REPUBLIC OF THE PHILIPPINES

No. 8

THE FEASIBILITY STUDY ON DALTON PASS TUNNEL PROJECT

Final Report (Appendices)

March, 1982

Japan International Cooperation Agency

Republic of the Philippines

The Feasibility Study on Dalton Pass Tunnel Project

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MASTERLIST OF APPENDICES

APPENDIX A

REPORT ON TRAFFIC SURVEY

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1 Traffic Counting

1.1 Outline of Survey

The traffic counting was carried out as hereunder specified. At the same time and place, Origin-Destination survey was also undertaken.

(1) Date and Site:

1) Laoag City on 10 July 1981

2) Sta. Fe on 17 July 1981

(2) Hour:

24 hours from 6:00 AM to 6:00 AM

(3) Direction:

Both directions

The counting station at Sta. Fe is about 7 kms. away from Dalton Pass. But it is possible to consider the traffic at Sta. Fe as just the traffic at Dalton Pass, as there is no intervening short trip in Sta. Fe.

Bicycles and motorcycles were excluded.

1.2 Result of Survey

The results of the survey are shown in Table 1.1 and 1.2. Since no adequate seasonal factor is available, the traffic in Table 1.1 as it is, should unavoidably be considered as the AADT at Dalton Pass.

As evidence of the accuracy of traffic in Table 1.1, we present the 1980 traffic count at Sta. Fe in Table 1.3 and the 1979 traffic count at Bone South (8 kms. north of Sta. Fe) in Table 1.4.

Table (1.1) and (1.2) are classified by direction as shown in Table (1.5) and (1.6)

Table (1.3)

DALTON PASS TUNNEL PROJECT FEASIBILITY STUDY

TRAFFIC COUNT SUMMARY I

STA. NO. 2.0 LOCATION C. V. R. Sta. Fe, Nuevo Vizcaya 17 July 1981 BOTH DIRECTIONS

HOUR	VEHICLE TYPE							
	CARS	BIG BUS	MINI BUS INCLUDING JEEPNEYS	BIG TRUCK 6 OR MORE TYRES	TRUCK – TRAILER & SEMI – TRAILER	ALL OTHERS		TOTAL
24 – 01	9	4		50	3	1		67
01 – 02	7	4		39	1	1		52
02 – 03	8	3		27	3			41
03 – 04	5	1	1	31	1			39
04 – 05	3	1		24	4			32
05 – 06	7			32	3			42
06 – 07	15	2	1	32	1	8		59
07 – 08	24	4		37	3	7		75
08 – 09	27	5	2	23	5	5		67
09 – 10	26	10	4	28	1			69
10 – 11	41	21	3	27	4	3		99
11 – 12	30	21	1	24	4	4		84
12 – 13	29	25	3	14				71
13 – 14	25	24		24	10	3		86
14 – 15	29	8		11	1			49
15 – 16	33	20	2	33	8			96
16 – 17	25	7		37	7			76
17 – 18	29	9	5	45	9	1		98
18 – 19	17	3	1	39	9			69
19 – 20	24	4		44	3			75
20 – 21	12	7	1	47	1			68
21 – 22	11	6		54	1			72
22 – 23	11	8		47	2	6		74
23 – 24	12	7	1	42	6			68
Σ 24 Hrs.	459	204	25	811	90	39		1628

Table 1.2

DALTON PASS TUNNEL PROJECT FEASIBILITY STUDY

TRAFFIC COUNT SUMMARY I

STA. NO. 10 LOCATION Laoag - Burgos Section (M. N. R. - Ilocos Norte) BOTH DIRECTIONS

HOUR	VEHICLE TYPE							
	CARS	BIG BUS	MINI BUS INCLUDING JEEPNEYS	BIG TRUCK 6 OR MORE TYRES	TRUCK - TRAILER & SEMI - TRAILER	ALL OTHERS		TOTAL
24 - 01	1			2				3
01 - 02				1				1
02 - 03				2		1		3
03 - 04		1		2		2		5
04 - 05				3				3
05 - 06	2	3	3			4		12
06 - 07	4	5	22			49		80
07 - 08	6	7	12	2		53		80
08 - 09	10	5	13	6		41		75
09 - 10	11	2	6	3		37		59
10 - 11	10	6	11	3		39		69
11 - 12	10		4	5		35		54
12 - 13	3	8	5	5		28		49
13 - 14	7	8	4	8		25		52
14 - 15	17	5	4	7		28		61
15 - 16	10	3	7	18		16		54
16 - 17	4	5	8	3		45		65
17 - 18	13		6	3		43		65
18 - 19	7	3	3	5		25		43
19 - 20	7	1	3	5		25		36
20 - 21	5		1	6		9		21
21 - 22	6			1		2		9
22 - 23	2	3	1	2				9
23 - 24	1			2		7		10
Σ 24 Hrs.	136	65	113	91		512		918

Table 1.3

DAILY SUMMARY

MANUAL TRAFFIC CLASSIFICATION COUNT

NTPP/NEDA/MPH TRAFFIC SURVEY

STA. NO. 03 SAN JOSE CITY, km. 160,000 NORTH OF SAN JOSE BOTH DIRECTIONS

DAY	Car Jeep	Pick-Up Van	Jeepney	Small Bus	Big Bus	Truck 2-Axles	Truck 3-Axles	Truck Comb.	Special Vehicles	Tri-Cycle	Motor Cycle	Animal Drawn	SUB-TOTAL	TOTAL
Monday	307	116	138	61	178	382	256	69	15	758	56	3	1507	2339
Tuesday	290	102	157	44	194	387	203	89	17	772	87	5	1466	2347
Wednesday	318	111	173	61	188	407	223	108	13	785	84	5	1589	2476
Thursday	304	170	159	61	193	431	256	78	10	750	116	4	1652	2532
Friday	275	130	179	44	185	434	232	74	13	686	64	6	1553	2322
Saturday	249	168	149	58	178	413	265	81	14	629	74		1561	2278
Sunday	256	154	148	50	174	314	234	55	6	859	92	4	1385	2346
Total	1999	951	1103	379	1290	2768	1669	554	88	5239	573	27	10713	16640
ADT June '81	286	136	158	54	184	395	238	79	13	748	82	4	1530	2377
Seasonal Factor	1.08	1.08	0.99	1.02	1.16	1.02	0.60	0.93	1.00	1.00	1.00	1.00		
AADT 1981	309	147	156	55	213	403	143	73	13	748	82	4	1499	2346

Sub-Total exclude motorcycle, tricycle and special vehicle, animal drawn

Seasonal Factors derived from seasonal Sta. No. 3620, km. 103, Sta. Rosa - Gapan Section, 1979 Traffic Data

Table 8.4
Traffic Survey at Bono South
(North of Sta. Fe)

Sta. 110 KM. 227	1978	1979
Car	323	352
Jeepney	166	160
Bus	171	234
Truck	339	586
Total	999	1332

Source: Internal Paper of Feasibility Study Division of Region IV.

DALTON PASS TUNNEL PROJECT FEASIBILITY STUDY

TRAFFIC COUNT SUMMARY I

Table (7.5)

STA. NO. 20 LOCATION C.V.R. STA. FE NUEVA VIZCAYA

HOUR	DIR. A: From MANILA To ISABELA: CARS	BIG BUS	MINI BUS INC. JEEPNEYS	BIG TRUCK 6 OR MORE TYRES	TRK.-TLR. & SEMI-TLR.	ALL OTHERS	TOTAL	DIR. B: From ISABELA To MANILA: CARS	BIG BUS	MINI BUS INC. JEEPNEYS	BIG TRUCK 6 OR MORE TYRES	TRK.-TLR. & SEMI-TLR.	ALL OTHERS	TOTAL
24 – 01	2	2		25	1		30	7	2		25	2	1	37
01 – 02	3	2		21	1	1	28	4	2		18			24
02 – 03	5	2		21			28	3	1		6	3		13
03 – 04	2	1		16			19	3		1	15	1		20
04 – 05	1	1		13	2		17	2			11	2		15
05 – 06	3			19	3		25	4			13			17
06 – 07	11	2	1	14	1	4	33	4			18		4	26
07 – 08	9	3		16		3	31	15	1		21	3	4	44
08 – 09	19	1	1	13	4	5	43	8	4	1	10	1		24
09 – 10	16	7	3	22	1		49	10	3	1	6			20
10 – 11	19	8		19	3	3	52	22	13	3	8	1		47
11 – 12	18	11		14	4	1	48	12	10	1	10		3	36
12 – 13	16	11	2	10			39	13	14	1	4			32
13 – 14	15	16		15	3	1	50	10	8		9	7	2	36
14 – 15	11	1					12	18	7		11	1		37
15 – 16	18	13	1	21	4		57	15	7	1	12	4		39
16 – 17	7	4		17	2		30	18	3		20	5		46
17 – 18	13	3	2	20	5	1	44	16	6	3	25	4		54
18 – 19	9	2	1	16	1		29	8	1		23	4		40
19 – 20	15	1		24	2		42	9	3		20	1		33
20 – 21	6	6	1	12			25	6	1		35	1		43
21 – 22	11	3		24			38		3		30	1		34
22 – 23	6	3		20	2	2	33	5	5		27		4	41
23 – 24	7	3	1	15	4		30	5	4		27	2		38
Σ 24 Hrs.	242	106	13	407	43	21	832	217	98	12	404	47	18	796
Σ X Hrs.														
Ratio 24/X														

DALTON PASS TUNNEL PROJECT FEASIBILITY STUDY

TRAFFIC COUNT SUMMARY

Table 1.0

STA. NO. 10 LOCATION LAOAG - BURGOS SECTION (H.N.R. ILOCOS NORTE)

DIR. A: From LAOAG To BURGOS

HOUR	CARS	BIG BUS	MINI BUS INC. JEEPNEYS	BIG TRUCK 6 OR MORE TYRES	TRK.-TLR. & SEMI-TLR.	ALL OTHERS	TOTAL
24 – 01	1						1
01 – 02				1			1
02 – 03							
03 – 04		1		1			2
04 – 05				2			2
05 – 06	1	3	3			4	11
06 – 07	2	4	14			27	47
07 – 08	4	4	3	2		23	36
08 – 09	7	3	4	4		17	35
09 – 10	3	1	1	1		22	28
10 – 11	6	4	8	3		22	43
11 – 12	2		2	3		19	26
12 – 13	2	2	2	3		14	23
13 – 14	2	2	1	4		14	23
14 – 15	9		1			14	24
15 – 16	4	2	6	2		9	23
16 – 17	1	1	6	2		25	35
17 – 18	3		4	1		24	32
18 – 19	4	1	3	3		13	24
19 – 20	3	1		2		12	18
20 – 21	2		1	2		6	11
21 – 22	5			1		1	7
22 – 23	2	1	1			1	5
23 – 24						4	4
Σ 24 Hrs.	63	30	60	37		271	461
Σ X Hrs.							
Ratio 24/X							

DIR. B: From BURGOS To LAOAG

HOUR	CARS	BIG BUS	MINI BUS INC. JEEPNEYS	BIG TRUCK 6 OR MORE TYRES	TRK.-TLR. & SEMI-TLR.	ALL OTHERS	TOTAL
24 – 01				2			2
01 – 02							1
02 – 03				2		1	3
03 – 04				1		2	3
04 – 05				1			1
05 – 06	1						1
06 – 07	2	1	8			22	33
07 – 08	2	3	9			30	44
08 – 09	3	2	9	2		24	40
09 – 10	8	1	5	2		15	31
10 – 11	4	2	3			17	26
11 – 12	8		2	2		16	28
12 – 13	1	6	3	2		14	26
13 – 14	5	6	3	4		11	29
14 – 15	8	5	3	7		14	37
15 – 16	6	1	1	16		7	31
16 – 17	3	4	2	1		20	30
17 – 18	10		2	2		19	33
18 – 19	3	2		2		12	19
19 – 20	4		3			11	18
20 – 21	3			4		3	10
21 – 22	1					1	2
22 – 23		2		2			4
23 – 24	1			2		3	6
Σ 24 Hrs.	73	35	53	54		242	457
Σ X Hrs.							
Ratio 24/X							

2 Origin-Destination Survey

2.1 Purpose of O.D Survey

The O.D Survey was carried out with the following purposes:

(1) To grasp the social and economic relationship between Dalton Pass and the Cagayan Valley.

(2) To confirm the distribution of zonal pair traffic between National Road No. 5 and No. 3.

2.2 Method of Survey (see Table 2.1 and 2.2)

(1) Date and Site:

Laoag City on 10 July 1981 and Sta. Fe on 17 July 1981

Survey stations were located in places where there were no intervening short trips available.

(2) Hour:

24 hours from 6:00 AM to 6:00 AM

(3) Directions:

Both directions

(4) Vehicle Classification

Vehicles were classified as follows:

1) Car (including van and wagon)
2) Big Bus (with seat capacity more than 30)
3) Mini Bus (including jeepneys)
4) Big Truck (with more than 6 tyres)
5) Semi-Trailer and Full Trailer
6) All Others (excluding motor-cycles)

(5) Commodity Classification:

Commodities were classified as follows:

1) Cereals and Unprocessed Agricultural grains
2) Forestry Products

3) Mineral Oil Products

4) Cement

5) Building and Construction Materials

6) Soft Drinks, Beer, Wines

7) All Others

(6) Sampling Rate:

Target was 100% and actual was 100% also.

2.3 Zoning

The zoning is shown in Table 2.3 and Figure 2.1 gives the location of each zone center.

2.4 Result of O.D Survey

The result of the O.D Survey is shown in Table 2.4 to Table 2.28 and in Table 2.29.

2.5 Share of Diesel Vehicles

In the Philippines, the share of diesel vehicles is very large. In the O.D Survey undertaken for this study, the diesel vehicle sharing was not included. However, we are presenting Table 2.30 showing the diesel vehicle share obtained from a survey at San Jose in 1980.

TRAFFIC SURVEY PROGRAM

Table (2.1)

TRAFFIC SURVEY STATION	NATURE OF SURVEY	HOUR PER DAY	LOCATION	KM. NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
					W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F
10	ODS	24	Laoag - Burgos Section (Ilocos Norte)								A_1	B	C	X																					
20	ODS	24	CVR Sta. Fe. (Nueva Viscaya)												A_2	B	C	X	D/A_3																

MONTH/YEAR JULY 1981

NOTE:

A_1 - Travel Time. - Manila to Laoag

B - Recruitment O.D.S Interviewers and Organization

C - Seminar and Dry Run

X - OD Survey Operation

D - Compilation of Field Sheet (Raw Data) Gathering, and Arragement of Traffic Road Signs.

A_2 - Travel Time - Laoag to Sta. Fe

R - Rest Day

A_3 - Travel Time - Sta. Fe - Manila

O.D.S - Origin - Destination Survey

- Field Data Processing

DALTON PASS TUNNEL PROJECT FEASIBILITY STUDY

OD INTERVIEW FIELD SHEET 1981

TABLE (2.2)

STA.NO. ________ DATE: ____________________ HOUR: __________ PROVINCE: ______________

DIRECTION: FROM : ________________________________ TO: ________________________________

1.VEHICLE TYPE	☐ 1. CARS ☐ 2. BIG BUS ☐ 3. MINI BUS (INCLUDING JEEPNEYS)	4. BIG TRUCK (WITH MORE THAN 6 TYRES) ☐ 5. ALL OTHERS ☐	
	2. ORIGIN	3. DESTINATION	4. INTERMEDIATE STOP
BARRIO			
CITY/MUNICIPALITY			
PROVINCE			
5.NUMBER OF PERSONS (INCLUDING DRIVER AND CONDUCTOR (S))			
6.SEAT CAPACITY (ONLY FOR BUS, JEEPNEY)		PASSENGER SEATS	
7.COMMODITY TYPE	TYPE 1.		
	TYPE 2.		
	TYPE 3.		
	TYPE 4.		
Empty ☐	TYPE 5.		
8.COMMODITY WEIGHT	TYPE 1. WEIGHT		KGS
	TYPE 2. WEIGHT		KGS
	TYPE 3. WEIGHT		KGS
	TYPE 4. WEIGHT		KGS
	TYPE 5. WEIGHT		KGS
9.TOTAL COMMODITY WEIGHT			KGS
10.NET LOAD CAPACITY			KGS

Table (2.3) ZONAL DIVISIONS

NO.	(ZONE CENTER)	Zonal Description (Provinces, Cities & Municipalities Included)
01	San Fernando	La Union (all municipalities
02	Bontoc	Mountain Province (all municipalities.
03	Bulnao	Kalinga-Apayao (all municipalities
04	Bayombong	Nueva Vizcaya, Ifugao (all municipalities
05	Cordon	Cordon, Santiago
06	Magapit	Cagayan: Aparri, Buguey, Calayan, Camalaniugan, Gonsaga, Lal-lo, Sta. Ana, Sta. Teresita Abulug, Allacapan, Ballesteros, Claveria, Lasam, Pamplona, Sanchez Mira, Langangan Alcala, Amulung, Baggao, Gattaran Iguig, Magapit
07	Tuguegarao	Cagayan: Tuguegarao, Enrile, Penablanca, Solana
08	Alicia	Isabela: Alicia, Angadanan, Cauayan, Echague, Jones, Luna, Reina Mercedes, San Agustin, San Guillermo, SanIsidro, Cabatuan, Aurora, Benito, Dinapigui, Mallig, Quezon, Roxas, San Manuel, San Mateo, Ramon
09	Ilagan	Isabela: Ilagan, Soliven, Burgos, Cabagan, Divilican, Gamu,Macanacon, Magsaysay, Naguilian,Palanan, Quirino, San Mariano, San Pablo, Santa Maria, Santo Tomas, Tumauini
10	Urdaneta	Pangasinan (all municipalities and cities)
11	Sta. Rita	Bulacan (all municipalities except Valenzuela)
12	Sta. Rosa	Nueva Ecija: Sta. Rosa, Cabanatuan, Gapan, General Tinio, Penaranda, San Leonardo, Jaen, San Antonio, San Isidro, Cabiao, Aliaga, Licab, Quezon, Zaragoña, Palayan City, Bongabon, Gabaldon, Natividad, Laur, Llanera, Pantabangan, Rizal
13	Talavera	Nueva Ecija: Guimba, Cuyapo, Nampicuan, Talugtug, Talavera, Sto. Domingo
14	San Jose	Nueva Ecija: Carranglan, Lupao, Muñoz , San Jose City
15	Metro Manila	Metro Manila, Rizal, Cavite, Laguna, Batangas, Quezon, Albay, Camarines Norte, Camarines Sur, Sorsogon, (all municipalities and cities)
16	Tarlac	Tarlac (all municipalties and cities)
17	San Fernando	Bataan, Pampanga, Zambales, (all municipalities)
18	Laoag	Ilocos Norte (all cities and municipalities)
19	Vigan	Abra, Ilocos Sur (all municipalities)
20	Baguio	Benguet (all cities and municipalities)

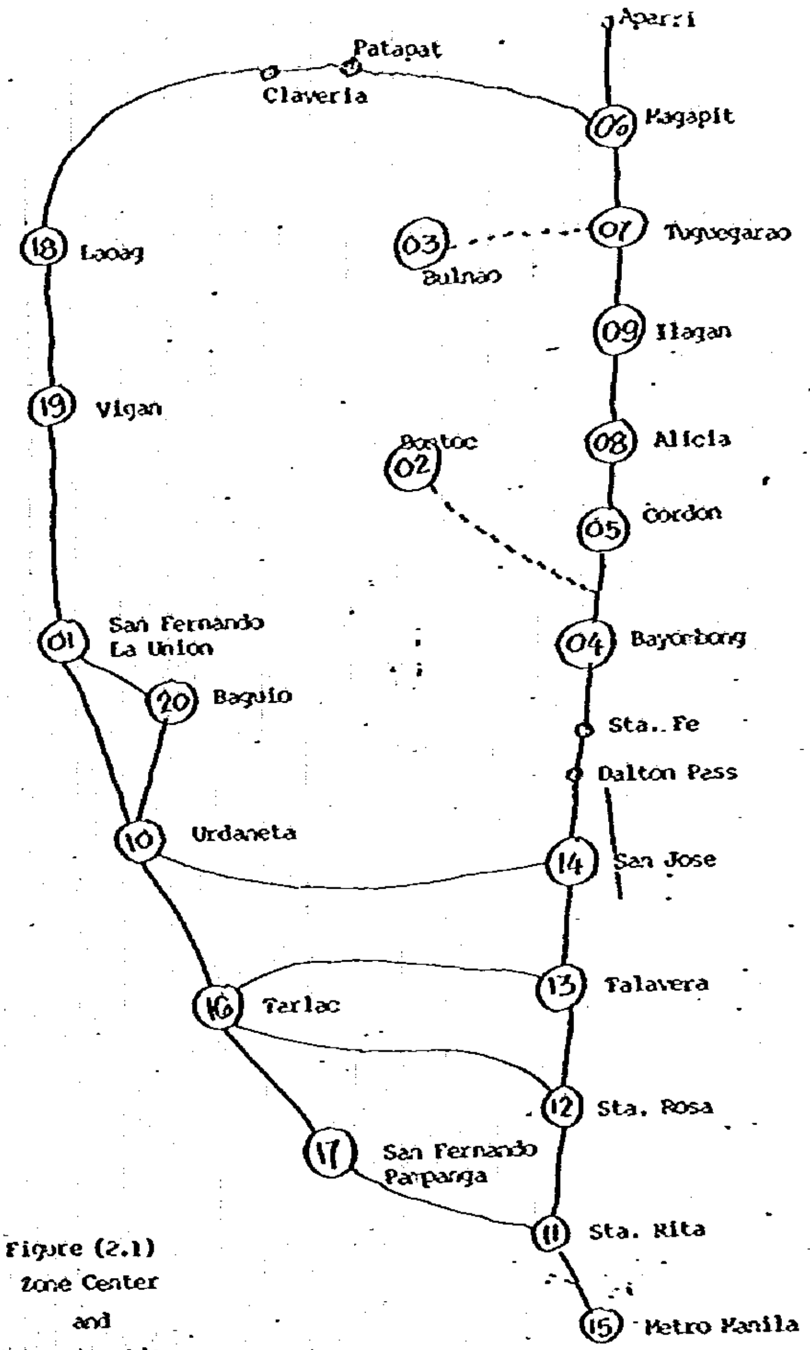


Figure (2.1)
Zone Center
and
Link Connection

DALTON PASS TUNNEL PROJECT FEASIBILITY STUDY

TABLE (2.4)

OD MATRIX

STATION NUMBER - 20 VEHICLE TYPE CARS

O \ D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL
1																					
2																					
3																					
4	3	1		6																	10
5																					
6																					
7																					
8	1																				1
9																					
10			1	8	1			5													15
11				1	5		1	1													8
12				15	13	3	6	8	4												49
13				6					5												11
14		1		10	3		3	3	3												23
15			10	81	45	13	39	69	40												297
16			4	4		2		7	1												18
17				3	1			2	11												17
18																					
19				3																	3
20				12																	12
TOTAL	4	2	15	149	68	18	49	95	64												464

DALTON PASS TUNNEL PROJECT FEASIBILITY STUDY

TABLE (2.5)

OD MATRIX

STATION NUMBER - 20

VEHICLE TYPE BIG BUS

O \ D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL
1																					
2																					
3																					
4		1																			1
5	1																				1
6																					
7																					
8	2																				2
9																					
10			3	1	5		1	9	2												21
11																					
12																					
13																					
14																					
15		4	10	8	8	55	29	35	11												160
16								3													3
17				1				3	2												6
18																					
19					1			1													2
20				5								1			2						8
TOTAL	3	5	13	15	14	55	30	51	15			1			2						204

DALTON PASS UNNEL PROJECT FEAS._.LITY STUDY

TABLE (2.6)
OD MATRIX

STATION NUMBER - 20 VEHICLE TYPE MINI BUS

O \ D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL
1																					
2																					
3																					
4				1																	1
5																					
6																					
7																					
8																					
9																					
10				2	1																3
11				1				1													2
12				1	1			1													3
13				1																	1
14				1		1		1													3
15				2	1	1		1	2												7
16				1																	1
17																					
18								1													1
19				1																	1
20				1																	1
TOTAL				12	3	2		5	2												24

DALTON PASS TUNNEL PROJECT FEASIBILITY STUDY.

TABLE (2.7)

OD MATRIX

STATION NUMBER – 20

VEHICLE TYPE BIG TRUCKS

O \ D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL
1																					
2																					
3	2																				2
4	6			2																	8
5	10																				10
6																					
7	7																				7
8	3			1																	4
9	2																				2
10		1	2	10	6	7	5	11	7												49
11			7	27	11	13	5	31	23												117
12			4	8	9	9	14	3	10												57
13				3		1			1												5
14			1	5	2	4		3													15
15			11	65	49	33	46	142	106												452
16				8	1	1	2	2	3												17
17			2	8	9	1	6	9	22												57
18																					
19				1			2	5													8
20				1																	1
TOTAL	30	1	27	139	87	69	80	206	172												811

DALTON PASS TUNNEL PROJECT FEASIBILITY STUDY

TABLE (2.8)"

OD MATRIX

STATION NUMBER – 20 VEHICLE TYPE TRUCK-TRAILER

O \ D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL
1																					
2																					
3																					
4	4																				4
5	1																				1
6																					
7																					
8																					
9	3																				3
10						1	1	10													12
11						1	1	6	5												13
12					1			1	1												3
13								1	1												2
14																					
15				7	4	2	7	14	9												43
16				1																	1
17					4	1		1	1												7
18																					
19																					
20																					
TOTAL	8			8	9	5	9	33	17												89

DALTON PASS TUNNEL PROJECT FEAS ILITY STUDY

TABLE (2.9)

OD MATRIX (In Tons)

STATION NUMBER - 20

Cereals and Unprocessed Agricultural

O \ D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL
1																					
2										8.8											8.8
3										4.3	40.8	33.5		8.7	18.9						106.2
4										11.8	64.1		5.3	0.6	50.7	5.2			14.3		152.0
5											21.6	4.5			10.8		3.6				40.5
6										11.1	127.8	16.5				18.4					173.8
7														0.4	76.8	11.2	8.5		50.0		146.9
8	16.5									29.7	114.2	8.3	0.7		379.6		9.2		11.7		569.9
9										17.3	6.0		0.2		90.3	0.2					114.0
10						3.0															3.0
11					9.0			1.0													10.0
12			0.5	0.9	1.6		3.8														6.8
13																					
14																					
15					18.2	6.3		1.1	2.4												28.0
16																					
17						6.8			9.0												15.8
18																					
19								0.1													0.1
20																					
TOTAL	16.5		0.5	0.9	28.8	16.1	3.8	2.2	11.4	83.0	374.5	62.8	6.2	9.7	627.1	35.0	21.3		76.0		1375.8

DALTON PASS TUNNEL PROJECT FEASIBILITY STUDY

TABLE (2.10)

OD MATRIX (In Tons)

STATION NUMBER - 20 Forestry

O \ D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL
1																					
2																					
3											13.1				1.7						14.8
4	23.6									47.0	97.5				250.1	8.0	19.0				439.2
5															51.5						51.5
6										9.0	85.9			24.4	242.1		28.9				390.3
7											113.9				211.9						325.8
8										14.0	56.3			2.3	377.8	113.6	0.5				564.5
9										59.5	278.7	11.4	10.0		726.4	31.9	62.3				1180.2
10																					
11																					
12																					
13																					
14																					
15				3.0				0.1													3.1
16																					
17																					
18																					
19																					
20																					
TOTAL	23.6			3.0				0.1		123.5	745.4	11.4	10.0	26.7	861.5	53.5	110.7				2969.4

DALTON PASS TUNNEL PROJECT FEASIBILITY STUDY

TABLE (2.11)

OD MATRIX (In Tons)

STATION NUMBER = 20 | Mineral Oil Products

O \ D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL
1				3.5	18.8			7.0	3.0												32.3
2																					
3																					
4													2.5	24.0	3.3						29.8
5																					
6															3.0						3.0
7																					
8												0.5			0.3						0.8
9										11.2			3.1								14.3
10																					
11								7.5													7.5
12																					
13																					
14																					
15				58.0	68.0		20.0	123.3	28.3												297.6
16																					
17																					
18																					
19																					
20																					
TOTAL				61.5	86.8		20.0	137.8	31.3	11.2		0.5	5.6	24.0	6.6						385.3

DALTON PASS UNNEL PROJECT FEAS...LITY STUDY

TABLE (2.12)

OD MATRIX (In Tons)

STATION NUMBER - 20 | Cement

O \ D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL
1																					
2																					
3																					
4																					
5																					
6																					
7																					
8																					
9																					
10				40.0	52.0	12.0	56.0	258.7	28.0												446.7
11			10.0	12.0			2.6														24.6
12						48.0	42.0														90.0
13																					
14																					
15					45.0	16.0	54.0	76.6	42.0												233.6
16																					
17																					
18																					
19																					
20																					
TOTAL			10.0	52.0	97.0	76.0	154.6	335.3	70.0												794.9

DALTON PASS TUNNEL PROJECT FEASIBILITY STUDY

TABLE (2.13)

OD MATRIX (In Tons)

STATION NUMBER - 20 Building and Construction Materials

O \ D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL
1			14.0		10.0																24.0
2																					
3																					
4										15.9											15.9
5																					
6																					
7																					
8	8.0														33.7						41.7
9															18.5						18.5
10																					
11				3.0																	3.0
12																					
13																					
14																					
15			24.0	28.6	14.5		42.5	38.9													148.5
16																					
17									12.0												12.0
18																					
19																					
20																					
TOTAL	8.0		38.0	31.6	24.5		42.5	38.9	12.0	15.9					52.2						263.6

DALTON PASS TUNNEL PROJECT FEASIBILITY STUDY

TABLE (2.14)

OD MATRIX (In Tons)

STATION NUMBER - 20 　　　　　　　　Softdrinks, beer, wines

O \ D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL
1				48.2	10.4				15.8												74.4
2																					
3																	12.2				12.2
4	17.1														15.1						32.2
5																	20.2				20.2
6																					
7															144.7						144.7
8																					
9	8.3														4.2						12.5
10							15.0														15.0
11								21.4													21.4
12																					
13																					
14																					
15			1.5				1.4		26.9												29.8
16																					
17					36.1		39.3														75.4
18																					
19																					
20																					
TOTAL	25.4		1.5	48.2	46.5		55.7	21.4	42.7						163.4		32.4				437.2

DALTON PASS TUNNEL PROJECT FEASIBILITY STUDY

TABLE (2.15)

OD MATRIX (In Tons)

STATION NUMBER – 20

																		All Others		
O \ D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL
1							4.0														4.0
2																					
3																					
4				0.6										1.6	7.8		10.8				20.8
5															0.2		3.0				3.2
6										0.1											0.1
7															8.6		8.6				17.2
8															14.2				14.5		28.7
9															0.1						0.1
10			5.6	16.0				0.6													22.2
11					21.0			26.0													47.0
12				1.6			13.9		0.1												15.6
13																					
14				1.8																	1.8
15			49.3	13.4	73.9	36.2	96.0	107.7	28.0												404.5
16			0.2	2.9	0.4																3.5
17				21.0	8.3			31.2	0.5												61.0
18																					
19																					
20																					
TOTAL			55.1	57.3	103.6	36.2	113.9	165.5	28.6	0.1				1.6	30.9		22.4		14.5		629.7

DALTON PASS 'UNNEL PROJECT FEAS :LITY STUDY

TABLE (2:16)
OD MATRIX

STATION NUMBER - 20
PERSON TRIP 1) (24 hours)

O \ D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL
1																					
2																					
3																					
4	5	4		13																	22
5																					
6																					
7																					
8	2																				2
9																					
10			4	37	2			16													59
11				2	17		3	12													34
12				49	39	9	7	8	8												120
13				18					9												27
14		6		52	2		7	4	14												85
15			47	304	129	30	126	221	157												1014
16			4	11		6		14	9												44
17				12	4			3	32												51
18																					
19				14																	14
20				20																	20
TOTAL	7	10	55	532	193	45	143	278	229												1492

1) Passengers on Cars and other private passenger vehicles only

DALTON PASS TUNNEL PROJECT FEASIBILITY STUDY

TABLE (2:17)

OD MATRIX

STATION NUMBER - 10 VEHICLE TYPE CARS

O \ D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL
1																					
2																					
3																					
4																					
5																					
6	2																				2
7																					
8																					
9																					
10																					
11																					
12																					
13									1												1
14																					
15						4		1													5
16																					
17																					
18			2			3	2		17	1					4			94			123
19						3	1														4
20			1																		1
TOTAL	2		3			10	3	1	18	1					4			94			136

DALTON PASS TUNNEL PROJECT FEASIBILITY STUDY

TABLE (2.18)

OD MATRIX

STATION NUMBER - 10 VEHICLE TYPE BIG BUS

O \ D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL
1																					
2																					
3																					
4																					
5																					
6																					
7																					
8																					
9																					
10																					
11																					
12																					
13																					
14																					
15																					
16																					
17																					
18			3		1	19	3		2						2			19			49
19						16															16
20																					
TOTAL			3		1	35	3		2						2			19			65

DALTON PASS TUNNEL PROJECT FEASIBILITY STUDY

TABLE (2.19)

OD MATRIX

STATION NUMBER - 10 VEHICLE TYPE MINI BUS

O \ D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL
1																					
2																					
3																					
4																					
5																					
6																					
7																					
8																					
9																					
10																					
11																					
12																					
13																					
14																					
15						1															1
16																					
17																					
18			5			7		1	35						1			63			112
19																					
20																					
TOTAL			5			8		1	35						1			63			113

DALTON PASS TUNNEL PROJECT FEASIBLITY STUDY

TABLE (2.20)

OD MATRIX

STATION NUMBER - 10 VEHICLE TYPE BIG TRUCKS

O \ D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL
1																					
2																					
3																					
4																					
5																					
6	1																				1
7																					
8																					
9																					
10						1															1
11			1			1															2
12																					
13																					
14																					
15						4	3	1													8
16																					
17			1			5															6
18	1					18	1		4						4			28			56
19						16			1												17
20																					
TOTAL	2		2			45	4	1	5						4			28			91

DALTON PASS TUNNEL PROJECT FEASIBILITY STUDY

TABLE (2.3[illegible])

OD MATRIX (In Tons)

STATION NUMBER - 10 — Cereals and Un-processed Agricultural

O \ D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL
1																					
2																					
3											5.0						4.0	2.6			11.6
4																					
5																					
6	0.9										8.4				1.0			89.7	55.0		155.0
7																		0.5			0.5
8																					
9																					
10						1.8															1.8
11																					
12																					
13																					
14																					
15																					
16																					
17																					
18										0.1								3.6			3.7
19																					
20																					
TOTAL	0.9					1.8				0.1	13.4				1.0		4.0	96.4	55.0		172.6

DALTON PASS TUNNEL PROJECT FEASIBILITY STUDY

TABLE (2.22)

OD MATRIX (In Tons)

STATION NUMBER - 10 — Forestry

O \ D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL
1																					
2																					
3																					
4																					
5																					
6	7.8																		5.4		13.2
7																					
8																					
9																					
10																					
11																					
12																					
13																					
14																					
15																					
16																					
17																					
18																		1.0			1.0
19																					
20																					
TOTAL	7.8																	1.0	5.4		14.2

DALTON PASS TUNNEL PROJECT FEASIBILITY STUDY

TABLE (2.23)

OD MATRIX (In Tons)

STATION NUMBER – 10 Mineral Oil Products

O \ D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL
1																					
2																					
3																					
4																					
5																					
6																		0.1			0.1
7																					
8																					
9																					
10																					
11																					
12																					
13																					
14																					
15																					
16																					
17																					
18																		3.0			3.0
19																					
20																					
TOTAL																		3.1			3.1

DALTON PASS TUNNEL PROJECT FEASIBILITY STUDY

TABLE (2.24)

OD MATRIX (In Tons)

STATION NUMBER - 10

Building and Construction Materials

O \ D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL
1																					
2																					
3																					
4																					
5																					
6															10.3		12.7				23.0
7																					
8																					
9																					
10																					
11																					
12																					
13																					
14																					
15																					
16																					
17																					
18						32.5									38.1			17.8			88.4
19						10.0															10.0
20																					
TOTAL						42.5									48.4		12.7	17.8			121.4

DALTON PASS TUNNEL PROJECT FEASIBILITY STUDY

TABLE (2.25)

OD MATRIX (In Tons)

STATION NUMBER - 10

Softdrinks, Beer, Wines

O \ D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL
1																					
2																					
3																					
4																					
5																					
6																	17.3	3.0			20.3
7																					
8																					
9																					
10																					
11																					
12																					
13																					
14																					
15																					
16																					
17																					
18						14.0			3.0						14.0			14.9			45.9
19																					
20																					
TOTAL						14.0			3.0						14.0		17.3	17.9			66.2

DALTON PASS TUNNEL PROJECT FEASIBILITY STUDY

TABLE(2.26)

OD MATRIX (In Tons)

STATION NUMBER - 10 Processed Agricultural Products

O \ D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL
1																					
2																					
3																					
4																					
5																					
6																					
7																					
8																					
9																					
10																					
11																					
12																					
13																					
14																					
15																					
16																					
17																					
18																		1.0			1.0
19																					
20																					
TOTAL																		1.0			1.0

DALTON PASS TUNNEL PROJECT FEASIBILITY STUDY

TABLE (2.27)

OD MATRIX (In Tons)

STATION NUMBER – 10   All Others

O \ D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL
1																					
2																					
3																					
4																					
5																					
6																					
7																					
8																					
9																					
10																					
11																					
12																					
13																					
14																					
15						3.4	4.2	8.0													15.6
16																					
17						33.0															33.0
18						17.4	0.2		0.1									0.8			18.5
19																					
20																					
TOTAL						53.8	4.4	8.0	0.1									0.8			67.1

DALTON PASS TUNNEL PROJECT FEASIBILITY STUDY

TABLE (2.23)

OD MATRIX

STATION NUMBER = 10

PERSON TRIP[1] (24 hours)

O \ D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	TOTAL
1																					
2																					
3																					
4																					
5																					
6	9																				9
7																					
8																					
9																					
10																					
11																					
12																					
13									9												9
14																					
15						15		3													18
16																					
17																					
18			9			26	10		75	4					23			347			494
19						11	3														14
20			4																		4
TOTAL	9		13			52	13	3	84	4					23			347			548

1) Passengers on Cars and other private passenger vehicles only

Table (2.29)

Summary of Cargo Traffic on Dalton Pass

(ton/day)

	Outgoing from Cagayan Valley	Incoming to Cagayan Valley
Grain	1312	63
Lumber	2966	3
Cement	0	795
Fuel	47	338
Construction Material	75	189
Soft Drinks, Beer and Wines	0	216
All Others (grocery in main)	70	560
Total	4470	2165

This is daily traffic ascertained by the O.D survey in July 1981 in Sta. Fe.

TABLE (2.30)
Share of Diesel at San Jose
(In 1980)

AADT 1980	GAS		DIESEL		TOTAL	
	No. of Vehicle	%	No. of Vehicle	%	No. of Vehicle	%
Cars	424	72.6	162	27.6	586	100.0
Big Bus	4	1.9	204	98.1	208	100.0
Mini Bus	41	32.3	85	67.7	126	100.0
Big Trucks	7	1.0	720	99.0	727	100.0
TRK/TLR SEM/TLR	1	1.4	101	98.6	102	100.0

3. Vehicle Operating Speed Survey

3.1 Purpose of the Survey

The time saving which may be brought about by the proposed tunnel is one of our greatest matters of concern. For estimating this time saving, first it is necessary to confirm the actual vehicle operating speed at the relevant Dalton section.

3.2 Date and Site

The survey was carried out for the 14 km. section between Capitalan (7 km. south of Dalton Pass) and Sta. Fe on 15 July 1981. The survey time was from 8:00 AM to 10:00 AM. Both directions, i.e., to and from Manila, were the objects of the survey.

3.3 Method of Survey

At both ends of the survey section, the plate number and the passing time of each sample vehicle was manually recorded.

3.4 Result of Survey

The records of all 91 sample vehicles are shown in Tables 3.1 to 3.10 while Table 3.11 gives the summary of the survey.

DALTON PASS TUNNEL PROJECT

TABLE 3.1

Result of Travel Time Survey — Vehicle Type: Cars, Jeeps

July 15, 1981 (8:00 – 10:00 AM) — Direction: To Manila

Sample No. (Registered Plate No.)	Recorded Time At			Travel Time (Hrs.)			Ave. Speed in KPH		
	C	B	A	C-B	B-A	CA	C-B	B-A	CA
1. FR - 378	8:03	8:17	8:27	0.23	0.17	0.4	29.35	41.24	34.4
2. 327 - HL	8:10	8:29	8:42	0.32	0.21	0.53	21.09	33.38	25.96
3. 569 - 8T	8:15	8:29	8:46	0.23	0.28	0.51	29.35	25.04	26.98
4. CL - 379	8:51	9:05	9:17	0:23	0.2	0.43	29.35	35.05	32.0
5. E3 - 584	9:05	9:20	9:31	0.25	0.18	0.43	27.0	38.94	32.0
6. 441 - 7D	9:09	9:35	9:43	0.43	0.22	0.65	15.70	31.86	21.17
7. V5 - 283	9:15	9:29	9:40	0.23	0.18	0.41	29.35	38.94	33.56
8. EX - 359	9:32	9:45	9:58	0.22	0.22	0.44	30.68	31.86	31.27

NOTE:

Capintalan — Pt. "A"
Dalton — Pt. "B"
Sta. Fe — Pt. "C"

Distance From: A – B = 7.01 kms.
B – C = 6.75 kms.
A – C = 13.76 kms.

DALTON PASS TUNNEL PROJECT

TABLE 3.2

Result of Travel Time Survey
July 15, 1981 (8:00 - 10:00 AM)

Vehicle Type: Cars, Jeeps
Direction: From Manila

Sample No. (Registered Plate No.)	Recorded Time At			Travel Time (Hrs.)			Ave. Speed in KPH		
	A	B	C	A-B	B-C	AC	A-B	B-C	AC
1. 2A - 321	8:11	8:25	8:38	0.23	0.22	0.44	30.68	32.14	30.58
2. 2T - 308	8:15	8:30	8:43	0.25	0.22	0.47	28.04	30.68	29.28
3. 9H - 319	8:20	8:31		0.18	-	-	38.94	-	-
4. R - 284	8:23	8:35	8:46	0.2	0.18	0.38	35.05	37.50	36.21
5. 402 - 3D	8:24	8:37	8:50	0.21	0.21	0.42	33.38	32.14	32.76
6. 181 - 3X	8:27	8:39	8:50	0.2	0.18	0.38	35.05	37.50	36.21
7. Q9 - 391	8:27	8:39		0.2	- -	-	35.05	-	-
8. EP - 400	8:32	8:43	8:56	0.18	0.22	0.4	38.94	30.68	34.40
9. 786 - 8N	8:33	8:45	8:56	0.2	0.18	0.38	35.05	37.50	36.21
10. 937 - 5H	8:33	8:45	8:56	0.2	0.18	0.38	35.05	37.50	36.21
11. N3 - 465	8:39	8:50	9:05	0.18	0.25	0.43	38.94	27.0	32.0
12. JH - 976	8:49	8:59	9:09	0.17	0.17	0.34	41.24	39.71	40.47
13. 306 - 5V	8:50	9:00	9:46	0.17	0.76	0.93	41.24	8.88	14.80
14. 409 - 4J	8:59	9:27		0.47	-	-	14.91	-	-
15. ER - 394	9:00	9:10	9:21	0.17	0.18	0.35	41.24	37.50	39.31
16. 865 - 5K	9:04	9:23	9:33	0.31	0.17	0.48	22.16	39.71	28.67
17. 621 - 8A	9:09	9:19	9:30	0.17	0.18	0.35	41.24	37.50	39.31
18. 523 - 6F	9:15	9:31	9:40	0.27	0.15	0.42	25.96	45.0	32.76
19. PS - 393	9:18	9:32	9:54	0.23	0.37	0.6	30.48	18.24	22.93
20. 846 - 4H	9:39	9:50		0.18			38.94	- -	-
21. DR - 128	9:41	9:52		0.18			38.94	-	-
22. CI - 251	9:49	10:01		0.2			35.05	-	-

NOTE:

Capintalan — Pt. "A"
Dalton — Pt. "B"
Sta. Fe — Pt. "C"

Distance From: A – B = 7.01 kms.
B – C = 6.75 kms.
A – C = 13.76 kms.

DALTON PASS TUNNEL PROJECT

TABLE (3.3)

Result of Travel Time Survey — Vehicle Type: Big Bus

July 15, 1981 (8:00 – 10:00 AM) — Direction: From Manila

Sample No. (Registered Plate No.)	Recorded Time At			Travel Time (Hrs.)			Ave. Speed in KPH		
	A	B	C	A-B	B-C	AC	A-B	B-C	AC
1. 828 - FG	8:17	8:30	8:47	0.22	0.28	0.5	31.86	24.11	27.52
2. 417 - EH	8:56	9:06	9:19	0.2	0.22	0.42	35.05	30.68	32.76
3. 225 - FE	9:05	9:18	9:30	0.22	0.2	0.42	31.86	33.75	32.76
4. 489 - ET	9:20	9:31	9:44	0.18	0.22	0.4	38.94	30.68	34.40
5. 589 - FE	9:27	9:37	9:48	0.17	0.18	0.35	41.24	37.50	39.31
6. 944 - FE	9:46	9:59		0.21			33.38	-	-

NOTE:

Capintalan — Pt. "A"
Dalton — Pt. "B"
Sta. Fe — Pt. "C"

Distance From: A – B = 7.01 kms.
B – C = 6.75 kms.
A – C = 13.76 kms.

DALTON PASS TUNNEL PROJECT

TABLE (3.4)

Result of Travel Time Survey
July 15, 1981 (8:00 – 10:00 AM)

Vehicle Type: Big Bus
Direction: To Manila

Sample No. (Registered Plate No.)	Recorded Time At			Travel Time (Hrs.)			Ave. Speed in KPH		
	C	B	A	C-B	B-A	C-A	C-B	B-A	C-A
1. 594 - EU	8:25	8:45	8:58	0.33	0.22	0.55	20.45	31.86	25.02
2. 650 - EU	8:29	8:51	9:05	0.37	0.23	0.6	18.24	30.48	22.93
3. 335 - EU	8:52	9:09	9:21	0.28	0.2	0.48	24.11	35.05	28.67
4. 318 - EU	8:52	9:07	9:18	0.25	0.18	0.43	27.0	33.94	32.0
5. 409 - ET	8:57	9:09	9:18	0.18	0.17	0.35	37.5	41.24	39.31
6. 646 - EU	9:17	9:44	9:58	0.45	0.23	0.68	15.0	30.48	20.24
7. 578 - EK	9:21	9:33	9:46	0.2	0.22	0.42	33.75	31.86	32.76
8. 325 - EU	9:34	9:46	9:58	0.2	0.2	0.4	33.75	35.05	34.4

NOTE:

Capintalan — Pt. "A"
Dalton — Pt. "B"
Sta. Fe — Pt. "C"

Distance From: A – B = 7.01 kms.
B – C = 6.75 kms.
A – C = 13.76 kms.

DALTON PASS TUNNEL PROJECT

TABLE (3.5)

Result of Travel Time Survey
July [illegible] (8:00 – 10:00 AM)

Vehicle Type Jeepneys , Mini-Bus
Direction: From Manila

Sample No. (Registered Plate No.)	Recorded Time At			Travel Time (Hrs.)			Ave. Speed in KPH		
	A	B	C	A-B	B-C	AC	A-B	B-C	AC
1. 421 - AT	9:05	9:24	9:39	0.32	0.25	0.57	21.91	27.0	24.14
2. 716 - 4M	9:15	9:28	9:59	0.21	0.52	0.73	33.38	12.98	18.85

NOTE:

Capintalan — Pt. "A"
Dalton — Pt. "B"
Sta. Fe — Pt. "C"

Distance From: A – B = 7.01 kms.
B – C = 6.75 kms.
A – C = 13.76 kms.

DALTON PASS TUNNEL PROJECT

TABLE (3.6)

Result of Travel Time Survey
July 15, 1991 (8:00 – 10:00 AM)

Vehicle Type Jeepney, Mini - Bus
Direction: To Manila

Sample No. (Registered Plate No.)	Recorded Time At			Travel Time (Hrs.)			Ave. Speed in KPH		
	C	B	A	C-B	B-A	C-A	C-B	B-A	C-A
1. 793 - 8A	8:16	8:29	8:52	0.22	0.38	0.6	30.68	18.45	22.93

NOTE:

Capintalan – Pt. "A"
Dalton – Pt. "B"
Sta. Fe – Pt. "C"

Distance From: A – B = 7.01 kms.
B – C = 6.75 kms.
A – C = 13.76 kms.

DALTON PASS TUNNEL PROJECT

TABLE (3.7)

Result of Travel Time Survey — Vehicle Type: Trucks (6 or more wheels)

July 15, 1991 (8:00 – 10:00 AM) — Direction: From Manila

Sample No. (Registered Plate No.)	Recorded Time At			Travel Time (Hrs.)			Ave. Speed in KPH		
	A	B	C	A-B	B-C	A-C	A-B	B-C	A-C
1. 165 - GQ	8:05	8:24	-	0.32	-	-	21.91	-	-
2. 2X - 914	8:07	8:26	8:41	0.32	0.25	0.57	21.91	27.0	24.14
3. 2S - 843	8:07	8:38	8:53	0.52	0.25	0.77	13.48	27.0	17.87
4. 2R - 627	8:08	8:27	8:47	0.32	0.23	0.55	21.91	29.35	25.02
5. 2M - 114	8:11	8:46	9:02	0.58	0.27	0.85	12.09	25.0	16.19
6. 647 - GG	8:16	8:28	8:41	0.2	0.22	0.42	35.05	30.68	32.76
7. QA - 297	8:20	8:36	8:52	0.27	0.27	0.54	25.96	25.0	25.48
8. NAD - 654	8:22	8:38	8:55	0.27	0.28	0.55	25.96	24.11	25.02
9. 314 - GG	8:40	8:51	9:01	0.18	0.17	0.35	38.94	39.71	39.31
10. 2U - 286	8:46	8:58	9:11	0.2	0.22	0.42	35.05	30.68	32.76
11. DX - 190	8:56	9:09	9:23	0.22	0.23	0.45	31.86	29.35	25.96
12. VT - 231	8:58	9:16	9:30	0.3	0.23	0.53	23.37	29.35	25.96
13. 215 - GL	8:59	9:23	9:41	0.4	0.3	0.7	17.53	22.50	19.66
14. VT - 624	9:17	9:44	9:58	0.45	0.23	0.68	15.58	29.35	20.24
15. 690 - 8V	9:17	9:32	9:44	0.25	0.2	0.45	28.04	33.75	30.58
16. 111 - 6J	9:20	9:31	9:43	0.18	0.2	0.38	38.94	33.75	36.21
17. WB - 776	9:24	9:41		0.28	-	-	25.04	-	-
18. 448 - 6D	9:24	9:36	9:47	0.2	0.18	0.38	35.05	37.50	36.21
19. 302 - GL	9:29	9:54		0.42	-	-	16.69	-	-
20. NBN - 159	9:31	10:01		0.5	-	-	14.02	-	-
21. 2K - 697	9:35	9:50		0.25	-	-	28.04	-	-
22. TJ - 199	9:35	9:48	9:59	0.22	0.18	0.4	31.86	37.50	34.40
23. QS - 854	9:42	9:55		0.22	-	-	31.86	-	-
24. QP - 129	9:44	9:58		0.23	-	-	30.48	-	-

NOTE:

Capintalan — Pt. "A"
Dalton — Pt. "B"
Sta. Fe — Pt. "C"

Distance From: A – B = 7.01 kms.
B – C = 6.75 kms.
A – C = 13.76 kms.

DALTON PASS TUNNEL PROJECT

TABLE (3.8)

Result of Travel Time Survey — Vehicle Type: Trucks (6 or more wheels)

July 15, 1981 (8:00 – 10:00 AM) — Direction: To Manila

Sample No. (Registered Plate No.)	Recorded Time At			Travel Time (Hrs.)			Ave. Speed in KPH		
	C	B	A	C-B	B-A	C-A	C-B	B-A	C-A
1. 955 - CG	8:00	8:20	8:43	0.33	0.38	0.72	20.45	18.45	19.11
2. 255 - FY	8:12	8:41	8:58	0.48	0.28	0.77	14.06	25.04	17.87
3. 244 - GL	8:12	8:38	8:58	0.43	0.33	0.77	15.70	21.24	17.87
4. 2S - 930	8:15	8:43	9:01	0.45	0.32	0.77	15.0	21.91	17:87
5. QE - 618	8:19	8:51	9:12	0.53	0.35	0.88	12.74	20.03	15.64
6. 759 - GN	8:19	8:50	9:27	0.51	0.62	1.13	13.24	11.31	12.18
7. 760 - GN	8:20	8:51	9:27	0.52	0.6	1.12	12.98	11.68	12.29
8. QU - 326	8:21	8:50	9:06	0.48	0.27	0.75	14.06	25.96	18.35
9. QU - 112	8:23	9:12	9:40	0.81	0.47	1.28	8.33	14.91	10.75
10. 2H - 496	8:39	9:10	9:48	0.52	0.63	1.15	12.98	11.13	11.97
11. 2T - 401	8:44	9:11	9:31	0.45	0.33	0.78	12.98	21.24	17.64
12. 2D - 751	8:51	9:17	9:47	0.43	0.5	0.93	15.0	14.02	14.80
13. 5K - 857	8:51	9:12	9:28	0.35	0.27	0.62	19.29	25.96	22.19
14. I2 - 212	9:04	9:29	9:46	0.42	0.28	0.7	16.07	25.04	19.65
15. I2 - 196	9:04	9:29	9:47	0.42	0.3	0.72	16.07	23.37	19.11
16. 2K - 510	9:18	9:39	9:55	0.35	0.27	0.62	19.29	25.96	22.19

NOTE:

Capintalan — Pt. "A"
Dalton — Pt. "B"
Sta. Fe — Pt. "C"

Distance From: A – B = 7.01 kms.
B – C = 6.75 kms.
A – C = 13.76 kms.

DALTON PASS TUNNEL PROJECT

TABLE (3.9)

Result of Travel Time Survey
July 15, 1981 (8:00 – 10:00 AM)

Vehicle Type: Truck - Trailers
Direction: To Manila

Sample No. (Registered Plate No.)	Recorded Time At			Travel Time (Hrs.)			Ave. Speed in KPH		
	C	B	A	C-B	B-A	C-A	C-B	B-A	C-A
1. 140 - CG	8:29	9:09	9:37	0.67	0.47	1.13	10.07	14.91	12.18
2. 400 - CQ	9:03	9:29	9:45	0.43	0.27	0.7	15.70	25.96	19.66

NOTE:

Capintalan — Pt. "A"
Dalton — Pt. "B"
Sta. Fe — Pt. "C"

Distance From: A – B = 7.01 kms.
B – C = 6.75 kms.
A – C = 13.76 kms.

DALTON PASS TUNNEL PROJECT

TABLE (3.10)

Result of Travel Time Survey
July 15, 1981 (8:00 – 10:00 AM)

Vehicle Type Truck - Trailer
Direction: From Manila

Sample No. (Registered Plate No.)	Recorded Time At			Travel Time (Hrs.)			Ave. Speed in KPH		
	A	B	C	A-B	B-C	A-C	A-B	B-C	A-C
1. 2C - 601	8:12	8:36	8:55	0.4	0.32	0.72	17.53	21.09	19.11
2. 995 - GG	9:04	9:49		0.75	-	-	9.35	-	-

NOTE:

Capintalan — Pt. "A"
Dalton — Pt. "B"
Sta. Fe — Pt. "C"

Distance From: A – B = 7.01 kms.
B – C = 6.75 kms.
A – C = 13.76 kms.

TABLE (3.11)

Summary of Vehicle Speed Survey at Dalton Pass

	From Manila				To Manila				Average Speed
	No. of Samples	Total Hour (mins.)	Average Hour (min.)	Average Speed (Km/h)	No. of Samples	Total Hour (min.)	Average Hour (min.)	Average Speed (Km/h)	Km/h
Cars	15	373	25	33	8	228	29	28	31
Big Bus	5	125	25	33	8	235	29	28	31
Mini Bus	2	78	39	21	1	36	36	23	22
Heavy Truck	18	583	32	26	18	932	52	16	17

APPENDIX B

COUNTERMEASURE METHODS

TABLE OF CONTENTS

I. INTRODUCTION

Topography between Balaho and Baliling with an approximate length of 60 km. is mountainous in nature consisting of some terrace and alluvial planes in the lower part. The existing national road (Route 5) passes at the foot of this area with steep slopes. This continous slope is found all throughout the road.

The cutting slope condition has a steep gradient and no slope protection. The geological condition of the existing road is quite poor with andesites and diabase indicative of shear zone. The existing road passes through a weak zone where weathering and hydrothermal alteration is advancing along the boundary. Thus, typhoons and heavy rainfalls induce failures in side slopes. On embankments failures also exist caused by ground and running water.

It is therefore important to clarify the slope condition and to carefully study the slope treatment based on the results of the survey. The Study Team provided a slope stability check table based on field reconnaissance as shown in II and III.

Located in the mountainous area, the side slopes form a long and continous steep slope along the existing national road with features as follows :

1) Generally,the slope gradient consists of the same material and is very steep.

2) Failure observation indicates that slope protection is not advisable for all side slopes.

3) There is no drainage preparation on side slopes. Running water and seepage water flows on the slopes resulting in the formation of gullies.

There are five types of failures classified as follows :

1) Type A - This is a surface failure induced by heavy rainfall. Side slope materials consist of talus and weathered soil existing in a plane of discontinuity between the strong base rock and soil. When heavy rainfall passes through gentle slopes, it normally penetrates to the soil and flows along the boundary of the base rock and soil strata. This is called seepage water and causes erosion and surface failures in this area. The formation of natural slopes is steep where surface water flows along its course and penetrates deeper, thus, causing surface erosion and gullies beyond its boundaries. In such cases failures normally occur along the gullies.

2) Type B - Failures of this type are exfoliated from fissures of base rock. As mentioned above the existing road of the project site has andesite and diabase formation. Shearing zone is evident near the boundary causing cracks and fissures on the base rock and weathering advances. Failure occurs from cracks on base rocks in cases where slope gradient exceeds the angle of crack gradient. This is caused by the decreasing resistance due to weathering and water penetration. When the trend of slopes coincides with the cracks and its gradient is at a low angle lesser than the slope gradient, failures develop into a landslide.

3) Type C - These are rock fragments coming from the cracks on the base rock and is made up of diorite, andesite, diabase and granite rock. These types of rock fragments usually originate from joints fissures and shear zones and normally appear during typhoons and heavy rains. When geology consists of terrace deposits, the gravel deposits are eroded by typhoons and heavy rains.

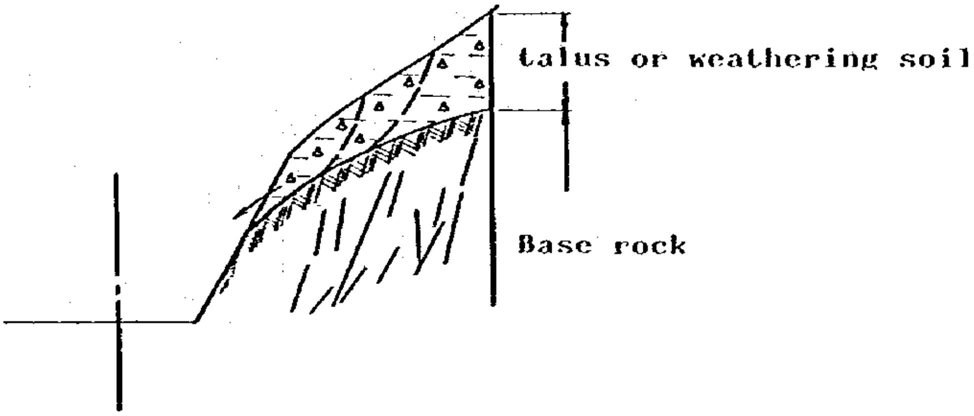
4) Type D - Failure of this type is similar to Type A. However, when the side slope materials are homogeneous void water pressure is developed and the shear strength of the material decreases which causes the landslide. Surface failure on granitic rock of less than 5 meters is distributed throughout the northern part of Dalton Pass.

5) Type E - This is a type of landslide caused by shearing zone. The formation of andesite and diabase on this section consists of shear zone bearing gouges and fault breccia. Ground water fills the fissures and cracks on the base rock and the reaction of the fault clay is to trap the water. In effect, it weakens the strength of soil bonding thereby causing landslide. Whenever the slope gradient and shear zone are in the same direction, a larger scale landslide is normally expected to occur.

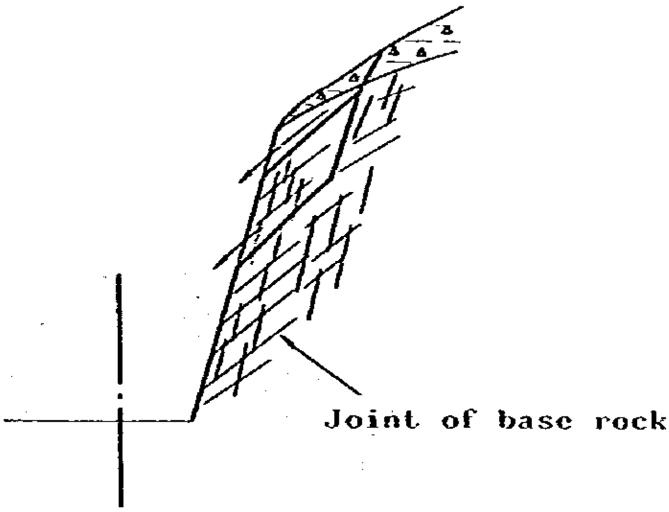
The different types of failures based on field reconnaissance are shown as follows :

TYPE	NO.	PERCENTAGE RATIO	NO. OF FAILURES/km
A	34	34	0.61
B	36	36	0.65
C	22	22	0.40
D	1	1	0.02
E	7	7	0.12
Total	100	100	

TYPE A

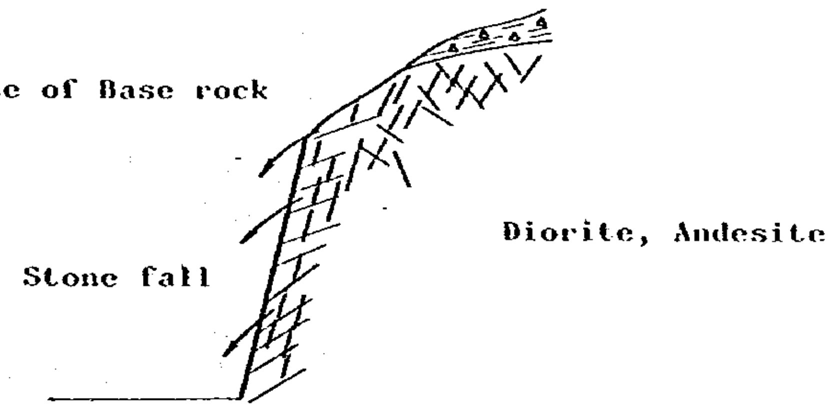


TYPE B



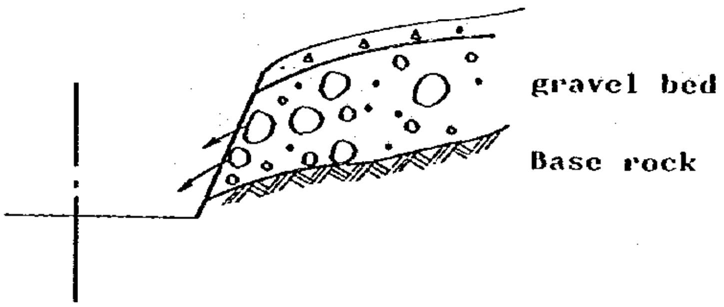
TYPE C

in case of Base rock

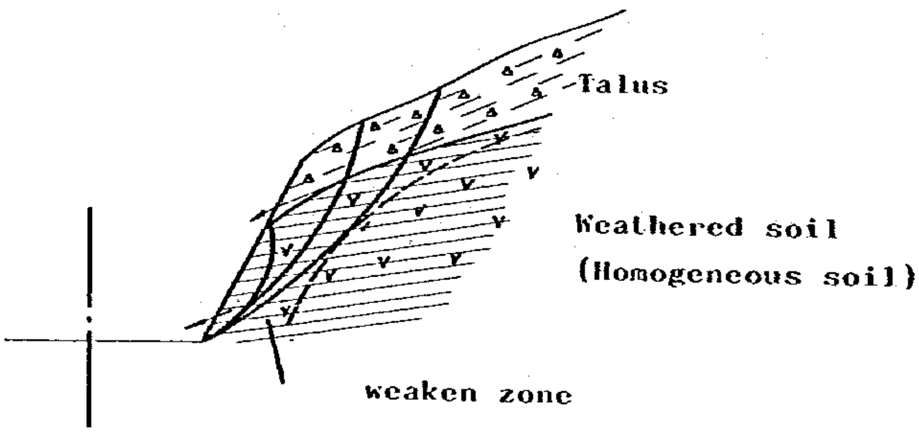


TYPE C

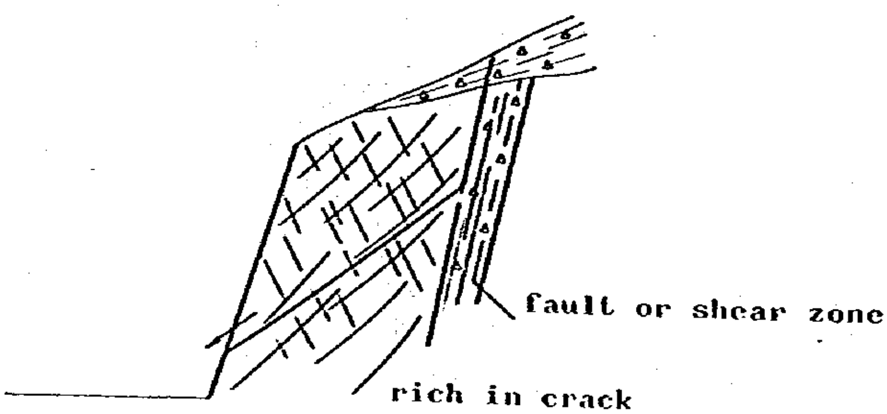
In case of Terrace deposits



TYPE D



TYPE E



Based on the above table, failures that occur on the existing national road with an approximate length of 55 km. from Balaho to Baliling are classified under Types A, B and C.

As observed during the field reconnaissance, side slopes along the existing road are of steep gradient bearing no slope protection for alteration. In effect, gullies are formed whenever typhoons and heavy rainfall occur causing failures on the side slopes. In such cases, countermeasures are necessary to avoid erosion and further landslides.

Based on the above findings and geological analyses, it is necessary to provide slope protection. Depending on what slope protection will be applied, the side slope materials are classified into three groups :

1) Topsoil mixtures of talus deposits, weathered soil and terrace deposits

2) Soft rock induced by weathering

3) Hard rock induced by weathering

Normally topsoil is a conglomerate of talus, terrace deposits and mixture of sand and gravel. When topsoil is imposed on the base rock failures are more likely to appear since the effect of ground water is to weaken the strength of bonding between the soil and the base rock. Countermeasures taken in this particular case are as follows :

1) Recutting - Since side slopes gradient ratio for this is normally considered to be 1:1.0 or 1:1.2, slope is usually protected by planting ipil-ipil all throughout the slopes.

2) Drainage Boring Method - This method is applied when the ground water level is high and has to be lessened to prevent landslides. Varied information is necessary to support this equation below which states that the ground water is inversely proportional to the resistant stress.

$$FS = \frac{C \times l + (W \cos \phi - u) \cdot \tan \phi}{W \sin \theta} \quad \text{..... Eq. 1}$$

Where :

FS	=	Factor of safety
C	=	Cohesion (m^2/t)
l	=	length of sliding mass (m)
W	=	Weight of sliding mass (t/m)
θ	=	Angle of sliding mass (°)
ϕ	=	Angle of internal friction (°)
u	=	Void water pressure (t/m)

3) Counterweight Method - Whenever the topsoil and base rock boundary occurs either on the topmost or lower part of the side slope, it is advisable to cut the nearest portion in the boundary of the topsoil and base rock, adopt a flat plane of about 2.5 meters and construct the gaboin along the flat plane in order to increase the force resistance and acquire a factor of safety. This method is normally combined with the drainage boring factor to give a better result of slope stability.

In cases where geological condition of cutting slope consists of soft rock, failure from cracks sometimes occurs. Generally, there are abundant open cracks in soft rock. Some cracks are filled with soft clay material, and failure is based on these cracks which cause the unsafe condition in high gradient cutting slopes.

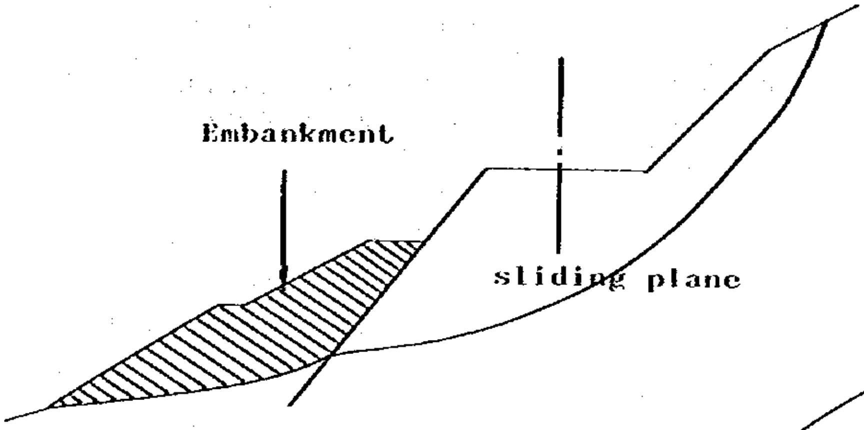
Based on the slope stability check table, slope gradient of soft rock is 1:0.3 - 1:0.5. This slope gradient is steep for soft rock and should undergo recutting to have a gradient of 1:0.8 - 1:1.0, considering high temperature and heavy rain in this area. However, because of the geological conditions recutting all slopes in existing road will be very difficult and therefore not advisable.

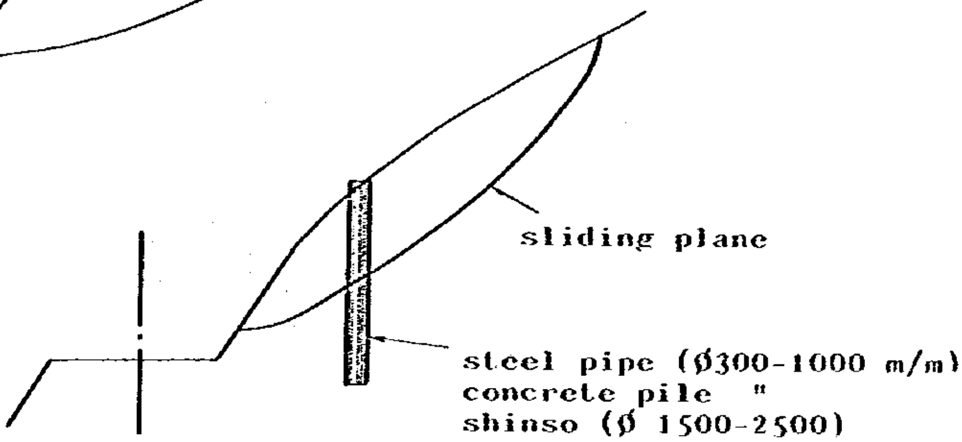
In this area, slope protection was not conducted for all slopes. Generally, slope protection for soft rock should be conducted to avoid advanced weathering in soft rock. Thus, there should be slope protection by means of concrete spreading with a thickness of 10 to 20 cm.

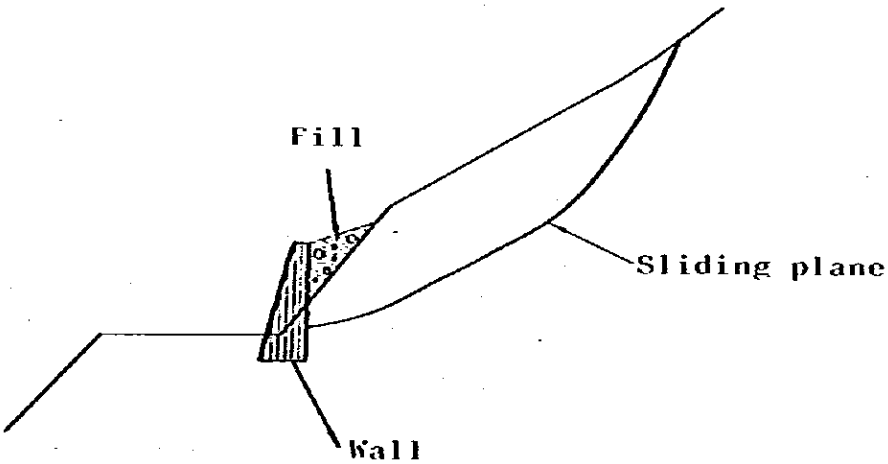
Failures in soft rock consist of stone falls and small failures from cracks except in the rock sliding by fault or shearing zone. Countermeasure works on failure types consisting of stone falls and small failures from cracks should be undertaken as follows :

1) Rock Net - This is used as protection by covering the slope consisting of soft rock. However, this method is not complete and should be used along with other protection methods, because sometimes small stones fall and will pass through the net mesh.

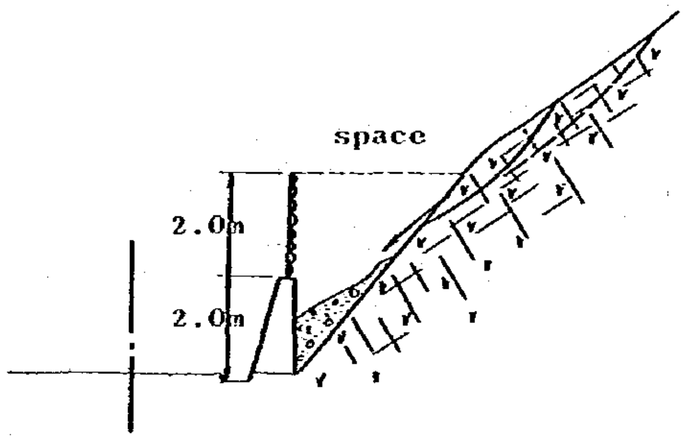
2) Spraying method - It is necessary to cover the surface of the slope in order to protect from advance weathering. Spraying method has been conducted in Japan widely. It consists of two methods: one is concrete spraying with a thickness of 5 to 15 cm. including wire net and the other is gunite shooting with thickness of 3 to 5 cm. In places where ground water flows, this should be treated completely for ground water.


Embankment
sliding plane


sliding plane
steel pipe (Ø300-1000 m/m)
concrete pile "
shinso (Ø 1500-2500)


Fill
Sliding plane
Wall

3) Spacing between shoulder of road and cutting slope - One method of protecting small failures from cutting slope consisting of soft rock is to keep a space between road and slope. Therefore there should be wall and rock fence at the shoulder of the road. In the space behind the wall and rock fence small rock mass can be kept and rock mass falling down from the cutting slope acts as counterweight.

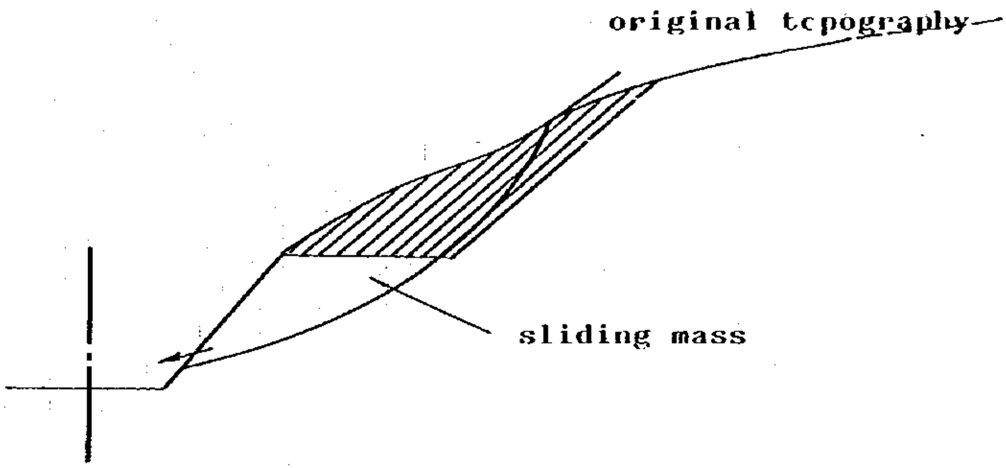


In cases of hard rocks consisting of cutting slope failure seldom occurs but ocassional stone falls from cracks occur. Therefore for stone falls from the cracks, rock net and spraying method should be adopted. Slope gradient of hard rock will be considered as 1:0.3 to 1:0.5.

Landslide areas may be avoided in new road designs. after conducting field reconnaissance. However, in existing roads it is very difficut to avoid landslides. Therefore it is necessary to protect these areas by conducting countermeasures. The most common methods for countermeasures against landslides are :

1) Excavation for sliding mass
2) Counterweight Method
3) Drainage Method

In the excavation for sliding mass the upper part of the sliding area is excavated upon which the sliding force decreases more than the resistant force thus increasing the safety of the sliding area. However, it is very difficult to decide the excavated area and detailed investigation for landslide is required. In case of wrong excavations, landslide will be activated.



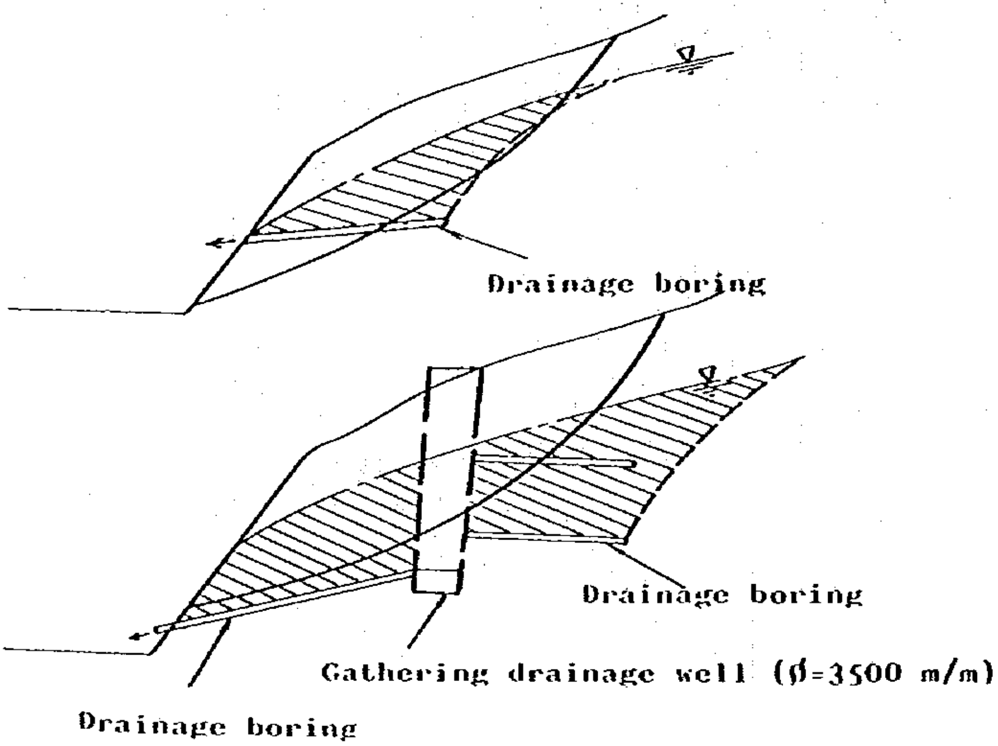
Counterweight method protects the landslide by using embankment weight, steel or concrete pile shinso and structures. It is necessary to confirm the position of the sliding plane and sliding form by geological investigation in the design of this method. If according to geological investigations, organization of landslide is confirmed, calculation of shear strength and bending resistance is necessary and countermeasure bearing will be attained using the following equation :

$$FS = \frac{C \cdot 1 + W \cos \theta - u) \tan \phi + PR}{W \sin \theta} \quad \ldots \quad \text{Eq. 2}$$

Where :

FS = Design safety factor
C = Cohesion (t/m)
l = Length of sliding mass (m)
W = Weight of sliding mass (t/m)
θ = Angle of sliding mass (°)
ϕ = Angle of internal friction (°)
u = Void water pressure
PR = Shear strength and bending resistance which each countermeasure will be bearing

Drainage method is used with other countermeasure methods to protect the landslide by drainage boring or gathering drainage well. If ground water level is brought down to ordinary level by drainage method, resistance force will increase more than before doing countermeasure.



The embankment in existing roads between Balaho and Baliling is half cut and fill type. Approximately fill type exists only at the glen or small stream. The characteristics of the embankment in this area are as follows :

1) The place of embankment is mainly located at the glen or small stream. Earth retaining structures are constructed at the end of the embankment. Thus, the size of embankment is lesser.

2) The gradient of embankment is 1: 0.3 to 1: 0.5.

3) There is no protection of embankment slope except for masonry.

4) Embankment height on the flat plane is less than 5 meters but at half-cut and fill embankment, the height is more than 5 to 10 meters because in the mountainous area, original topography is steep.

It was observed that there are many kinds of failures at the embankment area caused by bad drainage. The following types of embankment failures were observed :

1) Type A - Pavement crack or settlement - Cracks which are caused by grading settlement at the boundary of fill and original parts on the pavement exist.

2) Type B - Embankment failure by water action from ditch - The present road shoulder does not establish pavement at the ditch (gutter). When it rains, ditch water flows at the shoulder of the road. After road shoulder erodes and flood water from ditch falls at sag point of embankment slope, the water of embankment shoulder fails due to falling water action such as exfoliate.

3) Type C - Embankment failure by underground cross pipe failure - Underground pipe was established at the sag of the road but failed due to an unequal settlement of original ground and filling at the boundary. This embankment eroded at the underground due to leaking water from failure parts.

4) Type D - Embankment slope failures by river erosion - Embankment slope failures occured due to river erosion which has a large catchment area. Embankment slope failure is only at the riverside of Digdig and Sta. Fe rivers.

5) Type E - Exit part of underground pipe failure by water action - The front portion of the exit in underground pipe failure is caused by stream erosion. After embankment failure occured lateral erosion developed and expanded.

6) Type F - Pavement failure by water action from ditch - Ditches in the area are not sealed. During rainy periods, water stream at ditches penetrates into the subgrade which consists of coarse material such as gravel. Thus, soil particles in subgrade flows out and the pavement submerges due to these ground water currents.

According to reconnaissance, the main causes of embankment failure is that surface and shoulder drainage and the construction of pipe or culvert box in the embankment is not complete. Thus, it is necessary to protect the embankment failure by the following :

1) Rehabilitation of surface drainage and shoulder drainage

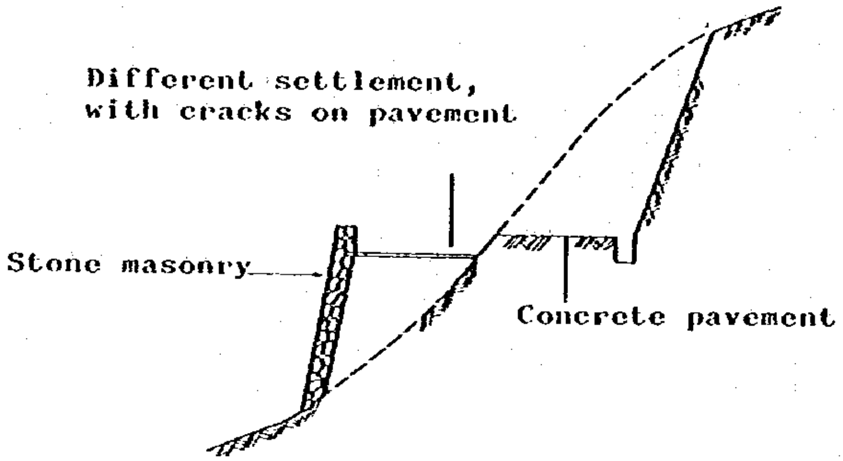
2) Reinforcement of structural foundation in granitic area

3) Revetment at the scoring area

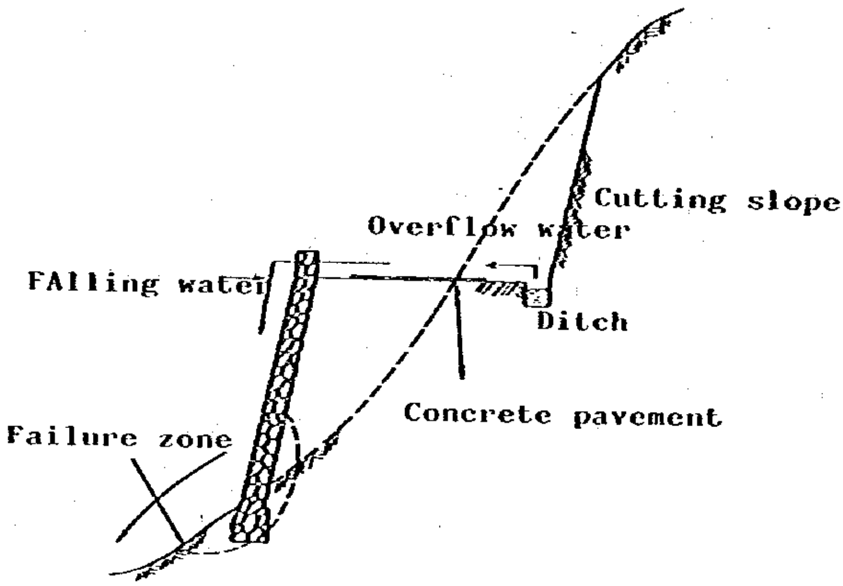
4) Installation of gullies at the mountain side of the road

5) Sweeping of pipe and culvert box

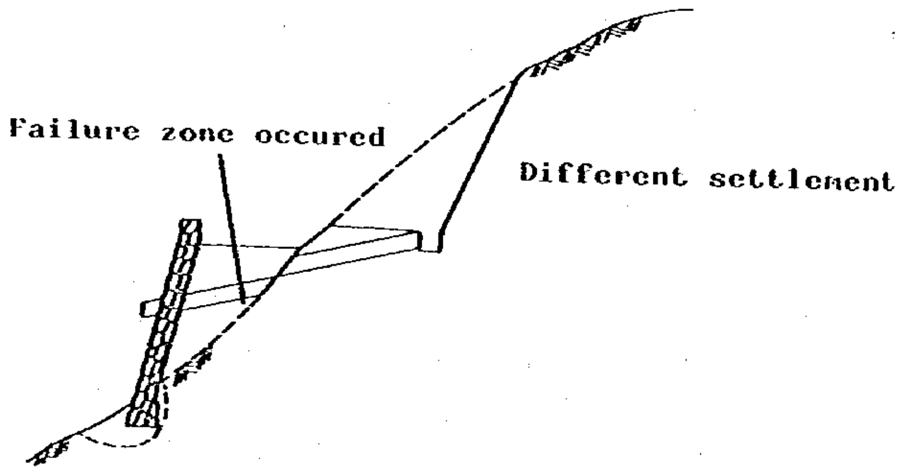
Type A



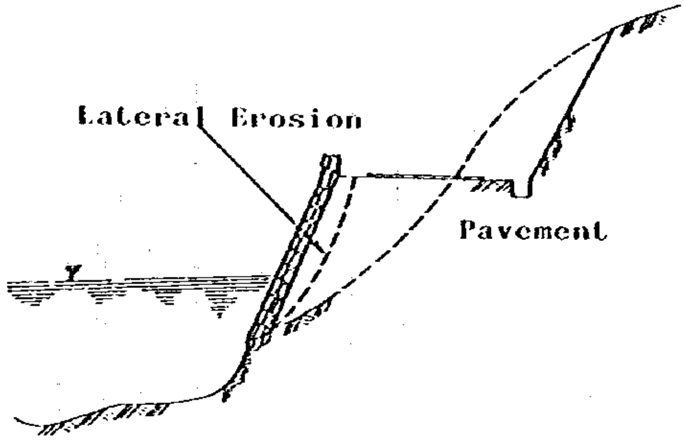
Type B



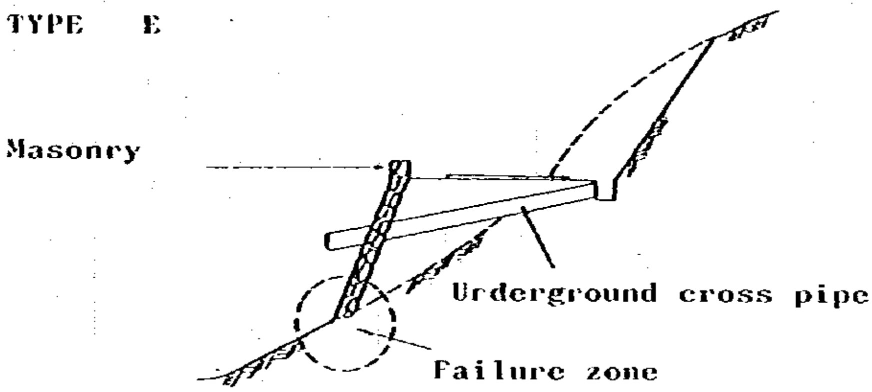
Type C



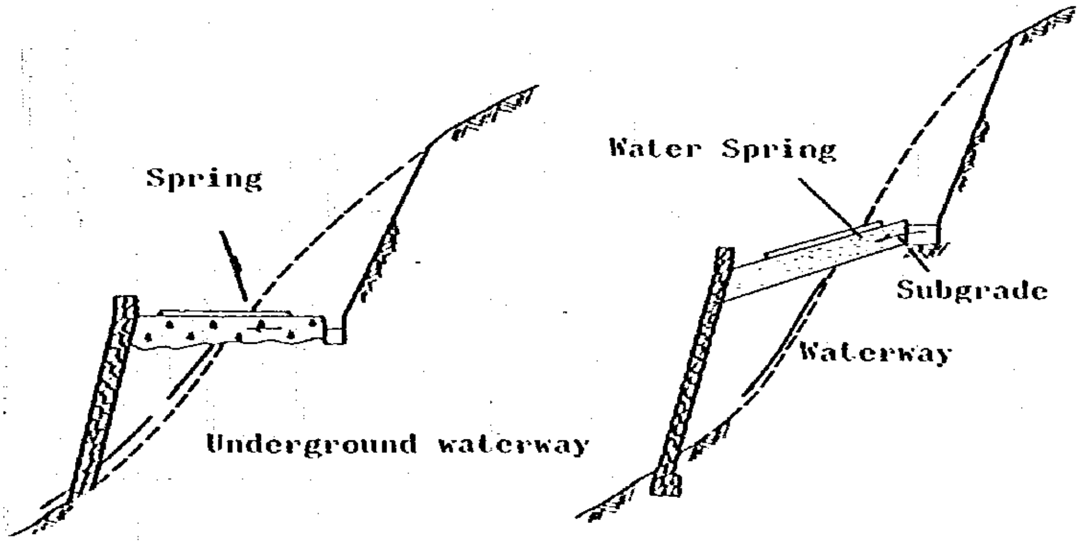
TYPE D



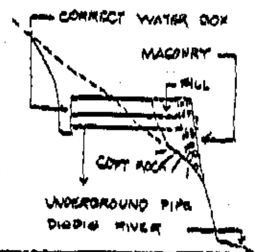
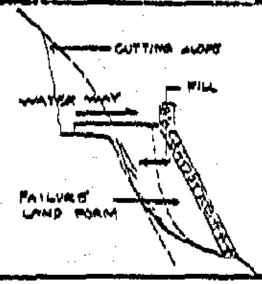
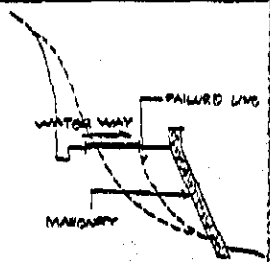
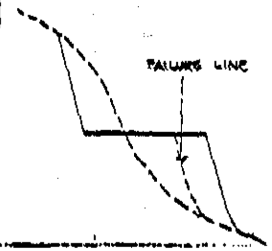
TYPE E



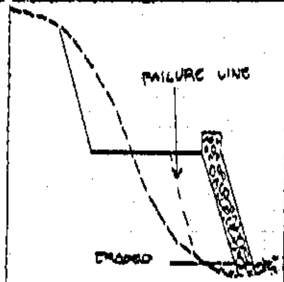
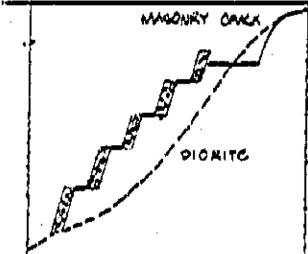
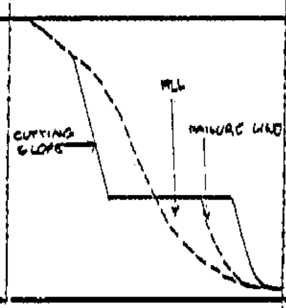
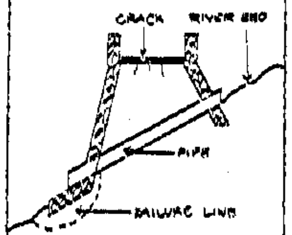
TYPE F



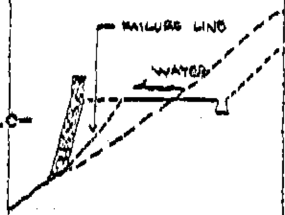
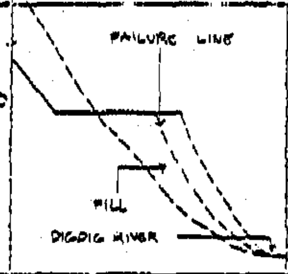
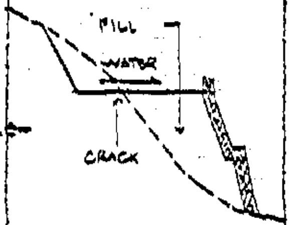
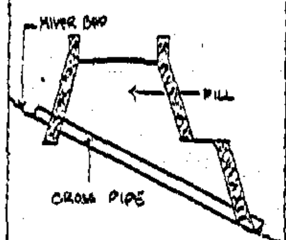
EMBANKMENT SLOPE STABILITY CHECK TABLE

NO.	KM.	LAND FORM FEATURE	CONDITION OF EMBANKMENT FEATURE	CONDITION OF PAVEMENT FEATURE	PRESENT LAND FORM	EMBANKMENT TREATMENT	NOTE
1	167.500	cutting and embankment	failure occurs at the under pipe	embankment settlement		failure zone repair by masonry and gutter repair	
2	167.580	cutting and embankment	* failure of embankment slope occurs due to under ground water, and overflow water	normal		failure zone repair by masonry and gutter repair	
3	185.900	cutting and embankment	* failure occurs due by overflow water	many cracks		failure zone repair by masonry and gutter repair	
4	186.100	cutting and embankment	* failure occurs due to running water from stream	normal		failure zone repair by masonry and gutter repair	

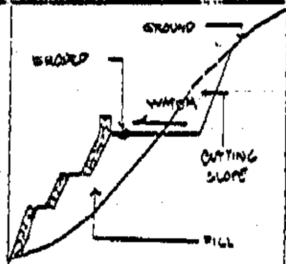
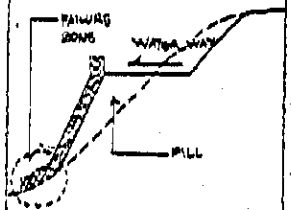
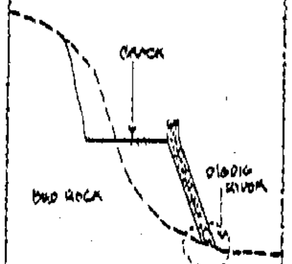
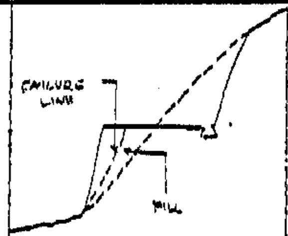
EMBANKMENT SLOPE STABILITY CHECK TABLE

NO.	KM.	LAND FORM TEXTURE	CONDITION OF EMBANKMENT	CONDITION OF PAVEMENT	PRESENT LAND FORM	EMBANKMENT TREATMENT	NOTE
5	186.300	cutting and embankment	* masonry foundation is eroded by Digdig river	crack		failure zone repair by masonry and gutter repair	
6	186.400		* masonry cracks	normal		gutter repair	
7	187.100		* embankment failure occurs by erosion of Digdig river	normal		failure zone repair zone by masonry and gutter repair	
8	187.200	embankment on gentle slope	* foundation of masonry is eroded by running water from pipe	settlement and cracks		appron foundation repair reinforcement of apron	

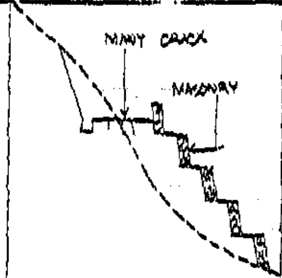
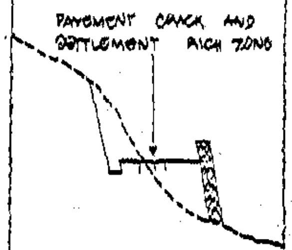
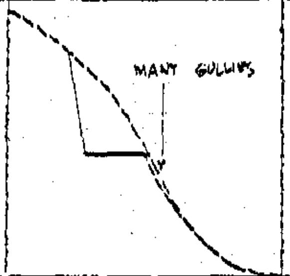
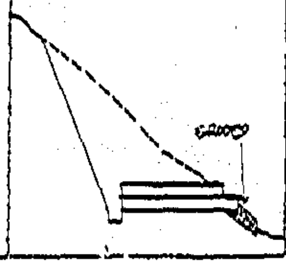
EMBANKMENT SLOPE STABILITY CHECK TABLE

NO.	K.M.	LAND FORM FEATURE	CONDITION OF EMBANKMENT	CONDITION OF PAVEMENT	PRESENT LAND FORM	SUGGESTMENT TREATMENT	NOTE
9	187.850	cutting and embankment	* masonry loosen	crack and grading settle- ment		failure zone repair by masonry	
10	188.100	cutting and embankment	* shoulder parts is eroded by digdig river	cracks on the pavement		failure zone repair by masonry	
11	188.300	cutting and embankment	masonry loosen	cracks and grading settle- ments		gutter repair	
12	188.350	embankment	normal				

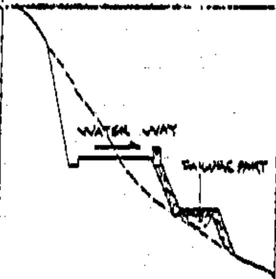
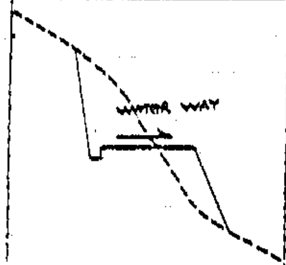
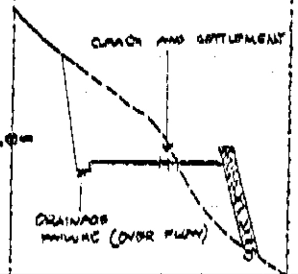
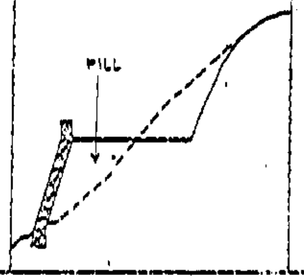
EMBANKMENT SLOPE STABILITY CHECK TABLE

NO.	KM.	LAND FORM FEATURE	CONDITION OF EMBANKMENT	CONDITION OF PAVEMENT	PRESENT LAND FORM	EMBANKMENT TREATMENT	NOTE
13	188.900	embankment	shoulder is eroded by overflow water from gutter	Many cracks on the pavement		gutter pavement	
14	190.500	cutting and embankment	Foot of masonry is eroded by overflow water	settlements and cracks		foundatinn repair	
15	192.600	cutting and embankment	Foot of masonry is eroded by overflow water	cracking		foundation repair	
16	192.700	cutting and embankment	Foot of masonry is eroded by overflow water	few cracks		protection of embankment slope is masonry	

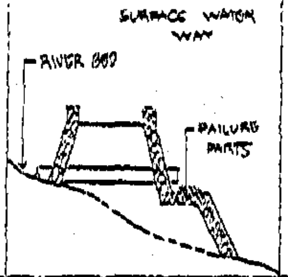
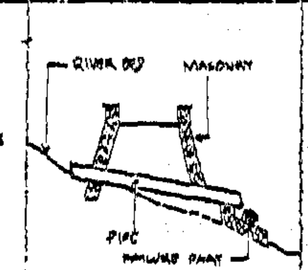
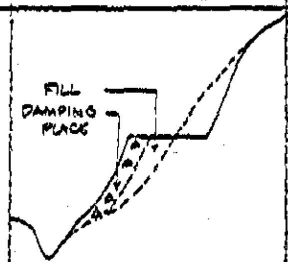
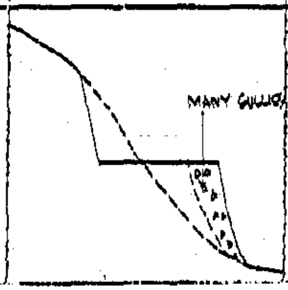
EMBANKMENT SLOPE STABILITY CHECK TABLE

NO.	K.M.	LAND FORM FEATURE	CONDITION OF EMBANKMENT	CONDITION OF PAVEMENT	PRESENT LAND FORM	EMBANKMENT TREATMENT	NOTE
17	195.800	cutting and embankment	normal	cracks and settloments		reinforcement of masonry	
18	201.500	cutting and embankment	normal	cracks and settloments		drainage boring	
19	203.400	cutting and embankment	natural slope, rich in many gullies	normal		gutter repair	
20	203.800	cutting and embankment	shoulder is croded by running water from pipe	normal		apron repair	

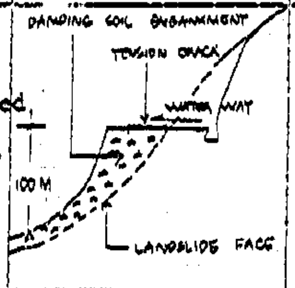
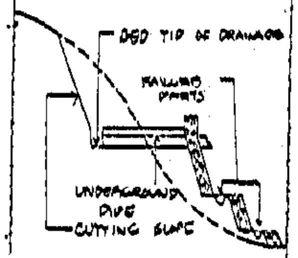
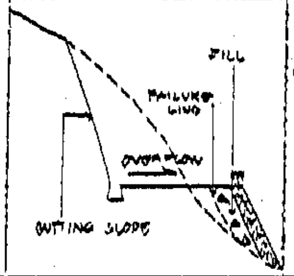
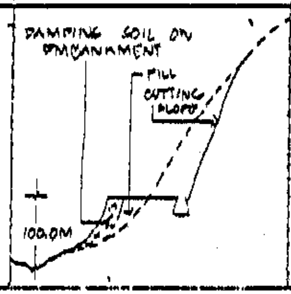
EMBANKMENT SLOPE STABILITY CHECK TABLE

NO.	K.M.	LAND FORM FEATURE	CONDITION OF EMBANKMENT FEATURE	CONDITION OF PAVEMENT FEATURE	PRESENT LAND FORM	EMBANKMENT TREATMENT	NOTE
21	204.500	cutting and embankment	failure of beam occurs by overflow water	normal		beam and gutter repair	
22	204.550	cutting and embankment	normal	cracks and settlements		gutter repair	
23	204.900	cutting and embankment	normal	cracks and grading settle-ments		gutter repair	
24	205.050	cutting and embankment	normal	normal			

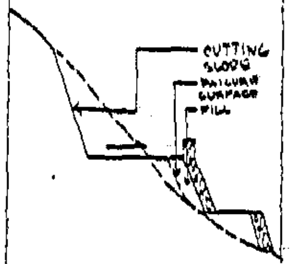
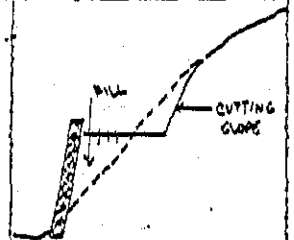
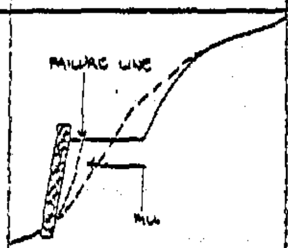
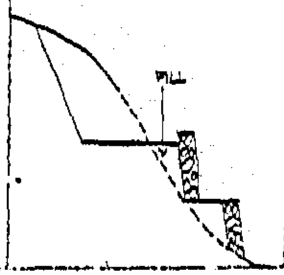
EMBANKMENT SLOPE STABILITY CHECK TABLE

NO.	KM.	LAND FORM FEATURE	CONDITION OF EMBANKMENT FEATURE	CONDITION OF PAVEMENT FEATURE	PRESENT LAND FORM	EMBANKMENT TREATMENT	NOTE
25	205.800	embankment on the swamp fill	masonry loose apron is eroded by water from pipe	many cracks		apron failure zone repair	
26	205.900	embankment on the swamp fill	masonry cracks apron is eroded by water from pipe	many cracks		apron repair	
27	206.100	cutting and embankment	embankment slope eroded by overflow water	normal		gutter repair	
28	206.400	cutting and embankment	embankment slope eroded by overflow water	cracks and settlements		gutter repair	

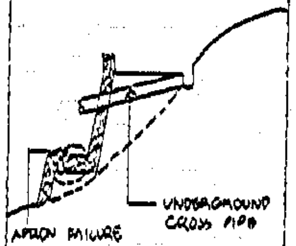
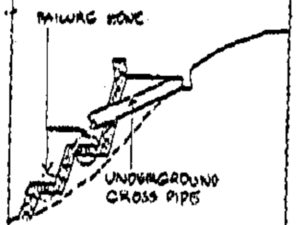
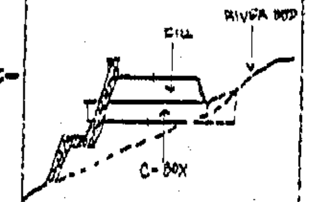
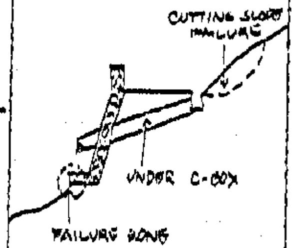
EMBANKMENT SLOPE STABILITY CHECK TABLE

NO.	KM.	LAND FORM FEATURE	CONDITION OF EMBANKMENT	CONDITION OF PAVEMENT	PRESENT LAND FORM	EMBANKMENT TREATMENT	NOTE
29	206.700	cutting and embankment	damping soil is sliding	cracks occured, damping soil is settlements		counterweight method for embankment drainage boring slope protection for cutting slope	
30	206.900	cutting and embankment	failure of masonry occuts by running water from pipe	many cracks		existing pipe repair vertical water way and gutter repair	
31	207.000	cutting and embankment	gutter and embankment failure	cracks and grading settlements		* gutter repair . embankment failure zone repair by masonry	
32	207.100	cutting and embankment	erosion and shoulder failure failure of embankment slope occurs by overflow water	normal		* shoulder failure repair by masonry	

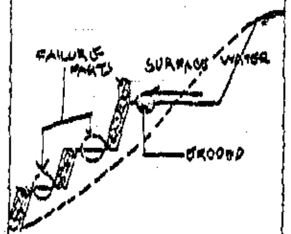
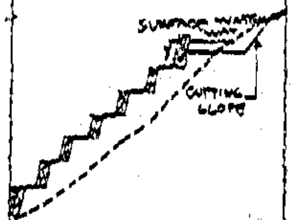
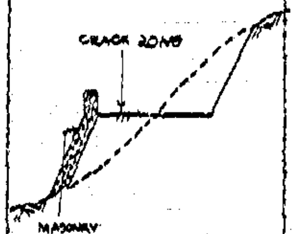
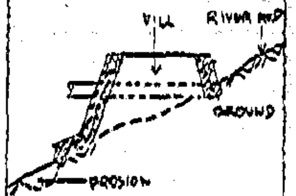
EMBANKMENT SLOPE STABILITY CHECK TABLE

NO.	KM.	LAND FORM FEATURE	CONDITION OF EMBANKMENT FEATURE	CONDITION OF PAVEMENT FEATURE	PRESENT LAND FORM	EMBANKMENT TREATMENT	NOTE
33	207.400	cutting and embankment	failure of road shoulder occurs by overflow water	crack		* shoulder failure repair by masonry	
34	207.500	cutting and embankment	masonry loosed	cracks and settlements		reinforcement of masonry	
35	207.600	cutting and embankment	failure of road shoulder occurs by running water from natural slope	many cracks and settlements		failure zone repair by masonry	
36	208.100	cutting and embankment	normal	normal			

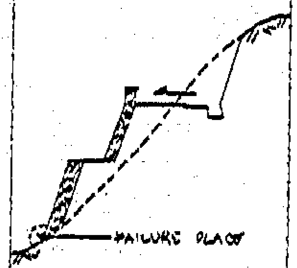
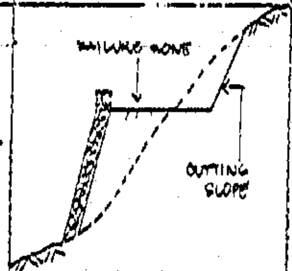
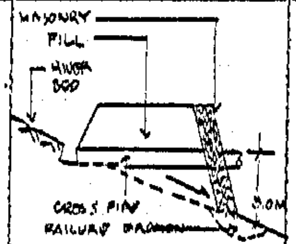
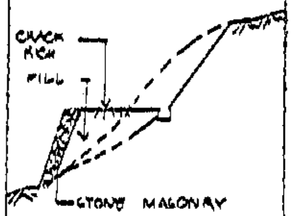
EMBANKMENT SLOPE STABILITY CHECK TABLE

NO.	KM.	LAND FORM FEATURE	CONDITION OF EMBANKMENT FEATURE	CONDITION OF PAVEMENT FEATURE	REGENT LAND FORM	EMBANKMENT TREATMENT	NOTE
37	208.200	embankment at ravine fill	failure of masonry occurs by running water from pipe	few cracks		failure of apron repair vertical water way.	
38	208.400	embankment at ravine fill	failure of masonry occurs by running water from pipe	many cracks		failure of apron repair vertical water way	
39	208.600	embankment at ravine fill	failure of masonry occurs by running water from pipe	cracks and grading settlements		failure of apron repair vertical water way	
40	209.200	embankment at ravine fill	failure of masonry occurs by running water from pipe	cracks and grading settlements		failure of apron repair vertical water way	

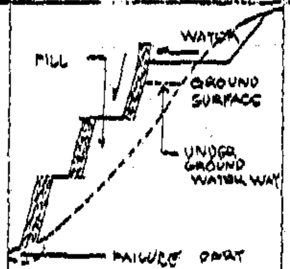
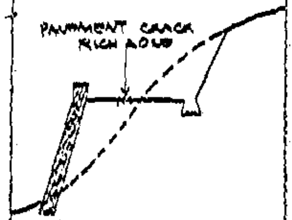
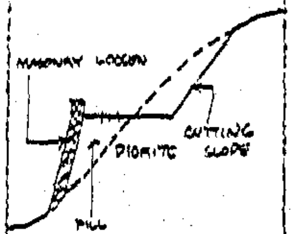
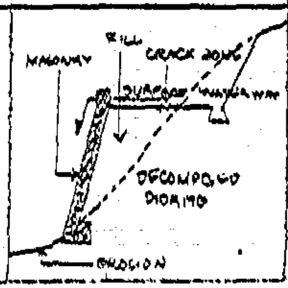
EMBANKMENT SLOPE STABILITY CHECK TABLE

NO.	KM.	LAND FORM FEATURE	EMBANKMENT FEATURE	PAVEMENT FEATURE	PRESENT LAND FORM	EMBANKMENT TREATMENT	NOTE
41	209.400	cutting and embankment	failure of apron occurs by over-flow water	cracking		apron repair gutter repair	
42	210.000	cutting and embankment	failure of apron occurs by over-flow water	cracks and grading settlements		gutter repair	
43	210.100	cutting and embankment	normal	cracks and grading settlements			
44	210.700	embankment	Toe of masonry foundation is eroded by running water from pipe	normal		apron repair and es-tablish vertical water way	

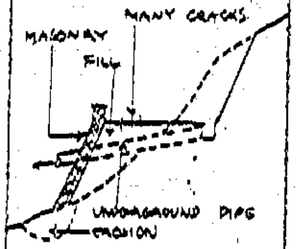
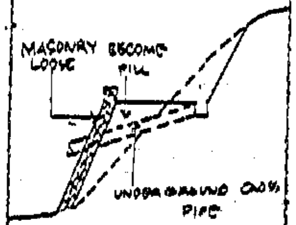
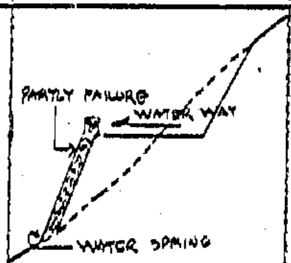
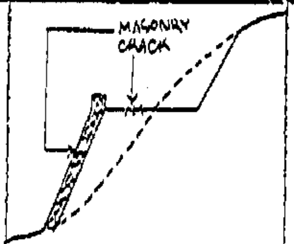
EMBANKMENT SLOPE STABILITY CHECK TABLE

NO.	KM.	LAND FORM FEATURE	EMBANKMENT	PAVEMENT	PRESENT LAND FORM	EMBANKMENT TREATMENT	NOTE
45	210.800	cutting and embankment	toe of masonry is eroded by overflow water	normal		reinforcement of foundation	
46	210.850	cutting and embankment	masonry loosen	cracks and grading settlements		reinforcement of masonry	
47	211.000	embankment	toe of masonry is eroded by water	normal		reinforcement of foundation apron and gutter repair	
48	211.700	cutting / and embankment	normal	cracks and grading		reinforcement of masonry	

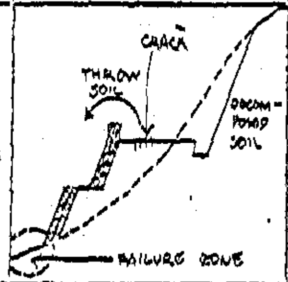
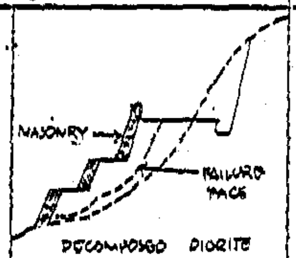
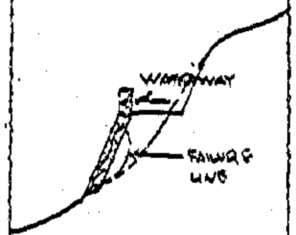
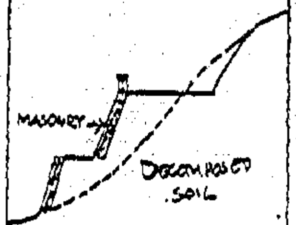
EMBANKMENT SLOPE STABILITY CHECK TABLE

NO.	KM.	LAND FORM FEATURE	CONDITION OF EMBANKMENT FEATURE	CONDITION OF PAVEMENT FEATURE	PRESENT LAND FORM	EMBANKMENT TREATMENT	NOTE
49	277.800	cutting and embankment	toe of foundation is eroded by over-flow water	normal		gutter repair	
50	277.900	cutting and embankment	normal	cracks and settlements		gutter repair over-lay	
51	272.500	cutting and embankment	normal	many cracks		overlay	
52	272.600	cutting and embankment	toe of masonry foundation is eroded by over-flow water from stream	many cracks		gutter repair overlay	

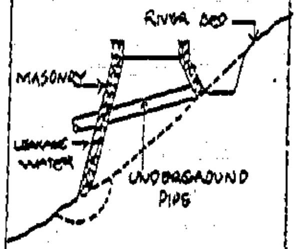
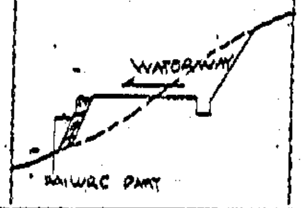
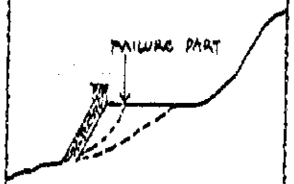
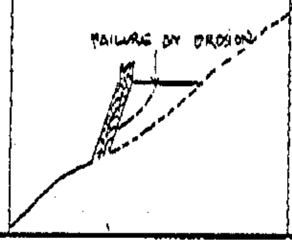
EMBANKMENT SLOPE STABILITY CHECK TABLE

NO.	KM.	LAND FORM	CONDITION OF EMBANKMENT	CONDITION OF PAVEMENT FEATURE	PRESENT LAND FORM	EMBANKMENT TREATMENT	NOTE
53	212.700	cutting and embankment	toe of masonry foundation is eroded by running water from	many cracks on pavements		vertical drain reinforcement of foundation	
54	212.750	cutting and embankment	masonry loose	many cracks and settlements		vertical drain	
55	213.000	cutting and embankment	masonry loose	normal		reinforcement of masonry	
56	213.200	cutting and embankment	normal	cracks and grading settlements		reinforcement of masonry	

EMBANKMENT SLOPE STABILITY CHECK TABLE

NO.	KM.	LAND FORM FEATURE	CONDITION OF EMBANKMENT	CONDITION OF PAVEMENT	PRESENT LAND FORM	EMBANKMENT TREATMENT	NOTE
57	213.250	cutting and embankment aglon fill	masonry foundation is eroded by ground water	many cracks		gutter repair reinforcement of foundation	
58	213.400	cutting and embankment	embankment failur occurs by over-flow water	normal		gutter repair reinforcement of masonry	
59	213.500	cutting and embankment	masonry loose	few cracks and settlements		gutter repair reinforcement of masonry	
60	213.600	cutting and embankment	normal	normal		gutter repair	

EMBANKMENT SLOPE STABILITY CHECK TABLE

NO.	KM.	LAND FORM FEATURE	CONDITION OF EMBANKMENT FEATURE	CONDITION OF PAVEMENT FEATURE	PRESENT LAND FORM	EMBANKMENT TREATMENT	NOTE
61	273.700	embankment	masonry foundation is eroded by running water from pipe	cracking		vertical drain reinforcement of foundation	
62	274.700	cutting and embankment	masonry loose	normal		gutter repair	
63	274.900	cutting and embankment	failure occurs due to overflow water	many cracks		reinforcement of masonry	
64	275.000	cutting and embankment	failure occurs by overflow water	cracks and settlements		reinforcement of masonry	