson the slope	.Rock fall .Progress of weathering is minimal.	.Removal .Anchor wire net	
11	IK-13	229+930 C – F	 W=30m	.Fresh ANDESITE .Regular cracks	.No water concentration exist on the slope.	.No protection facilities for rock fall. .Progress of weathering is minimal.	.Removal .Anchor wire net.	
12	IK-15	230+700 C – F	 W=26.5m	.Fresh DIORITE .Moderately jointed	.No water concentration existsonthe slope.	. No protection facilities for rock fall. . Progress of weathering is minimal.	.Removal .Anchor wire net	

CONDITION OF DISASTER AND SELECTED COUNTERMEASURES — KENNON ROAD (4)

No.	Disaster Spot No.	Km Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks
13	IK-19	234+300 C-F	 W=56m	·Highly weathered ANDESITE rocks ·Slightly to moderately weathered rocks in some parts of the slope.	·Water from hinterland flows at the hollow on the slope.	·No protection facilities on the slope. ·Slope gradient is steeper than the optimum. ·There are two kinds of hardness of rocks on the slope	·Re-cutting ·Concrete spraying (t=15 m) ·Sprayed concrete crib ·Vertical drain	
14	IK-20	234+400 C-F	 W=59 m	·Moderately weathered ANDESITE with developed cracks	·No water concentration existson the slope. ·Surface water flows on the slope.	·No protection on the slope ·Progress of weathering	·Removal ·Concrete spraying (t=10cm)	
15	IK-21	234+700 C-F	 W=43 m.	·Slightly weathered and moderately jointed GRANITE	·Water from hinterland is concentrated at one hollow on the slope.	·No protection facilities for rock fall. ·No progress of weathering is anticipated.	·Removal ·Anchor wire net ·Vertical drain and pipe culvert.	
16	IK-22(U)	234+900 C-F	 W=278m	·Slightly to moderately weathered and slightly jointed DIORITE	·Water from hinterland flows at a hollow on the slope.	·No existing slope protection for rock fall. ·No progress of weathering is anticipated.	·Removal ·Anchor wire net ·Vertical drain	

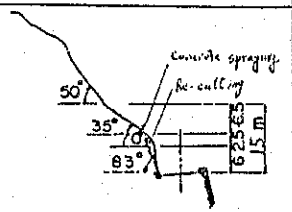
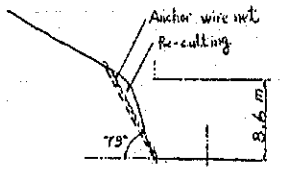
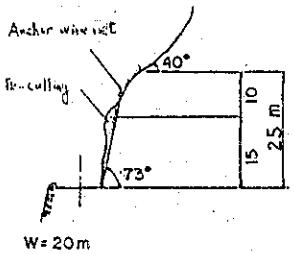
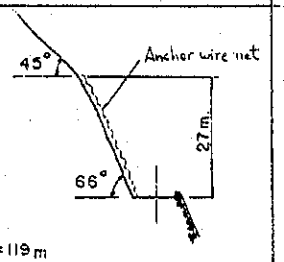
CONDITION OF DISASTER AND SELECTED COUNTERMEASURE

KENNON ROAD (5)

No.	Disaster Spot No.	Km Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks
17	IK-22(b)	234+900 E-D,F	 W=15m	·Embankment materials (Sand and gravel)	·Concentration of road surface water exists.	·Poor drainage facilities ·Embankment materials were saturated by road surface water.	·Re-filling ·Cast-in place concrete crib with concrete wall ·P.C. Anchor ·Side ditch	
18	IK-23	235+050 C-F	 W=72m	·Moderately to highly weathered DIORITE rocks. ·Developed cracks. ·Soft rock.	·No water concentration on the slope.	·Some unstable materials exist on the slope. ·Progress of weathering is anticipated.	·Re-cutting ·Concrete spraying (t=15cm)	
19	IK-24(a)	235+700 C-F	 W=110m	·Highly weathered DIORITE rocks. ·Highly jointed and developed cracks.	·Water from hinterland flows on the slope.	·Slope length is too long. ·Slope is steeper than the optimum gradient. ·Roadway is very narrow. ·Weathered soft rock exist.	·Removal and Re-cutting ·Sprayed concrete crib with grass ·Supported type Retaining wall.	
20	IK-24(b)	235+700 E-D,F	 W=80m	·Fresh DIORITE	·High velocity of river current	·Embankment scouring is anticipated. ·Existing grouted riprap is hanging on the slope. ·Foundation of riprap was washed out.	·Gravity type Retaining wall.	

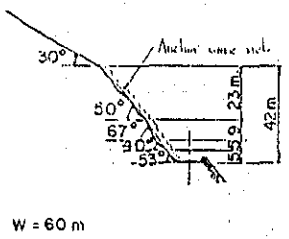
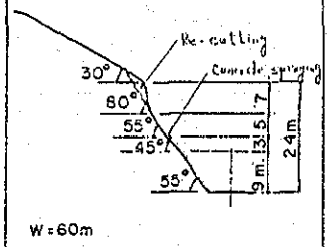
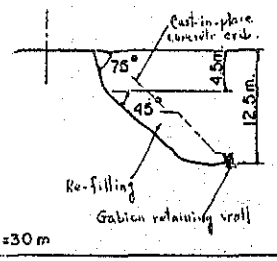
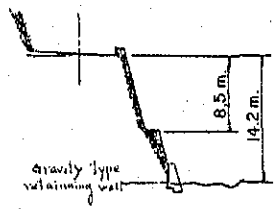
CONDITION OF DISASTER AND SELECTED COUNTERMEASURE

KENNON ROAD (6)

No.	Disaster-Spot No.	Km Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks
21	IK-25	236+100 C-F	 W = 34	• Highly weathered DIORITE with highly developed cracks and joints.	• Water from hinterland flows on the slope.	• No slope protection. • Weathering of rock is on progress due to slope surface water. • Hard rocks exist in some parts of the slope.	• Removal and Re-cutting • Concrete spraying (t = 10 cm) • Anchor wire net.	
22	IK-26	236+500 C-F	 W = 8 m	• Moderately to highly weathered DIORITE with developed cracks.	• No water concentration on the slope.	• Some unstable materials exist on the slope. • Slope gradient is steep but slope is low.	• Re-cutting. • Anchor wire net.	
23	IK-27	236+600 C-F	 W = 20 m	• Slightly to moderately weathered DIORITE with developed cracks.	• No water concentration on the slope.	• No protection for rock fall. • Some detached rocks exist on the slope.	• Re-cutting • Anchor wire net	
24	IK-28	236+700 C-F	 W = 119 m	• Slightly to moderately weathered DIORITE with developed cracks.	• No slope surface water concentration.	• Very high slope • No progress of weathering is anticipated.	• Removal • Anchor wire net	

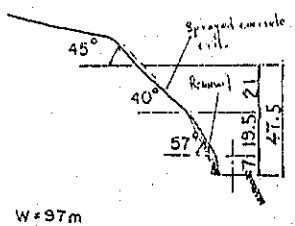
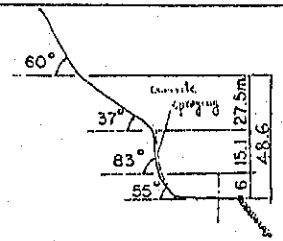
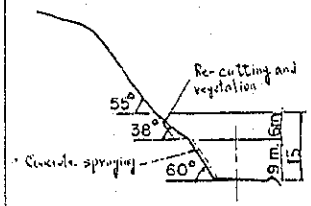
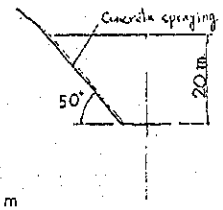
CONDITION OF DISASTER AND SELECTED COUNTERMEASURE

KENNON ROAD (7)

No.	Disaster Spot No.	Km Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks
25	IK-29	236+800 C-F		·Slightly weathered ANDESITE with regular cracks.	·Very little influence exists due to slope surface water.	·Some detached rocks exist. ·No progress of weathering is anticipated.	·Removal ·Anchor wire net	
26	IK-30(a)	236+900 C-F		·Highly weathered ANDESITE with highly jointed and developed cracks.	·Surface water flows on the slope.	·Width of roadway is very narrow. ·Slope gradient is steep but slope not so high. ·There is a little progress of weathering.	·Re-cutting ·Concrete spraying (t=10cm)	·The opposite side of this spot is spot no. IK-30(b).
27	IK-30(b)	236+900 E-D.F		·Embankment materials. (Sand and gravel)	·Concentration of road surface water exists.	·Poor drainage facilities ·Embankment materials were saturated by road surface water. ·Slope gradient is a little bit steep but not so high.	·Re-filling ·Cast-in place concrete crib ·Gabion retaining wall ·Side ditch	
28	IK-32	237+130 E-D.F		·Fresh ANDESITE	·High velocity of river current.	·Embankment scouring is anticipated. ·Existing grouted riprap is hanging. ·Foundation of riprap was washed out	·Gravity type Retaining wall	

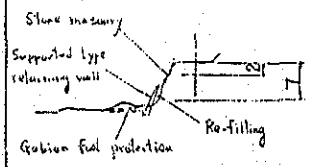
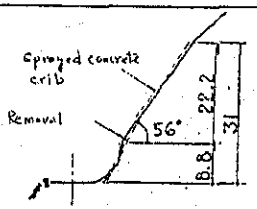
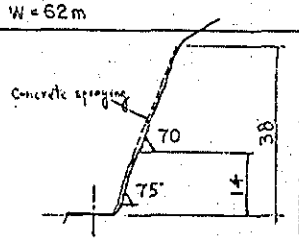
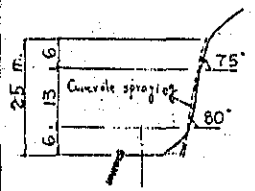
CONDITION OF DISASTER AND SELECTED COUNTERMEASURE

KENNON ROAD (8)

No.	Disaster Spot No.	Km Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks
29	IK-33	237+200 C-S.F	 W=97m	• Moderately to highly weathered ANDESITE rocks with highly developed cracks and joints.	• Surface water from hinterland flows on the slope but with less concentration of the surface water.	• Some unstable materials and detached rocks exist on the slope. • Slope is not steep but very high. • No slope protection on the slope.	• Removal Sprayed concrete crib.	
30	IK-34	237+300 C-F	 W=71m	• Highly weathered DIORITE rocks with highly jointed and developed cracks.	• A little influence exists due to the slope surface water.	• There is a little progress of weathering. • Two different kinds of hardness in rocks are present on the slope.	• Removal • Concrete spraying (t=15cm.) • Anchor wire net.	
31	IK-35	237+400 C-S.F	 W=120 m	• Moderately to highly weathered ANDESITE rocks with developed cracks. • Sand and gravel exist on the upper portion of the slope.	• Less concentration of the slope surface water.	• Slope is not so high nor steep. • There are two kinds of layers on the slope, one is hard rock and the other is soil.	• Re-cutting • Vegetation • Concrete spraying (t=10 cm)	
32	IK-36	237+900 C-S.F	 W=80m	• Moderately to highly weathered DIORITE and ANDESITE rocks with highly developed cracks.	Slope surface water flows on the slope but with less concentration of the surface water.	• Slope gradient is optimum. • No slope protection. • A little unstable materials.	• Removal • Concrete spraying (t=10 cm)	

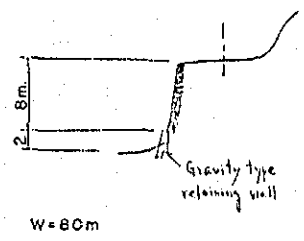
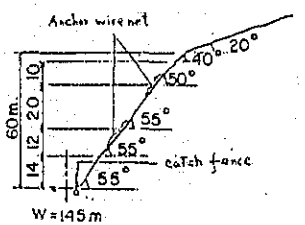
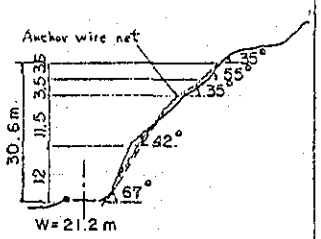
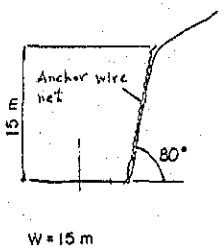
CONDITION OF DISASTER AND SELECTED COUNTERMEASURE

KENNON ROAD (9)

No.	Disaster Spot No.	Km Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks
33	IK-37(a)	238+120 E-D.F	 W = 177 m	• Embankment materials	• Concentration of road surface water exists. • High velocity of the river current.	• Poor drainage facilities in the roadway. • Scouring is caused by the river current.	• Re-filling • Stone masonry • Supported type Retaining wall. • Gabion foot protection • Side ditch	
34	IK-37(b)	238+300 C-S.F	 W = 62 m	• Highly weathered DIORITE rock with highly jointed and developed cracks	• Slope surface water flows on the slope, but less concentration of the surface water.	• Slope gradient is not so steep. • Very weak soft rock. • Some unstable materials are on the slope.	• Removal • Sprayed concrete crib with grass.	
35	IK-38	238+600 C-F	 W = 265 m	• Moderately to highly weathered DIORITE rocks with highly developed cracks.	• A little influence due to slope surface water	• Slope gradient is not so steep. • Two diffirent kinds of weakness in rocks exist on the slope. • Wide shoulder exists in some parts of the road-way.	• Removal • Concrete spraying (t = 10 cm, and t = 15 cm) • Catch Fence	
36	IK-39	239+900 C-F	 W = 90 m	• Moderately to highly weathered ANDESITE rocks with highly developed cracks.	• A little influence due to slope surface water.	• Slope is high but not so steep. • Only some detached rocks exist on the slope. • A little progress of weathering exists.	• Removal • Concrete spraying (t = 10cm.)	

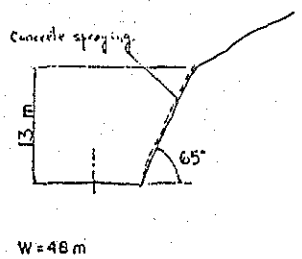
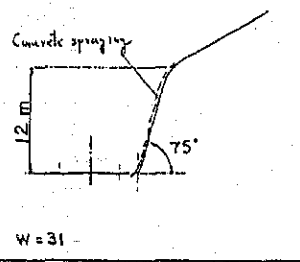
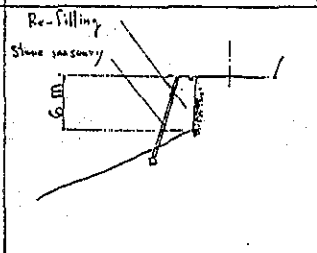
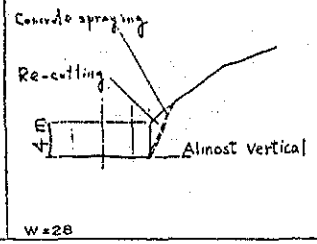
CONDITION OF DISASTER AND SELECTED COUNTERMEASURE

KENNON ROAD (10)

No.	Disaster Spot No.	Km Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks
37	IK-40	240+100 E-D, F		·Fresh ANDESITE	·High velocity of the river current.	·The existing grouted riprops are hanging. ·Foundation of riprap was washed out.	·Gravity type Retaining wall.	
38	IK-41	240+150 C-F		·Highly jointed with developed cracks ANDESITE are slightly weathered.	·Slope surface water flows on the slope.	·Slope gradient is not so steep but almost optimum with very high slope. ·Falling of rocks are expected in some parts of the slope. ·Wide shoulder width.	·Removal ·Anchor wire net (in some parts of the slope) ·Catch Fence	
39	IK-42	240+230 C-F		·Slightly to moderately weathered ANDESITE rocks are highly jointed.	·Very little influence exists due to surface water.	·Not steep nor high slope. ·Some detached rocks are on the slope.	·Removal ·Anchor wire net	
40	IK-43	240+350 C-F		·Slightly to moderately weathered ANDESITE rocks are highly jointed.	·Very little influence due to surface water. ·No water concentration on the slope.	·A little bit steeper slope, but slope is almost stable. ·Some detached rocks are on the slope	·Removal ·Anchor wire net.	

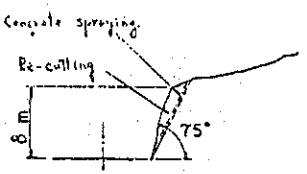
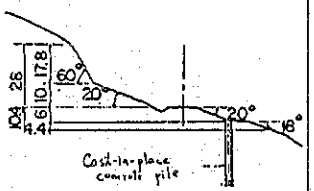
CONDITION OF DISASTER AND SELECTED COUNTERMEASURE

KENNON ROAD (II)

No.	Disaster Spot No.	Km Type of Disaster	Existing Slope Condition			Factor for selection of countermeasure	Countermeasure	Remarks
			Dimension of slope	Geological Condition	Water Condition			
41	IK-44	240+400 C-S.F		• Moderately to highly weathered DIORITE rocks with highly developed cracks.	• A little concentration of slope surface water exists.	• Slope is very steep but not so high. • Weak soft rocks. • There is a little progress of weathering.	• Re-cutting • Concrete spraying (t=10 cm)	
42	IK-45(a)	240+500 C-F		• Moderately to highly weathered DIORITE rocks with highly developed cracks.	• Very little influence of surface water on the spot.	• Slope is very steep. • Almost stable slope, but some detached rocks exist on the slope. • A little progress of weathering is anticipated. • There are two kinds of hardness in rocks on the slope.	• Removal • Concrete spraying (t=10) • Anchor wire net.	
43	IK-45(b)	240+500 E-D.F		• Embankment materials.	• Concentration of road surface water exists. • Embankment materials was saturated by the road surface water.	• Poor drainage facilities • Existing grouted riprap was destroyed due to the concentration of road surface water.	• Re-filling • Stone masonry • Side ditch	
44	IK-46(a)	240+600 C-F		• Moderately to highly weathered DIORITE rocks with highly developed cracks.	• Very little influence exists due to slope surface water.	• Slope is not high but steep. • There is a little progress of weathering.	• Re-cutting. • Concrete spraying. (t=10 cm)	

CONDITION OF DISASTER AND SELECTED COUNTERMEASURES

KENNON ROAD (12)

No.	Disaster Spot No.	Km Type of Disaster	Existing Slope Condition: Dimension of slope	Existing Slope Condition: Geological Condition	Existing Slope Condition: Water Condition	Factor for selection of countermeasure	Countermeasure	Remarks
45	IK-46(b)	240+700 C-F	 W = 35 m	• Moderately to highly weathered DIORITE rocks with highly developed cracks.	• Very little influence existsdue to slope surface water,	• No protection facilities on the slope. • There is a little progress of weathering. • Slope is not so high but so steep.	• Re-cutting • Concrete spraying (t = 10 cm)	
46	IK-48	247+400 L-S	 W = 150 m	• From the ground surface to a depth of 13 meters is clay and sand. (Alternate) • Below the depth of 13 meters is weathered TUFF and TUFF BRECCIA.	• In dry seasons,underground water level is very low.	• Bedding plane exists on the top of TUFF layer and is inclined towards slope surface. • There is a translational landslide type.	• Piling method	• The existing roadway runs on the top portion of the landslide. • Private residence area. • Re-cutting and counter weight fill can not be applied.