APPENDIX 12-1

SPECIFICATION FOR CONCRETE PAVEMENT

TABLE 1 STANDARD SPECIFICATION FOR CONCRETE PAVEMENT

REVISED 1972

Specification Item	Description
1. Aggregate Subbase Materials	1) Proportion of the filler passing N 200 sieve to that passing N 040 sieve is less than 2/3 and not to exceed of total
	2) Liquid limit = less than 25
	3) Plasticity index = less than 6
Compaction	1) More than 95% of maximum density as determined by AASHTO T-180, C or D.
2. Concrete Slab Materials	1) Cement = the requirement of AASHTO M 85 shall be conformed.
	2) Fine Aggregate =

Sieve Size	Percent Passing
3/8 inch	100
# 4	95-100
# 16	45- 80
# 50	10- 30
#100	2- 10

3) Coarse Aggregate

	Passing (40)		
	Grading A	Grading B	Grading C
2-1/2"		100%	
2"	100%	95-100	
1-1/2"	95-100		100%
1"		35- 70	95-100
3/4"	35- 70		
1/2"		10- 30	25- 60
3/8"	10- 30		
No. 4	0- 5	0- 5	0- 10

Specification Item	Description
	- Abrasion loss = less than 45
Concrete Strength	- Not specified
Measuring of Materials	- In principal, measured by weight but by equivalent volume will be permitted in special case.
	- Water shall be measured for each batch by accurate measure device.
Mixing	- Mixer with capacity at least 27 cubic feet
	- Maximum net water content per bag of cement is 23 liters.
	- Amount of cement is 7.85 bag per cubic meter.
	- Slump is within ranging from 5 cm to 7.5 cm.
Finishing and Compaction	- In principal, a mechanical concrete spreader and a finishing machine with vibrating, screeding and trowelling functionsshall be used but hand finishing will be permitted in special case.

TABLE 2 BPH MEMO CIRCULAR FOR CONCRETE PAVEMENT

Item 316 - Portland Cement Concrete Pavement

Cement - Type I, Portland Cement ASTM C-150 or AASHO M-85,

Fine Aggregate:

Sieve Designation	% Passing
3/8"	100
No. 4	95 - 100
No. 16	45 - 80
No. 50	10 - 30
No. 100	2 - 10
No. 200 (by Washing)	0 - 3
Mortar Strength - 90% min. at 7 days	

Coarse Aggregate

Sieve Designation	Grading A	Grading B	Grading C
2- 1/2"		100	
2"	100	95 - 100	100
1-1/2"	95 - 100		100
1"		35 - 70	95 - 100
3/4"	35 - 70		
1/2"		10 - 30	25 - 60
3/8"	10 - 30		
No. 4	0 - 5	0 - 5	0 - 10
No. 200 (By washing)			

Abrasion Loss: 45% max.

Water - Odorless, colorless, tasteless

Proportioning of Concrete: -

At least 4.5 bags/cu.yd (8.5 bags/m^3) based on 94-lb bags of cement. (BPH Mens. Circular No. 48 dated April 25, 1973)

Water - 6 gallons (23 L) max. per 94-lb. bag.

Slump - 2 to 3 inches (5 to 7.5 cm)

Flexural Strength at 14 - days (BPH, Memo. Circular No. 48):

525 psi by third-point method

600 psi by mid-point method

GENERAL SPECIFICATIONS FOR CONCRETE PAVEMENT

1976

ITEM 301 GRANULAR SUB-BASE

301.1 DESCRIPTION

1. This item shall consist of furnishing, spreading and compacting granular sub-base in accordance with the Specification and the Drawings. Granular sub-base shall consist of natural or processed aggregates such as gravel, sand or stone fragments which shall conform to the following requirements.
2. Sub-base material shall be either Class A or Class B as shown on the Drawings.
3. Where sub-base is required to be placed on a subgrade consisting of an existing cement concrete pavement prepared in a accordance with Clause 205.2.6 and where the surface levels of the resulting subgrade level are outside the permitted tolerance given in Table a levelling course of sub-base material shall be laid as shown on the Drawings. This work shall comply with the requirements of this Item.

301.2 MATERIAL REQUIREMENTS

1. The granular sub-base material shall be clean and free from organic matter and other deleterious substances and shall be of such nature that it can be compacted readily under watering and rolling to form a firm, stable base.
2. The material shall comply to the following grading and quality requirements.

   (a) The sub-base material shall have a grading curve within the limits of either Class A or Class B given in Table The Coefficient of Uniformity D_{60}/D_{10} shall be not less than 3, where D_{60} and D_{10} are the particle diameters corresponding, respectively, to 60% and 10% passing (by weight) in a grain size analysis.

TABLE 3 SUB-BASE MATERIAL GRADING

US Standard Sieve		Percent Passing By Weight	
mm	Alternative	Class A	Class B
75	(3")	100	
37.5	(1 1/2")	80 - 100	100
9.5	(3/8")	45 - 100	-
4.75	(No. 4)	30 - 85	60 - 100
2.00	(No. 10)	15 - 65	40 - 90
0.425	(No. 40)	5 - 35	15 - 50
0.075	(No. 200)	0 - 15	2 - 15

(b) The material shall have a soaked CBR-value of not less than 25%, determined according to ASTM D1883. The CBR-value shall be obtained at a density corresponding to 98% of the maximum dry density determined according to AASHTO T180 Method D.

(c) The coarse aggregate material retained on a 4.75 mm (No. 4) sieve shall have a percentage of wear by the Los Angeles Abrasion test (AASHTO T96) of not more than 50.

(d) The maximum dimension of any particle shall be not greater than two-thirds of the required thickness of the layer in which it is to be placed. Oversize material if present shall be removed at the pit by screens or grizzlies or by hand picking.

(e) In order to avoid intrusion in the sub-base of silty and clayey material from the subgrade, it will be required that the ratio D_{15} (Sub-base)/D_{85} (Subgrade) is less than 5, where D_{15} and D_{85} are the particle diameters corresponding, respectively, to 15% and 85% passing (by weight) in a grain size analysis.

3. The portion passing the 0.425 mm (No. 40) sieve shall have a liquid limit not greater than 35 and a plasticity index not greater than 11 as determined by AASHTO T89 and T90 respectively.

ITEM 406 CEMENT CONCRETE PAVEMENT

406.1 DESCRIPTION

This work shall consist of constructing a pavement of portland cement concrete on a prepared base in accordance with the Specification and the Drawings.

406.2 CLASSES OF CONCRETE

The classes of concrete for cement concrete pavement shall be Class E and Class F. The concrete shall satisfy the requirements of Table 4.

TABLE 4 REQUIREMENTS FOR CEMENT CONCRETE

Class	Max. Size of Coarse Aggregate		28 day Compressive Strength		28 day Flexural Strength	
	mm	in	kgf/cm^2	N/mm^2	kgf/cm^2	N/mm^2
E	75	(3)	280	(28)	43	(4.3)
F	50	(2)	280	(28)	43	(4.3)

406.3 MATERIAL REQUIREMENTS

406.3.1 Portland Cement

Portland Cement shall conform to the requirements of clause 501.3.1.

406.3.2 Fine Aggregate

Fine aggregate shall conform to the requirements of Clause 501.3.2.

406.3.3 Coarse Aggregate

The coarse aggregate shall conform to the requirements of Clause 501.3.3.

406.3.4 Combined Aggregate

The aggregate shall unless otherwise ordered by the Engineer be combined in proportions to produce a mixture within the grading limits for combined aggregates shown in Table 5.

TABLE 5 GRADING OF COMBINED AGGREGATES

US Standard Sieve		Percent Passing By Weight	
mm	Alternative	Class E	Class F
75	(3")	100	-
63	(2½")	95 - 100	-
50	(2")	80 - 95	100
37.5	(1½")	65 - 87	80 - 100
25	(1")	50 - 75	50 - 86
19	(3/4")	45 - 66	45 - 75
9.5	(3/8")	38 - 55	38 - 55
4.75	(No. 4)	30 - 45	30 - 45
2.36	(No. 8)	23 - 35	23 - 38
1.18	(No. 16)	17 - 27	17 - 33
0.600	(No. 30)	10 - 17	10 - 22
0.300	(No. 50)	4 - 9	4 - 10
0.150	(No. 100)	1 - 3	1 - 3
0.075	(No. 200)	0 - 2	0 - 2

APPENDIX 12-2

PRESENT STATE OF ASPHALT PAVEMENT

PRESENT STATE OF ASPHALT PAVEMENT

1 Material

1-1 Petroleum Asphalt

Crude Oil materials are mainly imported from the Middle East of varying types namely: the Arab Heavy, Arab Medium,and Kuwait types. Recently, crude oil has been produced from Philippine oil wells namely: the Minas, Tapis, Matinloc, Nido, Cadlao, etc.

1-1-1 Present Quantity of Production

Various petroleum companies have put up their refinery plants using crude oil or raw materials. Importation of crude oil are shown in Table 1 decreasing by year in thousand barrel as a result of inventory draw down.

TABLE 1
CRUDE OIL IMPORTATION (MB)

	1980	1981	1982	1983	1984	1985
Crude Oil	68,014	60,761	57,003	59,827	49,453	48,843

MB = Volume in Thousand Barrels
DATA SOURCE: Bureau of Energy

Total refinery production indicating percentage share of each By Products are shown in Table 1-1-1B.

TABLE 2
% SHARES OF REFINERY PRODUCTION
1980 - 1985

	1980	1981	1982	1983	1984	1985
AVGAS	-	-0.01	-	-0.01	-0.01	0.02
AVTURBO	3.5	3.3	4.4	11.9	7.0	6.2
Premium Gasoline	9.3	9.5	11.4	26.3	11.3	13.7
Regular Gasoline	8.6	6.9	4.9	11.6	4.4	5.2
Diesel	5.5	6.8	6.5	6.1	4.2	4.4
Fuel Oil	26.2	26.7	27.2	28.7	31.4	32.0
Kerosene	41.7	41.7	39.4	36.1	34.7	32.0
PG	0.4	0.3	0.3	0.3	0.3	-
LPG	2.8	2.1	2.1	2.6	2.8	3.2
Asphalt	0.5	0.6	0.7	1.0	0.6	0.5
Solvents	0.4	0.3	0.8	0.6	0.3	0.4
Naphtha	1.2	1.6	2.3	4.0	3.0	2.2
Others	-	-	-	-	-	-
Total Refinery Products	100.0	100.0	100.0	100.0	100.0	100.0

DATA SOURCE: Bureau of Energy

The total petroleum asphalt of production is shown in Table below.

TABLE 3
PETROLEUM ASPHALT PRODUCT

Name of Company	1 9 8 4	1 9 8 5
Petrophil. Corporation	47,180 m. ton	38,830 m. ton

DATA SOURCE: Petrophil. Corporation

1-1-2 Productive Capacity

There are only three major companies that produce asphalt. Their capacity are shown in Table

TABLE 4

PLANT REFINERY CAPACITY

Name of Company	Capacity Per Day
Petrophil. Corporation	150,000 Barrel/day
Caltex Philippines	70,000 Barrel/day
Pilipinas Shell	65,000 Barrel/day
T O T A L	285,000 Barrel/day

DATA SOURCE: Bureau of Energy

1-1-3 Quality

The quality of Asphalt produced are shown in Table 5 below.

TABLE 5

ASPHALT GRADE PRODUCED

Asphalt Type	G r a d e	%
Asphalt Cement	60/70, 85/100, 150/200	80%
Emulsified Asphalt	SS-1	10%
Cutback Asphalt	MC-70, MC-250, RC-800	10%
Oxidize Asphalt		

DATA SOURCE: Petrophil. Corporation

1-2 Aggregates

There are two ingredients in asphalt construction - aggregate, including mineral filler if it is used, and asphalt. The performance of asphalt structure can be influence by the properties of the aggregate and of the asphalt used.

Aggregate is the most important ingredient in asphalt paving. It is 92 to 96 percent of the weight of mixture. The aggregate fraction consist of coarse aggregate, fine aggregate and mineral filler. The dividing size between coarse and fine aggregate is 2.36 mm.

Coarse aggregate maybe obtained from gravel deposits or stone quarries. The source of fine aggregate are natural deposits of bank, river sand or screening from aggregate crushing plants.

Sand includes natural sand, artificial sand, crushed stone, dust, etc. Natural sand is classified by source of product into river sand, pit sand and sea sand. The most common source of sand used for road pavements originates from the rivers.

1-3 Filler

Mineral filler may consists of finely ground limestone, rock powder, naturally-occuring silt, portland cement, hydrated lime or similar clean non-plastic finely divided mineral matter. It may occur naturally in the fine and coarse aggregate as mineral dust or it maybe added as a separate ingredient.

2. Asphalt Concrete

Bituminous mixture is a proportioned combination of bituminous material and aggregate with or without mineral filler. The common practice is without mineral filler. The Asphalt Penetration Grade is 85 - 100.

A bituminous paving mixture is called "Plant Mix" if it is prepared in a central mixing plant. Depending on the grade of aggregate, the mixture maybe classified into dense graded and open graded. Both types maybe road or plant mix designed as base or surface courses. All types of bituminous materials maybe used except the rapid-curing cutbacks and the rapid-breaking emulsions.

3. Paving Operation

Paving Operation includes the preparation of the paving equipment and inspection of the Binder and the base. Check the paving equipment since the breaking down would affect the paving operation. The surface must be cleaned of loose and foreign material.

A Tack Coating is applied to the surface of an underlying course by spraying emulsified asphalt. The most common use is the Asphalt Sprayer or Asphalt Distributor. The rate of application of emulsified asphalt used in tack coating is within the range from 0.4 to 0.8 liters per square meter.

The most common use equipment is the Baber Greene and Blawknox for spreading. The paving width of the equipment is 3 meters. The spreading and finishing equipment in operation leaves in the new surface course tracks or indented areas that are not corrected by the scheduled operations or if other blemishes are produced, the use of such equipment shall be discontinued.

After spreading the material shall be thoroughly compacted to the required lines, grades and cross section by means of pneumatic tampers, or with other compacting equipment which consistently obtain the degree of compaction required. The compacting equipments use are the Macadam Roller, Pneumatic Self Propelled Roller and Tandem Static Smooth Drum Roller.

Joint shall be formed by cutting back on the previous days run so as to expose the full length of the course. The exposed edge shall be painted with a thin coat of hot asphalt cement or asphalt cement thinned with naptha, or emulsified asphalt. The fresh mixture shall be raked against the joint, thoroughly tamped with hot tampers and rolled.

4. Quality Control and Inspection

A higher degree of quality control is necessary in asphalt construction, compared to concrete construction. The temperature control is important since the asphalt is semi-solid under normal temperatures. Control of asphalt is also critical, since too much or too little of asphalt in the mixture will make it unstable. The quality control measures should be strictly followed in order to expect satisfactory performance of the asphalt structures.

Inspection involves investigation of the work done and material quality of the finished pavement, to check whether all aspects of pavement quality satisfy the requirements of contract plans and specification.

APPENDIX 12-3

TRAFFIC REGULATIONS

TABLE 1 COMPARATIVE TABLE OF VEHICLE WEIGHTS BY VARIOUS ACTS, LETTERS OF INSTRUCTIONS AND MEMORANDA

Type of Wheel/Axle/ Truck	RA 4136 1964	LOI 112 1973	LOI 874 1979	MPH Memorandum Circular 98 25 July 1977	MPH Memorandum of 8 Jan. 1979	MPWH Memorandum of 18 Dec. 1979	MPWH Memorandum of 11 Nov. 1981	MPWH Memorandum of Agreement 13 May 1983 d/
Per most heavily loaded wheel	3,600 kg							
Per most heavily loaded axle	8,000 kg							
Per most heavily loaded axle group (The two axles being at least 1 m & less than 2 m apart)	14,500 kg							
Truck with two axles (6 wheels)		15 tons a/	14 tons b/ net weight	14,700 kg to 16,000 kg c/	15,000 kg	16,000 kg	15,000 kg	15,000 kg
Truck with tandem rear axles (3 axles/10 wheel)		15 tons a/	25 tons b/ net weight	19,000 kg to 20,000 kg c/	21,000 kg	25,000 kg	21,000 kg	21,000 kg
Truck semi-trailer with five axles (18 wheels, Code 12-2)		27 tons a/			33,000 kg		33,000 kg	33,000 kg
Truck semi-trailer with four axles (14 wheels, Code 11-2 or 12-1)		27 tons a/					27,000 kg	27,000 kg
Truck semi-trailer with three axles (10 wheels, Code 11-1)		27 tons a/					20,000 kg	29,000 kg
Truck trailer with two axles at motor vehicle and two axles at trailer (Code 11-11)							28,000 kg	28,000 kg
Truck trailer with two axles at motor vehicle and three axles at trailer (Code 11-12)							34,000 kg	34,000 kg
Truck trailer with three axles at motor vehicle and two axles at trailer (Code 12-11)							35,000 kg	35,000 kg
Truck trailer with three axles at motor vehicle and three axles at trailer (Code 12-12)							41,000 kg	41,000 kg

a/ Apparently short tons (15 short tons - 13,608 kg; 27 short tons = 24,494 kg)

b/ The net load (metric tons) allowed by LOI No. 874 relates to palay, rice and corn only. The net limits were subsequently changed to gross weights of 19,000 kg for 6-wheelers and 30,000 kg for 10 wheelers, vide MPWH Memorandum date 7 May 1981. The LOI is still in force.

c/ The weights were limited to specific truck models, and did not include all truck models.

d/ Between the Ministry of Public Works and Highways, the Ministry of Transportation and Communications and Ministry of Defense. This Memorandum of Agreement has been signed by the respective Ministries but the implementing guidelines have yet to be introduced and it is not inforce.

CHAPTER III. PERMITTED WEIGHTS AND OVERALL DIMENSIONS OF VEHICLES

Article 5. Permitted Axle Loads

(a) The weight transmitted to the road surface by all the wheels of a single two tire axle shall not exceed 8,000 kg. A tandem axle shall be regarded as two single axles in this respect.

(b) The weight transmitted to the road surface by all the wheels of a single four tire axle shall not exceed 13,000 kg. A tandem axle shall be regarded as two single axles in this respect.

(c) The weight transmitted to the road surface by all the wheels of a three axle bogie (12 wheels) shall not exceed 30,000 kg.

(d) The weight transmitted to the road surface by all the wheels of a three axle bogie (6 wheels) shall not exceed 23,000 kg.

Article 6. Permitted Gross Weights For Trucks -

(a) The sum of the weights transmitted to the road surface by all the wheels of a truck with two axles (6 wheels) shall not exceed 18,000 kg.

(b) The sum of the weights transmitted to the road surface by all the wheels of a truck with three axles (10 wheels) of which two form a tandem with a single motive axle shall not exceed 28,000 kg.

(c) The sum of the weights transmitted to the road surface by all the wheels of a truck with three axles (10 wheels) of which two form a tandem with two motive axles shall not exceed 31,000 kg.

(d) The sum of the weights transmitted to the road surface by all the wheels of a truck with three axles (8 wheels) of which two axles are steering axles shall not exceed 26,000 kg.

(e) The sum of the weights transmitted to the road surface by all the wheels of a truck with four axles (12 wheels) shall not exceed 38,000 kgs.

(f) The sum of the weights transmitted to the road surface by all the wheels of a truck other than those specified in 6(a), 6(b), 6(c), 6(d), and 6(e) supra shall not exceed 90 (ninety) percent of the sum of the maxium permitted loads on the individual axles of the truck.

Article 7. Permitted Gross Combination Weights For Articulated Vehicles

(a) The sum of the weights transmitted to the road surface by all the wheels of an articulated vehicle with three axles (10 wheels) shall not exceed 31,000 kg.

(b) The sum of the weights transmitted to the road surface by all the wheels of an articulated vehicle with four axles (14 wheels) shall not exceed 41,000 kg.

(c) The sum of the weights transmitted to the road surface by all the wheels of an articulated vehicle with five axles (18 wheels) shall not exceed 50,000 kg.

(d) The sum of the weights transmitted to the road surface by all the wheels of an articulated vehicle with six axles (22 wheels) shall not exceed 50,000 kg where the length of the vehicle, not including projecting load, is less than 14 (fourteen) meters and shall not exceed 54,000 kg where the length of the vehicle, not including projecting load, is 14 (fourteen) meters or more but less than 15.5 (fifteen and a half) meters and shall not exceed 58,000 kg where the length of the vehicle, not including projecting load, is more than 15.5 (fifteen and a half) meters.

(e) The sum of the weights transmitted to the road surface by all the wheels of an articulated vehicle other than those specified in 7(a), 7(b), and 7(c) and 7(d) supra shall not exceed 90 (ninety) per cent of the sum of the maximum permitted loads on the individual axles of the vehicle.

Article 8. Permitted Gross Weights for Drawbar Trailers

(a) The sum of the weights transmitted to the road surface by all the wheels of a drawbar trailer with three axles (12 wheels) or more (12 wheels or more) shall not exceed 33,000 kg.

(b) The sum of the weights transmitted to the road surface by all the wheels of a drawbar trailer other than those specified in 8(a) supra shall not exceed 90 (ninety) percent of the sum of the maximum permitted loads on the individual axles of the trailer.

Article 9. Permitted Gross Combination Weights For Truck-Trailers

The sum of the weights transmitted to the road surface by all the wheels of a truck-trailer shall not exceed 50,000 kg where the length of the truck-trailer, not including projecting load, is less than 14 (fourteen) meters and shall not exceed 54,000 kg where the length of the truck-trailer, not including projecting load, is 14 (fourteen) meters or more but less than 15.5 (fifteen and a half) meters and shall not exceed 58,000 kg where the length of the truck-trailer, not including projecting load, is more than 15.5 (fifteen and a half) meters.

APPENDICES FOR CHAPTER 13

APPENDIX 13-1

FORMATS FOR PAVEMENT CONDITION SURVEY

TABLE 1

INDIVIDUAL PRESENT SERVICEABILITY RATING

BOUND : ______________________ DATE : ______________________

ROAD SECTION : ______________________ RATER : ______________________

VEHICLE : ______________________

KM.	Surface Condition					Acceptable		
	VG	G	F	P	VP	YES	NO	Un-decided

POINTS		SURFACE CONDITION
5 ~ 4	—	Very Good (VG) - Very Comfortable
4 ~ 3	—	Good (G) - Comfortable
3 ~ 2	—	Fair (F) - Satisfactory
2 ~ 1	—	Poor (P) - Uncomfortable
1 ~ 0	—	Very Poor (VP) - Very Uncomfortable

TABLE 2

INDIVIDUAL REHABILITATION REQUIREMENT RATING

BOUND: ____________________ DATE: ____________________

ROAD SECTION: ____________________ RATER: ____________________

VEHICLE: ____________________

KM.	Surface Condition					Acceptable		
	5	4	3	2	1	YES	NO	Un-decided

POINTS		SURFACE CONDITION
5 ~ 4	—	No Deficiencies
4 ~ 3	—	Little Deficiencies
3 ~ 2	—	Considerable Deficiencies but immediate treatment is not required.
2 ~ 1	—	Considerable severe deficiencies, immediate treatment is required
1 ~ 0	—	Reconstruction is immediately required.

REMARKS

A – Sealing

B – Patching

TABLE 3 OCULAR SURVEY OF PAVEMENT DEFICIENCIES AND GENERAL INFORMATIONS

Bound : ______________________ Date : ______________________

Section : ______________________ Surveyor : ______________________

KM.	Town / City	General Information					Crack (%)									Patching	Faulting	Sealant Failure	Pumping
		T	L	S	D	CY	Type	Crack Length per 100 m of a lane (m)											
								0	50	100	150	200	250	300	AVE.	m	Each		NO.
+000		1 2 3	1 2 3 4 5	1 2 3	1 2 3		1 2 3 4											1 2	
+100		1 2 3	1 2 3 4 5	1 2 3	1 2 3		1 2 3 4											1 2	
+200		1 2 3	1 2 3 4 5	1 2 3	1 2 3		1 2 3 4											1 2	
+300		1 2 3	1 2 3 4 5	1 2 3	1 2 3		1 2 3 4											1 2	
+400		1 2 3	1 2 3 4 5	1 2 3	1 2 3		1 2 3 4											1 2	
+500		1 2 3	1 2 3 4 5	1 2 3	1 2 3		1 2 3 4											1 2	
+600		1 2 3	1 2 3 4 5	1 2 3	1 2 3		1 2 3 4											1 2	
+700		1 2 3	1 2 3 4 5	1 2 3	1 2 3		1 2 3 4											1 2	
+800		1 2 3	1 2 3 4 5	1 2 3	1 2 3		1 2 3 4											1 2	
+900		1 2 3	1 2 3 4 5	1 2 3	1 2 3		1 2 3 4											1 2	

Topography (T)
1. Flat (F)
2. Rolling (R)
3. Mountainous (M)

Drainage Condition (D)
1. Good (G)
2. Fair (F)
3. Bad (B)

General Information
Location (L)
1. Rice Field (R)
2. Plowed Field (P)
3. Coconut Field (C)
4. Forest (F)
5. Wasteland (W)

Section Type (S)
1. Cut (C)
2. Embankment (E)
3. Cut / Embankment (C/E)

Construction Year (CY)

Types of Cracking
1. Longitudinal Cracking (L)
2. Transverse Cracking (T)
3. Corner Cracking (C)
4. Block / Random Cracking (A)

Sealant Failure
1. No Failure
2. Failure

TABLE 4

ROUGHNESS SURVEY

ROAD NO. ________ NAME ______________________________ RUN NO. ______

FROM ____________ TO ____________ DRIVER ____________ RECORDER ____________

SPEEDOMETER (AT START) ______ AT END ______ FACTOR ______ ACT. DIST. ______ DATE ______

TACHOMETER (AT START) ______ AT END ______ FACTOR ______ ACT. DIST. ______ ST. TIME ______

ODOMETER (AT START) ______ AT END ______ FACTOR ______ ACT. DIST. ______ FIN. TIME ______

ODOMETER	INTEGRATOR		PAVEMENT		STRUC. JCT.	REMARKS
	INTENSITY	DIFF.	TYPE	COND.		

APPENDIX 13-2

CORRELATION ON MEASUREMENT VARIABLES ON PAVEMENT CONDITIONS

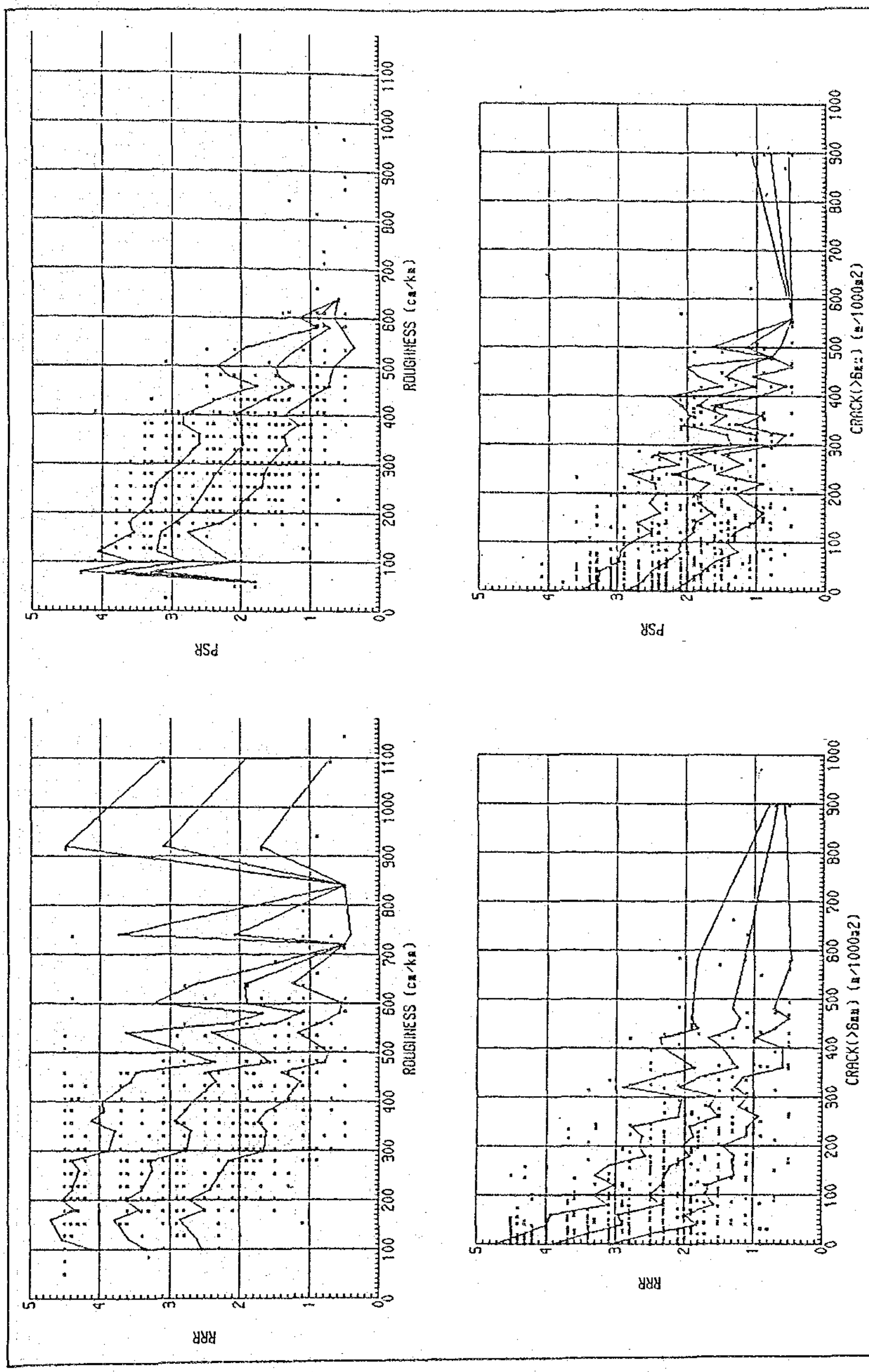


Figure 1 (a) RRR/PSR VS. MEASUREMENT VARIABLES (1)

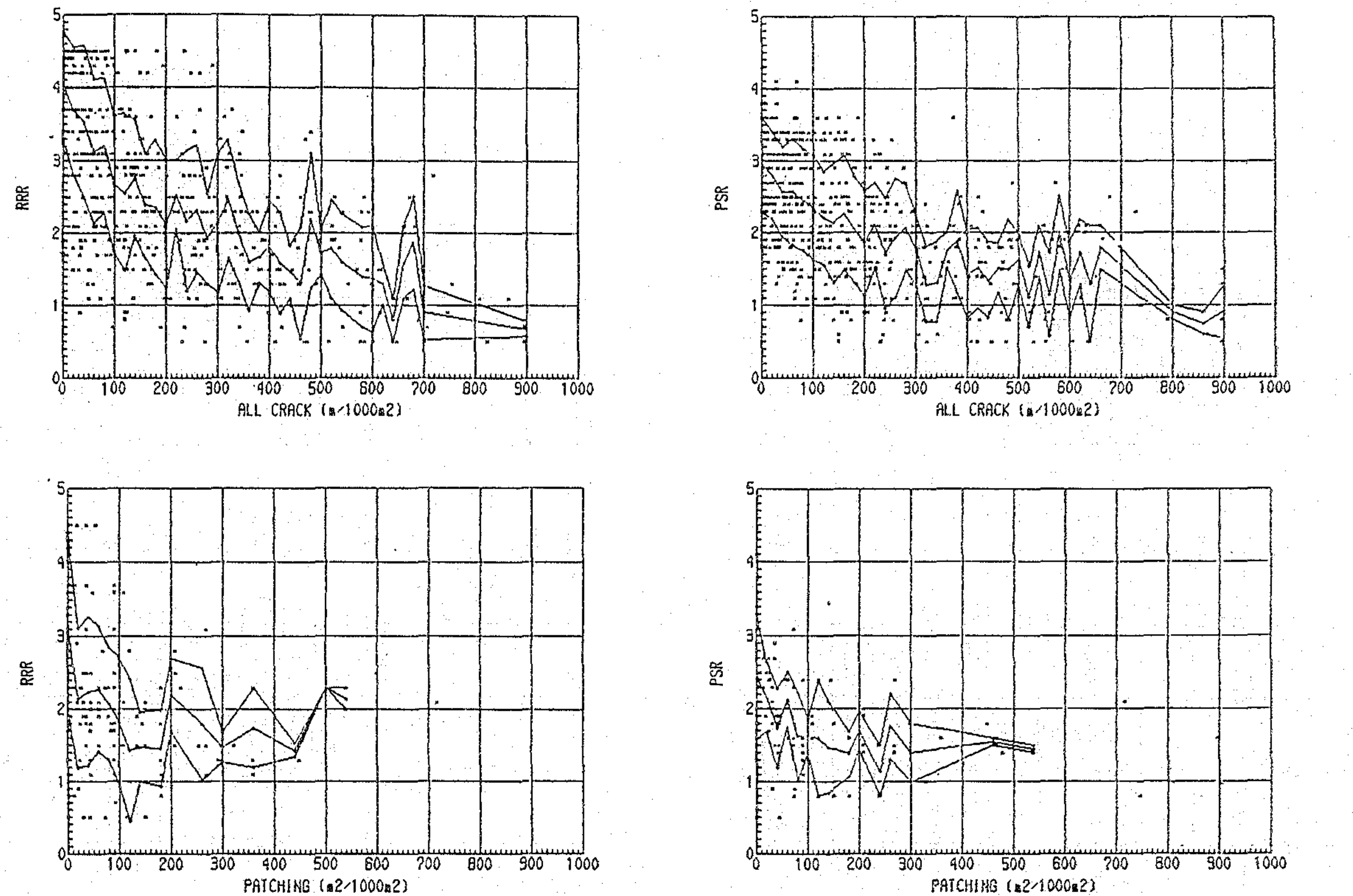


Figure I (b) RRR/PSR VS. MEASUREMENT VARIABLES (2)

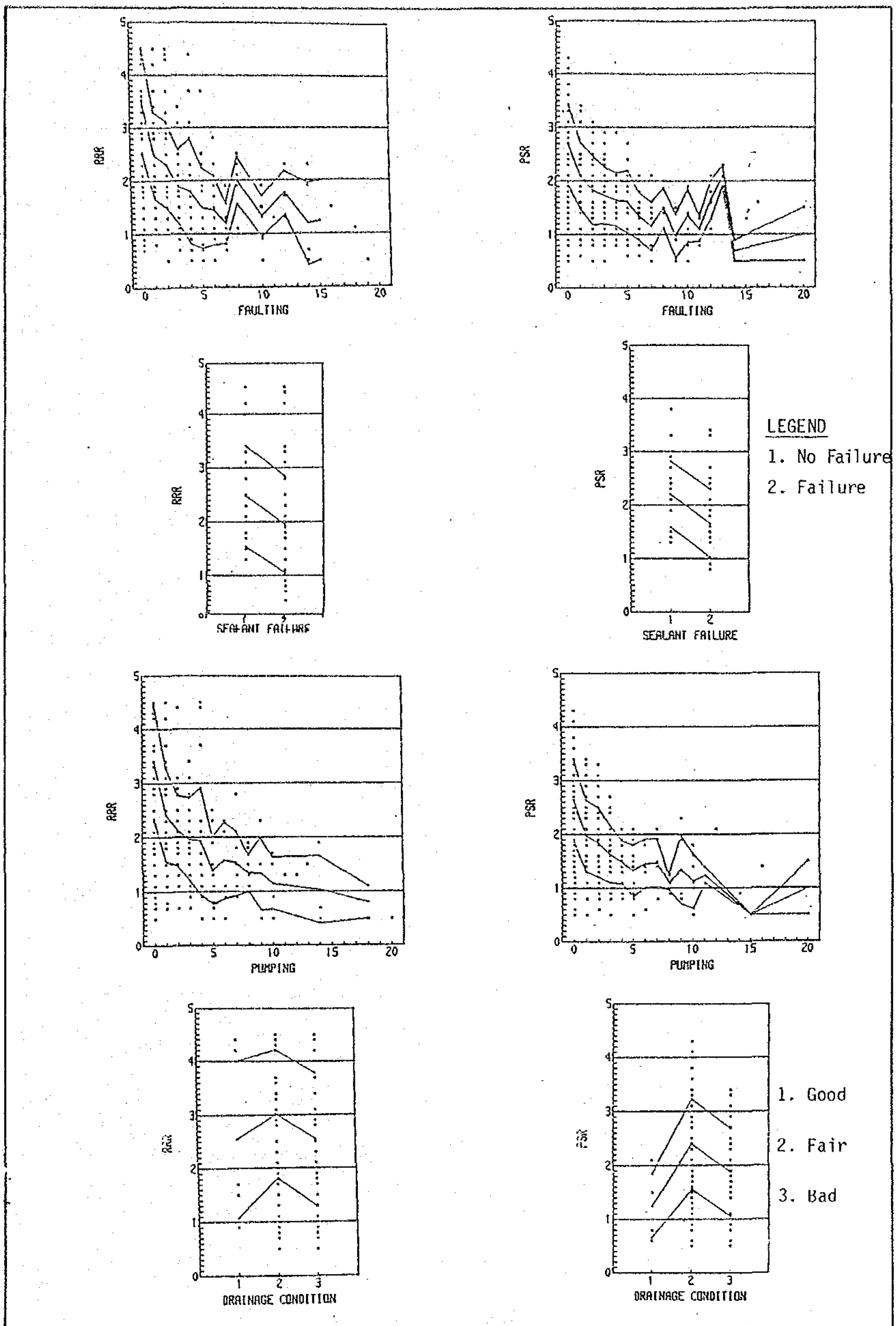


Figure 1(c) RRR/PSR vs MEASUREMENT VARIABLES (3)

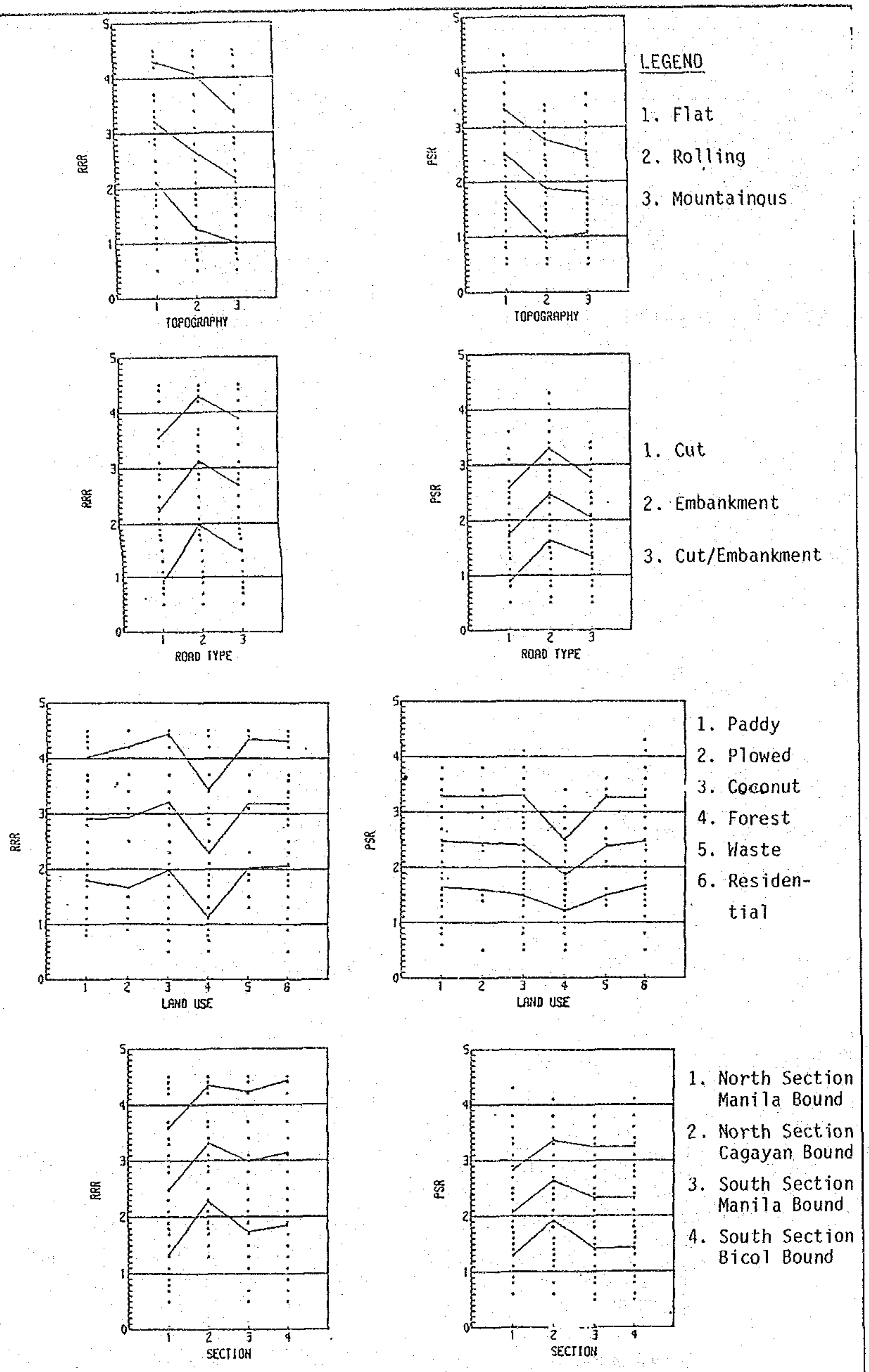


Figure I (d) RRR/PSR vs MEASUREMENT VARIABLES (4)

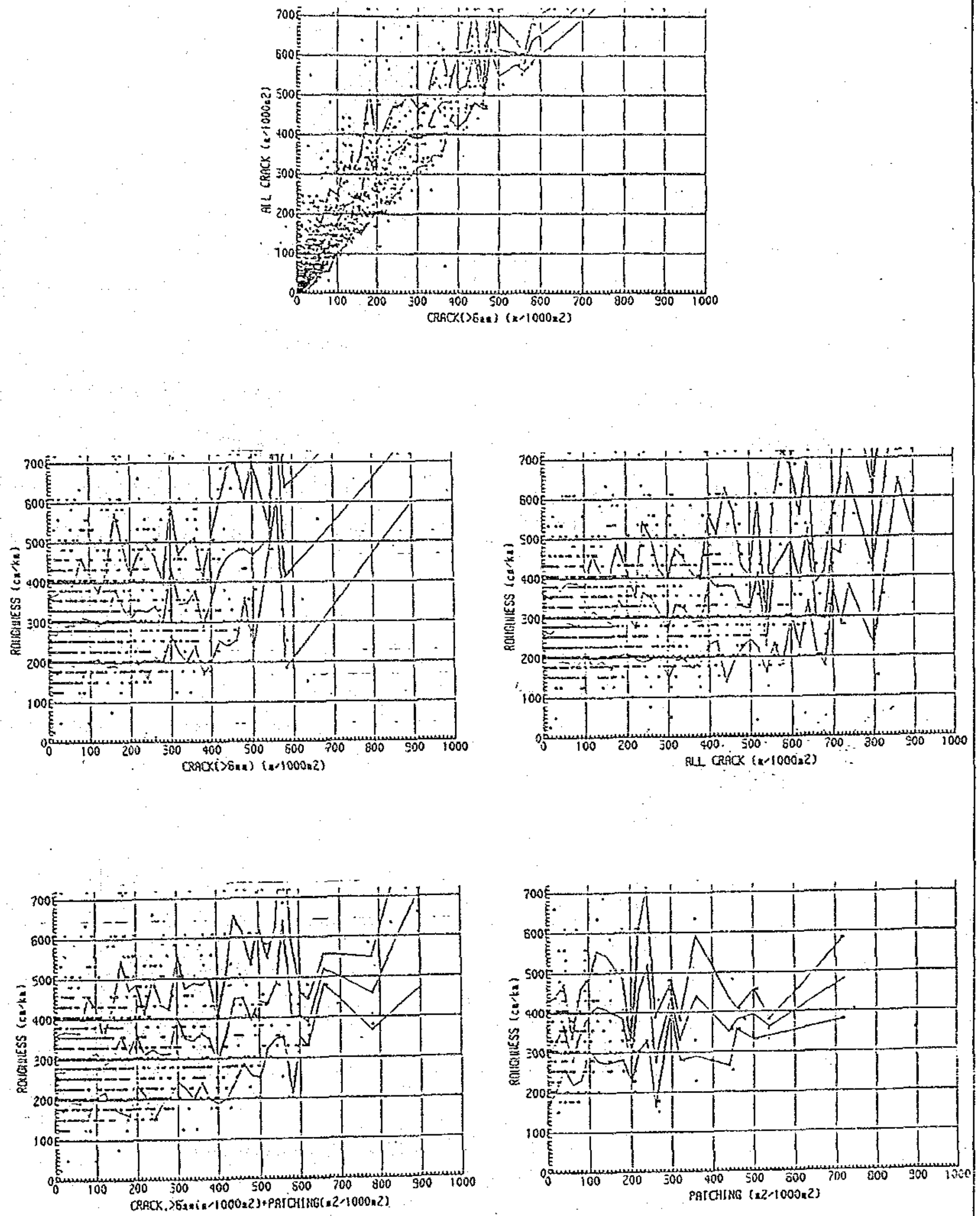


Figure 2 (a) CORRELATION BETWEEN MEASUREMENT VARIABLES

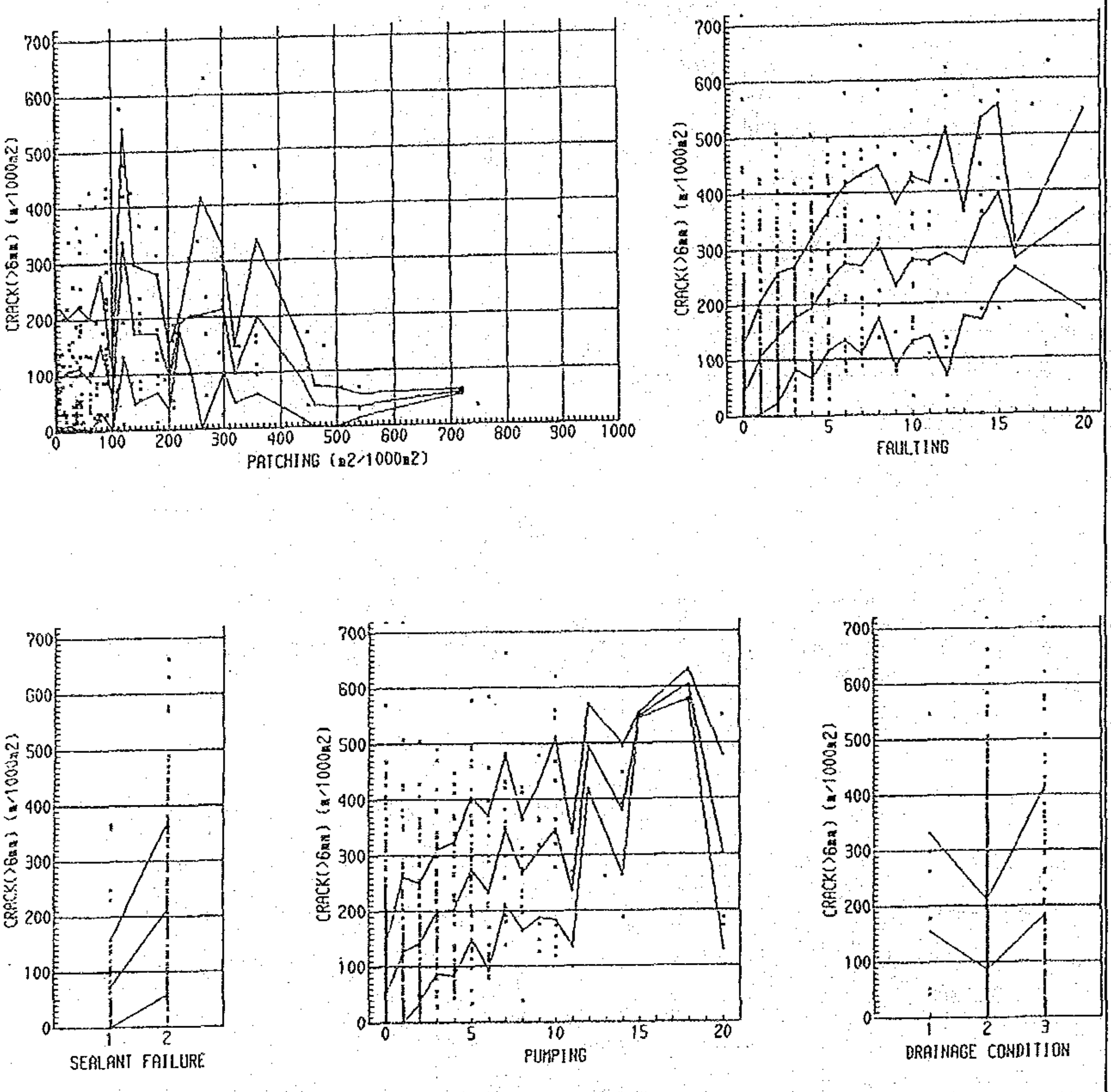


Figure 2 (b) CORRELATION BETWEEN MEASUREMENT VARIABLES (2)

APPENDIX 13-3
COMPARISON BETWEEN RRI IN THE STUDY AND PSI IN AASHO

1. Conversion of AASHTO'S PSI Formula

1) Symbols

R' = roughness in the AASHTO's formula (in/mile)
C' = cracking in the AASHTO's formula (ft/1,000 sq. ft.)
P' = patching in the AASHTO's formula (sq. ft/1,000 sq.ft.)
R = roughness measured in this Study (cm/km)
C = cracking measured in this Study ($m/1,1000\ m^2$)
P = patching measured in this Study ($m^2/1,000\ m^2$)
R1 = roughness measured with the British standard bump integrator (in/mile)
R2 = roughness measured with the British standard bump integrator (cm/km)

2) AASHTO's PSI Formula for Rigid Pavement

$$PSI = 5.41 - 1.80 \log (0.40 R' - 33) - 0.09 \sqrt{C'+P'}$$

3) Relationships between R1 and R2 and between R2 and R

$$R1 = \frac{0.394}{0.621} R2 = 0.634 R2 \quad \text{-------------------- (1)}$$

$$R2 = 100 + 0.75 R \quad \text{------------------------------ (2)}$$

Source: Philippine Island Road Feasibility Study Final Report, 1980

4) Relationship between R1 and R'

R1	R'
100	50
150	97
200	149
250	212

Source: Fig. 22.3 of "The Design and Performance of Road Pavements". TRRL, 1977 (See Figure 1)

By the least squares regression method, the relationship between R' and R2 is expressed as follows (see Figure 2)

$$R' = 1.08\ R1 - 61 \quad \text{---------------------------------} \quad (3)$$

5) Relationship between R' and R

By substituting the equations (1) and (2) into (3),

$$R' = 0.51\ R + 7.5$$

6) Relationships between C' and C and between P' and P

$$C' = 0.30\ C$$
$$P' = P$$

7) AASHTO's PSI Formula for Rigid Pavement Expressed by R, C and P

$$\begin{aligned} PSI &= 5.41 - 1.80 \log (0.40R' - 33) - 0.09\sqrt{C'+P'} \\ &= 5.41 - 1.80 \log \{0.40\ (0.51R + 7.5) - 33\} - 0.09\sqrt{0.30\ C+P} \\ &= 5.41 - 1.80 \log (0.20\ R - 30) - 0.05\ \sqrt{C+3.3\ P} \end{aligned}$$

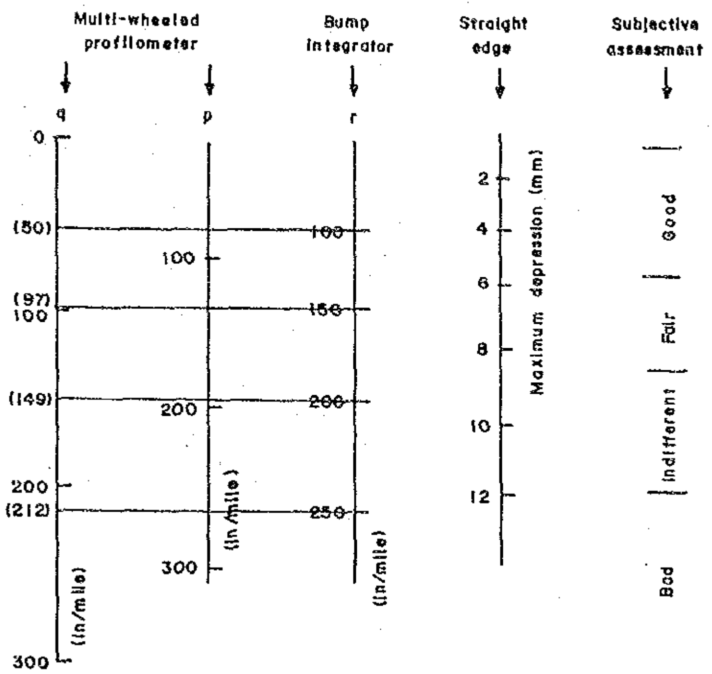


Fig. 22-3. Comparison between surface irregularity and riding quality.

Fig. I Relationship of roughness values

Source: The Design and Performance of Road Pavements, TRRL, 1977

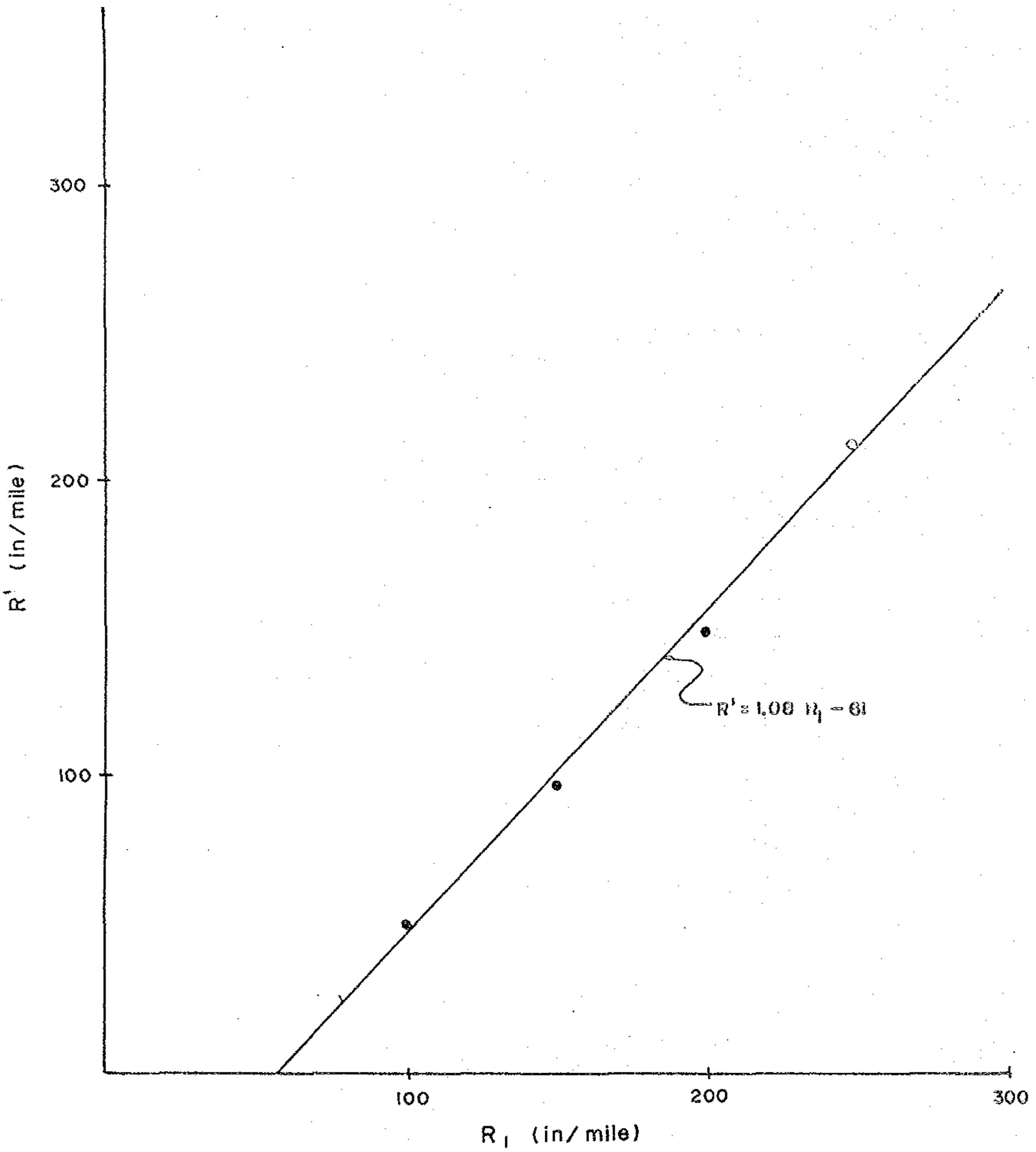


Figure 2 Relationship between R_1 and R'

2. Roughness and Cracking in AASHO's Road Test

Figure 3 based on AASHO Road Test shows the mean relationship between total length of cracking (projected in either the longitudinal or transverse directions) per 100 ft. of traffic lane and PSI derived from equation of AASHO's PSI formula.

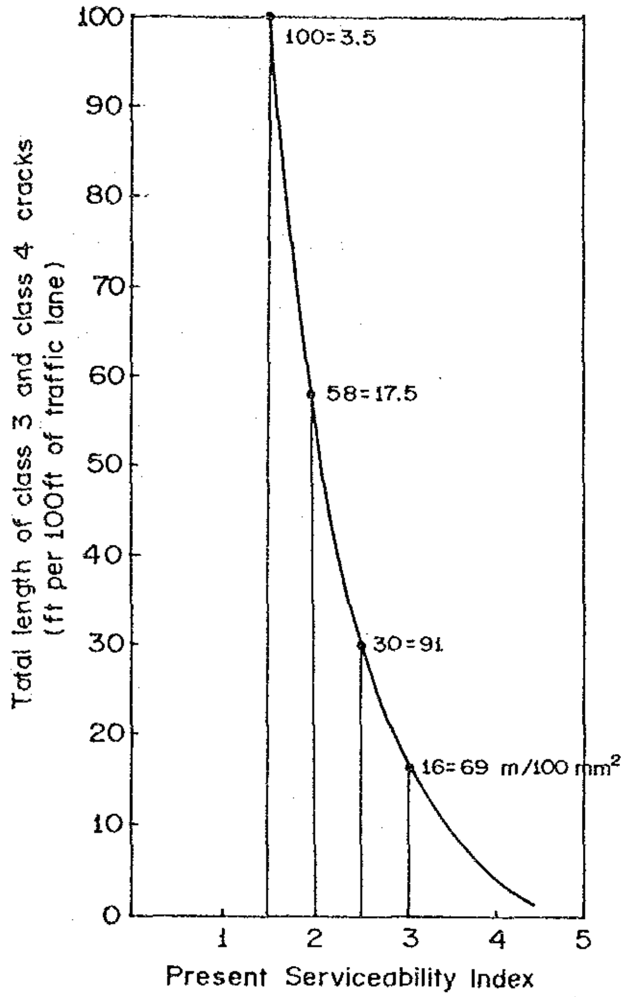


FIG. 3 RELATIONSHIP BETWEEN DEGREE OF CRACKING AND PRESENT SERVICEABILITY INDEX

Using Figure 3, cracking was estimated, at each level of PSI. And then, roughness was calculated using AASHO's PSI formula. The result is shown in Table 1.

TABLE 1 AVERAGE CONDITION IN AASHO ROAD TEST

AASHO's PSI	Cracking ($m/1000\ m^2$)	Roughness (cm/km)
4.0	12	180
3.5	28	200
3.0	50	220
2.5	110	260
2.0	220	300
1.5	350	340

3. Roughness and Cracking in the Study Section

Based on pavement surface condition survey and RRI and PSI analysis, the average roughness and cracking at each level of index is the Study Section were estimated as follows.

TABLE 2 AVERAGE CONDITION IN THE STUDY SECTION

RRI	Cracking	Roughness	PSI
4.0	5	155	3.2
3.5	12	270	2.7
3.0	58	289	2.4
2.5	136	315	2.1
2.0	248	340	1.7
1.5	393	368	1.4

RRI	Cracking	Roughness	PSI
4.0	0	75	4.7
3.5	0	133	4.3
3.0	4	207	3.8
2.5	34	282	3.2
2.0	153	319	2.4
1.5	356	362	1.6

4. Comparison between AASHO's PSI and RRI in the Study

Table 3 shows average cracking and roughness under each serviceability index of AASHO Road Test and in the Study Section.

Table 4 shows the difference of AASHO's PSI and RRI and PSI in the Study.

Figure 4 summarizes these comparisons.

TABLE 3 AVERAGE CRACKING AND ROUGHNESS CONDITION

AASHO Road Test			The Study in the Philippines					
PSI	Cracking ($m/1000\ m^2$)	Roughness (Cm/Km)	RRI	Cracking	Roughness	PSI	Cracking	Roughness
4.0	12	175	4.0	5	160	4.0	0	80
3.5	28	190	3.5	12	270	3.5	0	130
3.0	50	220	3.0	60	290	3.0	4	210
2.5	110	260	2.0	140	320	2.5	35	280
2.0	220	300	2.0	250	340	2.0	150	320
1.5	390	360	1.5	400	370	1.5	360	360

TABLE 4 COMPARISON OF SERVICEABILITY INDEX BETWEEN AASHO AND THE STUDY

Cracking and Roughness Condition (Average in AASHO's Road Test)		AASHO's PSI	In the Study RRI	In the Study PSI
Cracking ($m/1000\ m^2$)	Roughness (cm/km)			
12	175	4.0	3.8	3.1
28	190	3.5	3.5	2.9
50	220	3.0	3.2	2.6
110	260	2.5	2.8	2.3
220	300	2.0	2.2	1.9
390	360	1.5	1.5	1.5

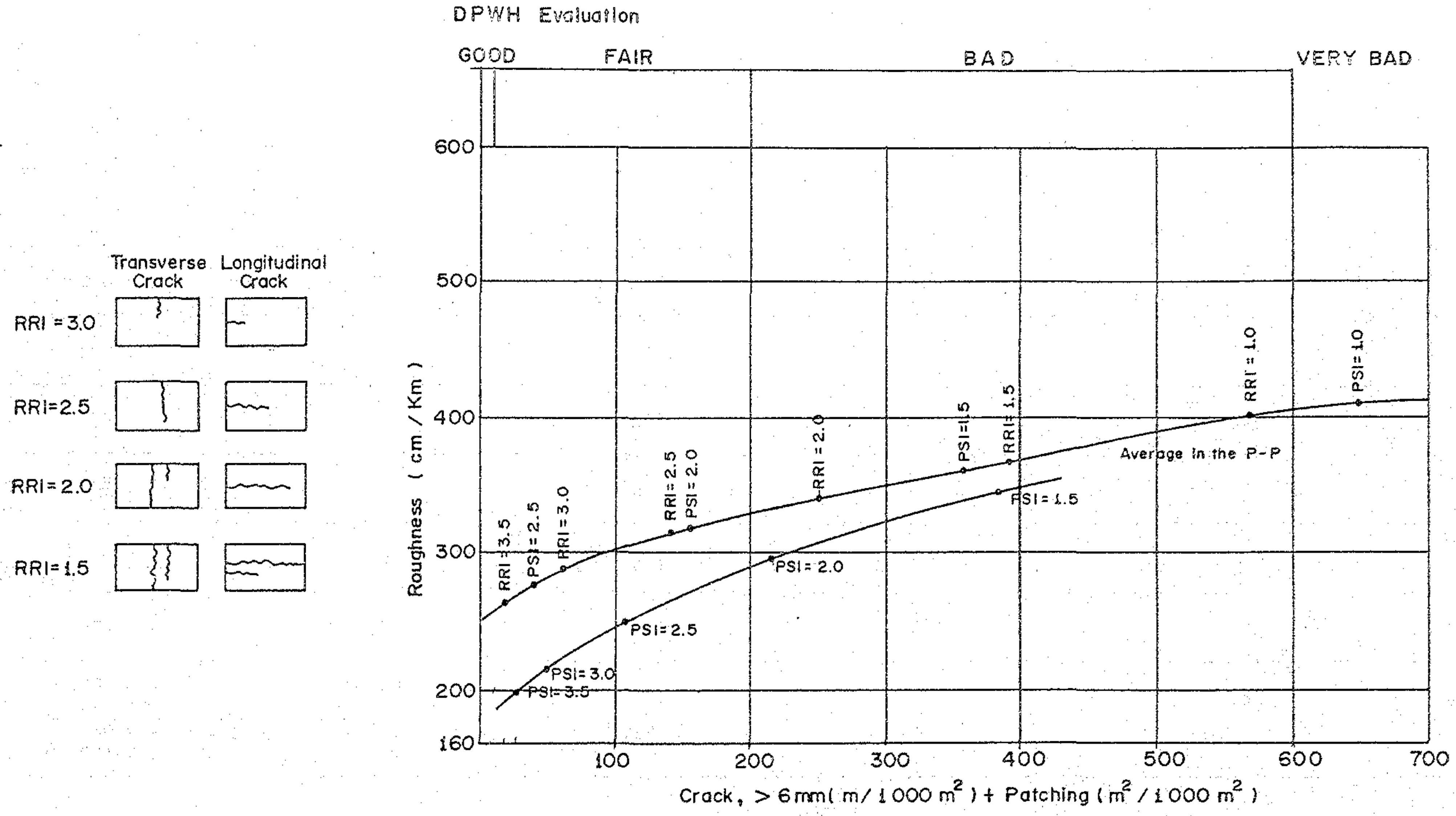
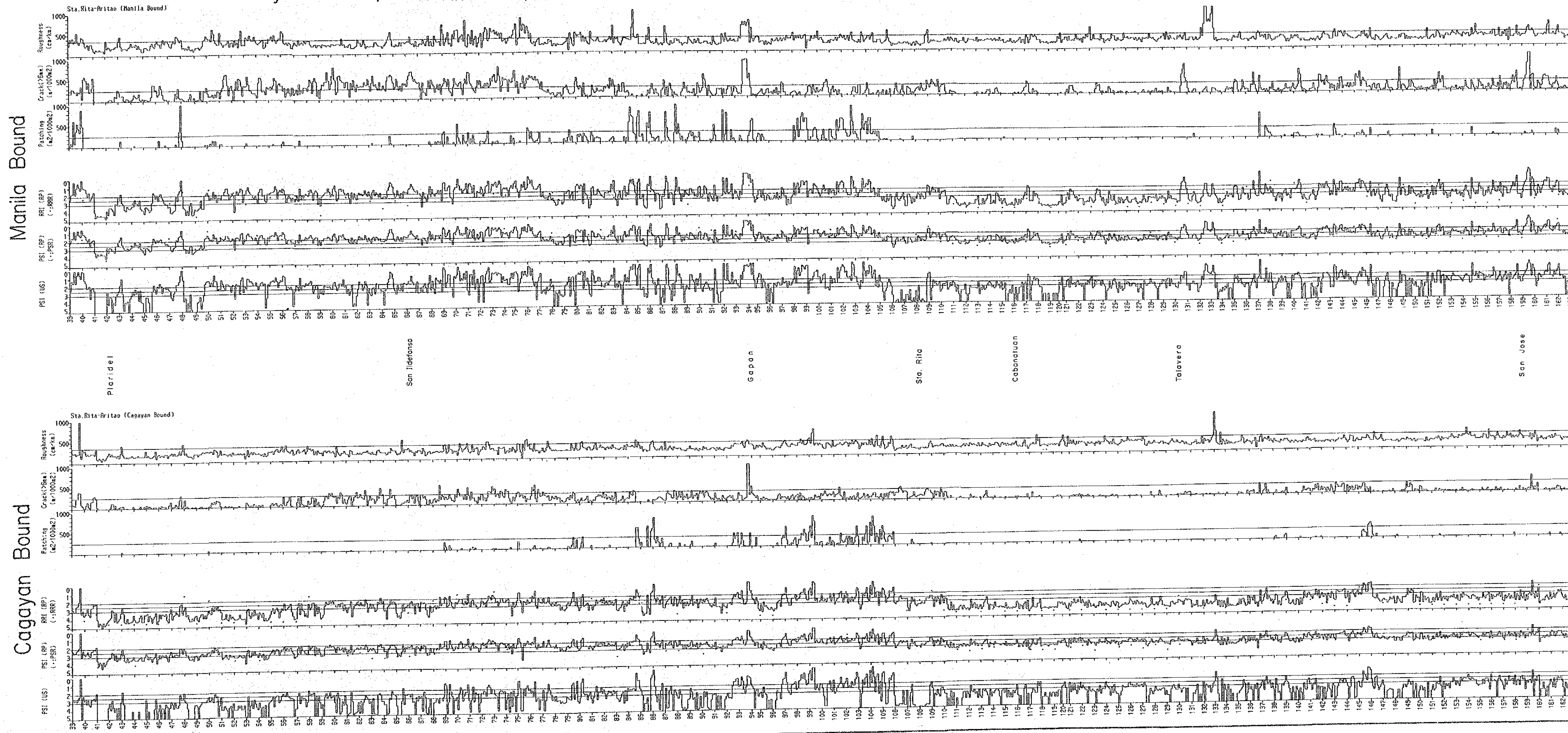


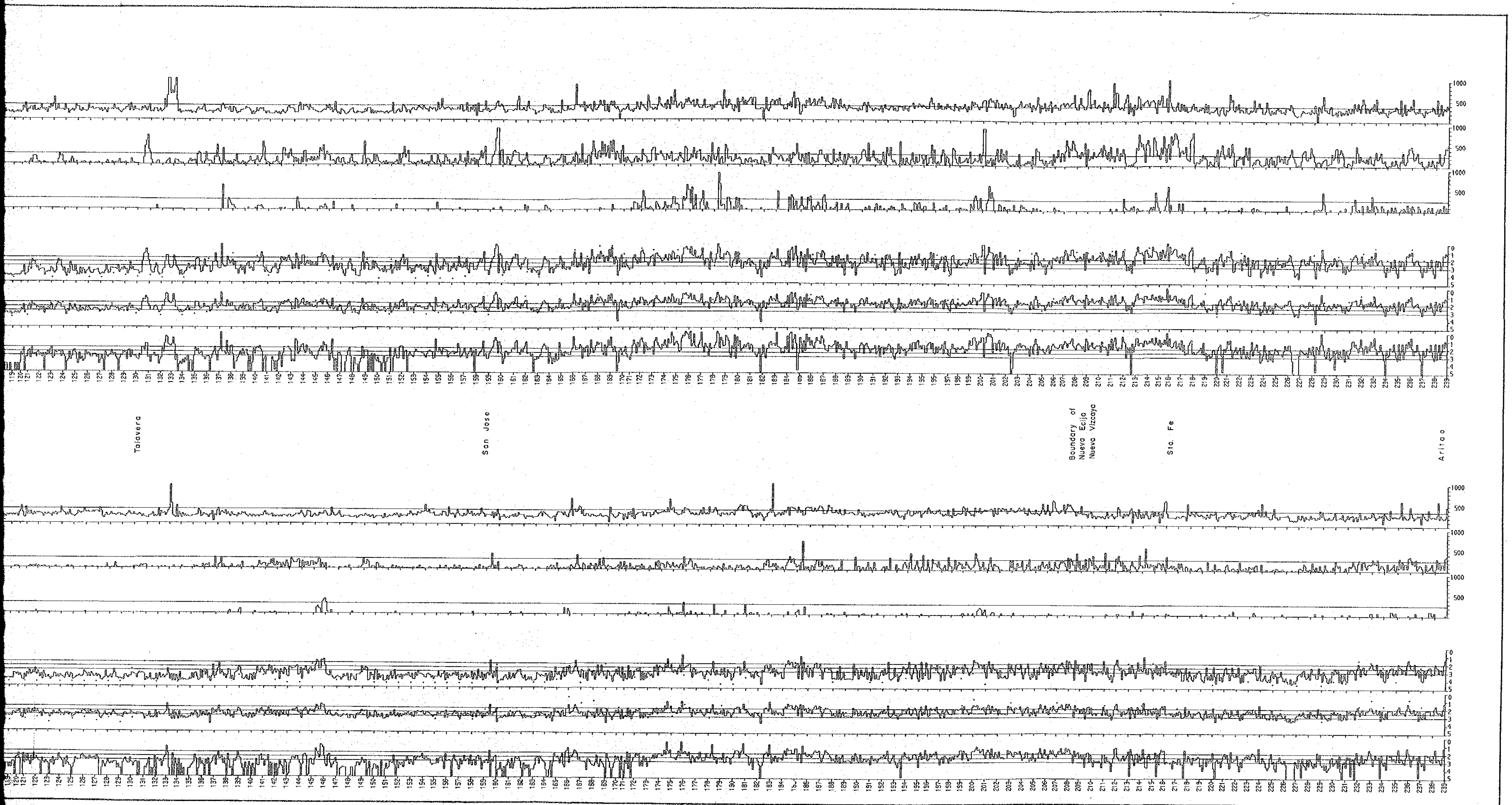
FIG. 4 AVERAGE RELATIONSHIP BETWEEN RRI AND ROUGHNESS, CRACKING, PATCHING

APPENDIX 13-4

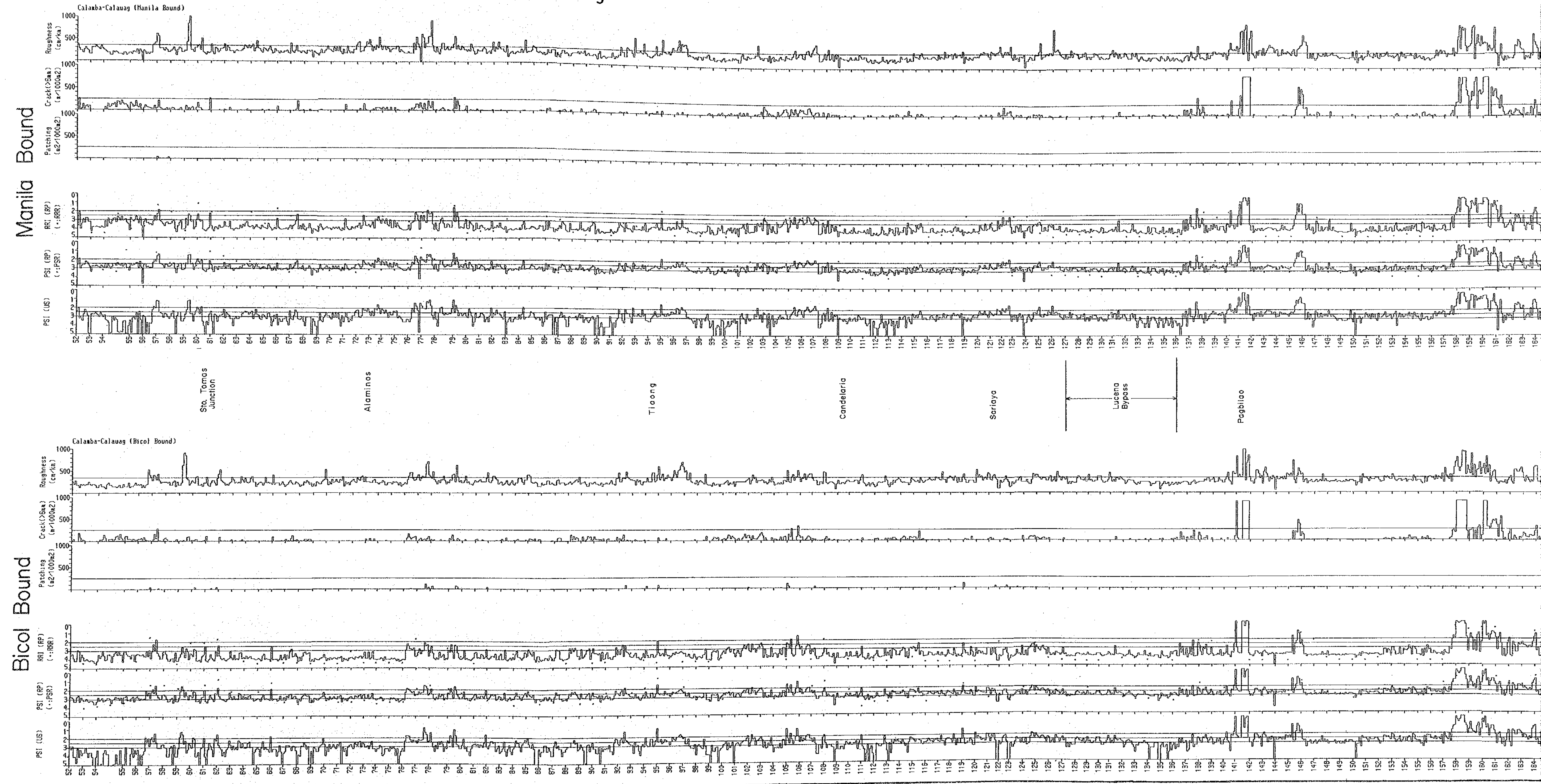
PAVEMENT SURFACE CONDITION AND EVALUATION

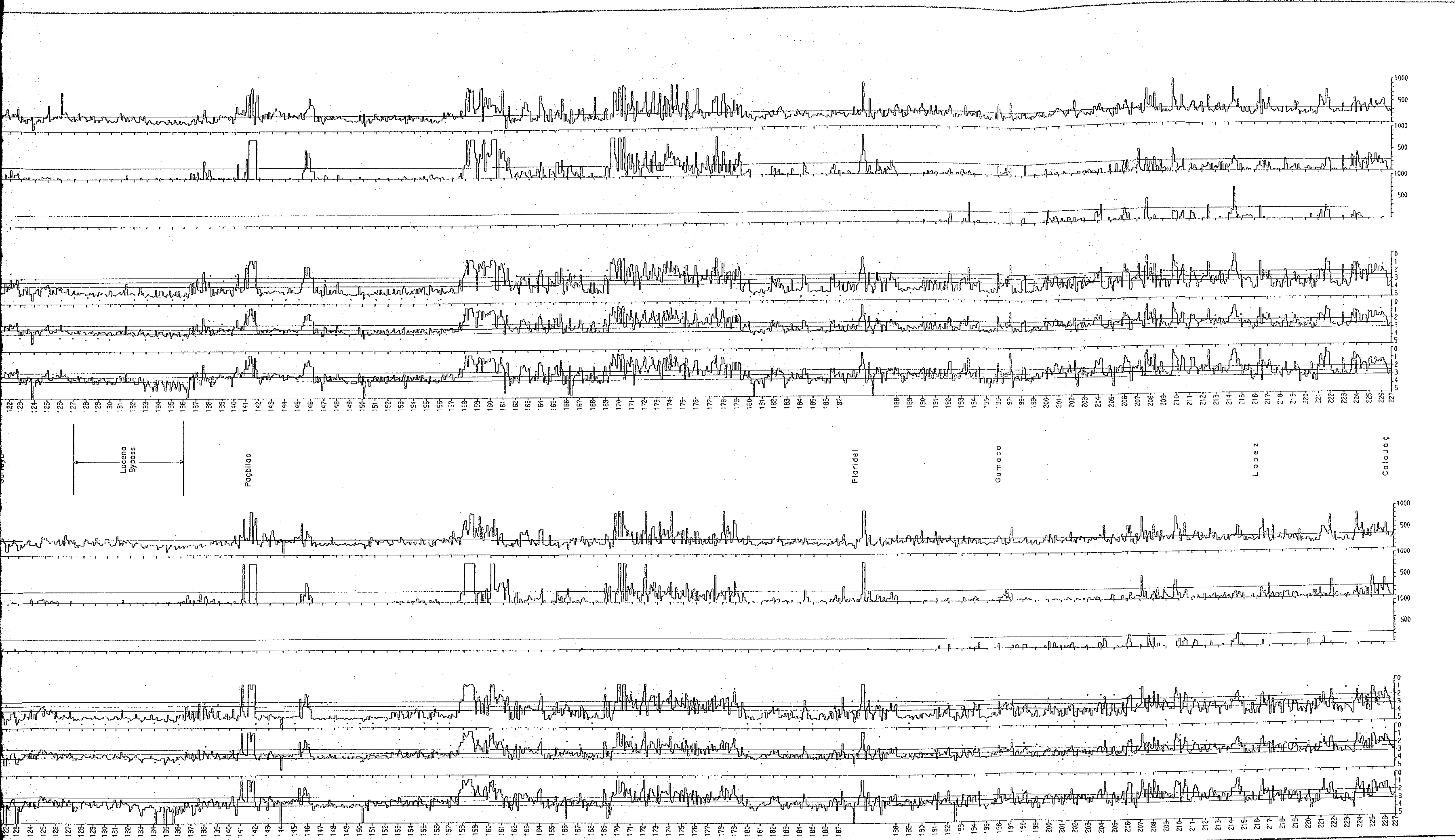
PAVEMENT SURFACE CONDITION AND EVALUATION
North Study Section ; Sta. Rita - Aritao




Talavera
San Jose
Boundary of Nueva Ecija Nueva Vizcaya
Sta. Fe
Aritao

PAVEMENT SURFACE CONDITION AND EVALUATION
South Study Section ; Calamba - Calauag

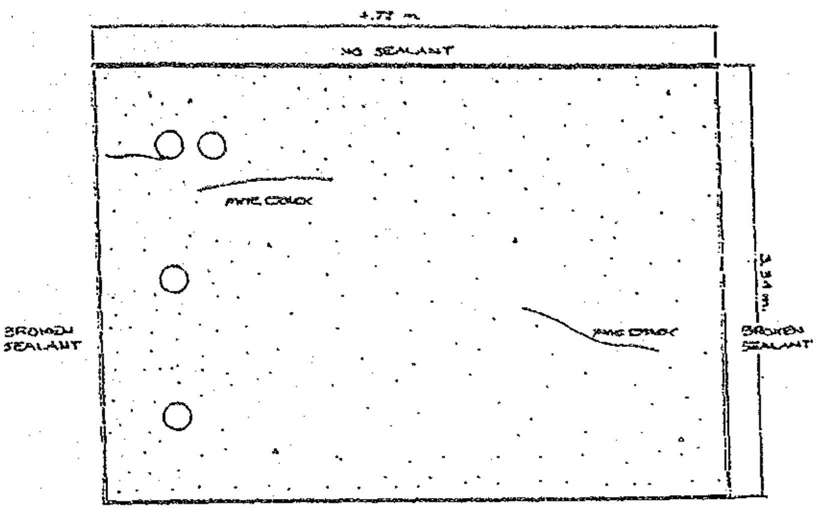




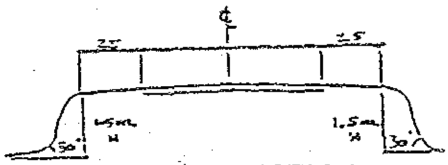
Lucena Bypass
Pagbilao
Plaridel
Gumaca
Lopez
Calauag
1000
500

APPENDICES FOR CHAPTER 14

APPENDIX 14-1
DETERIORATION CONDITION OF SURVEY SLABS



1. Cracking = No wide crack. Few fine crack.
2. Sealant Failure = No sealant at longitudinal joint.
   Broken sealant at contract joints.



CROSS SECTION
SCALE 1:300m.

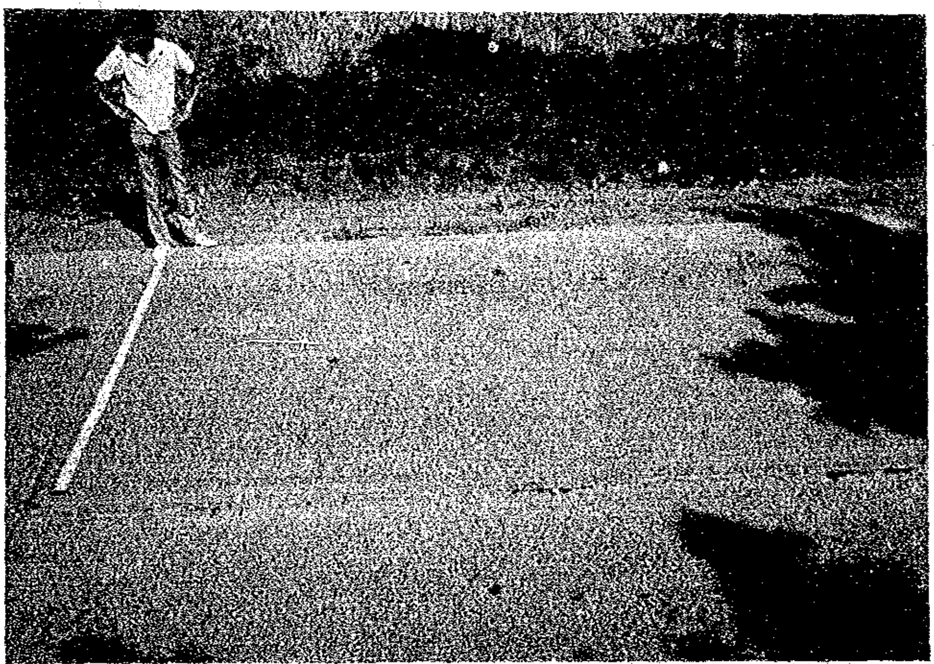
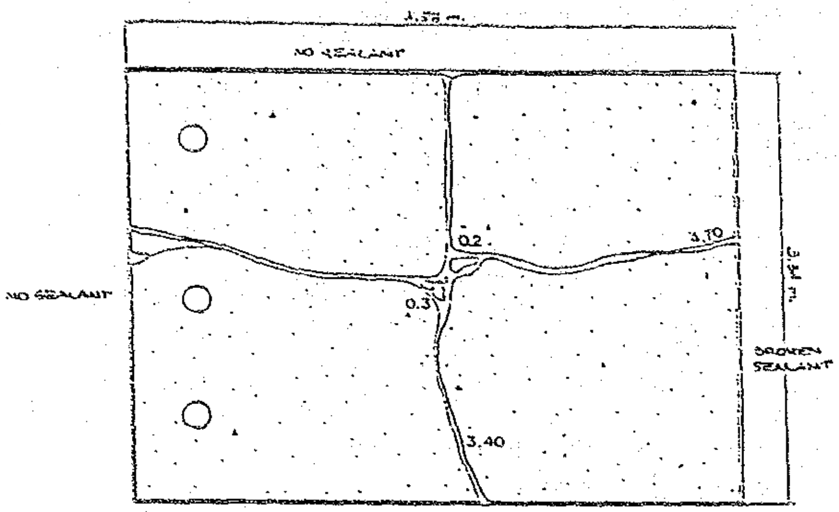
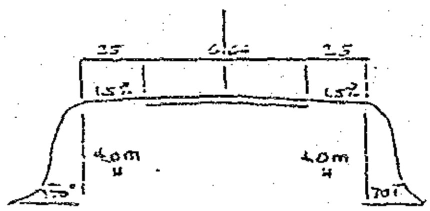


FIGURE 8.2-1 (1) DETERIORATION CONDITION OF N_1-G SLAB



SCALE 1:400 M.

1. Cracking = Wide crack total length = 8.60 m.
   Few fine crack.
2. Sealant Failure = No sealant in most part of joints.
   Broken sealant in some part.
3. Spalling = Observed at some part of cracks.



CROSS SECTION
SCALE 1:300m.

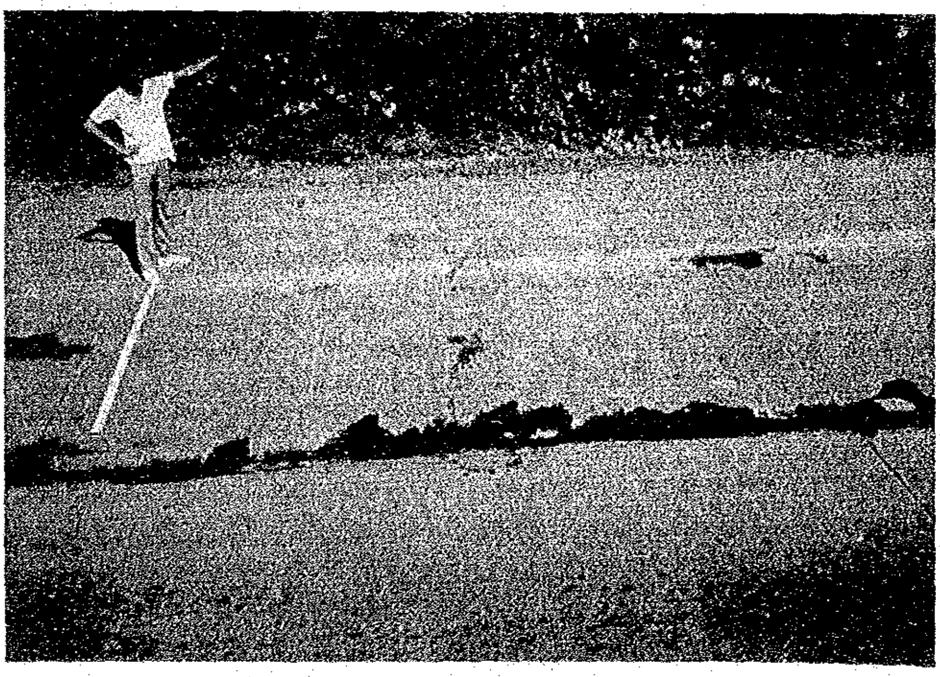
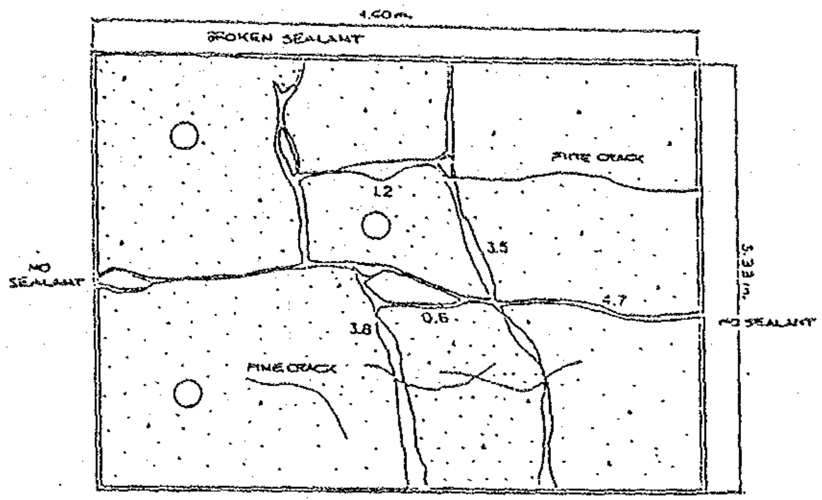
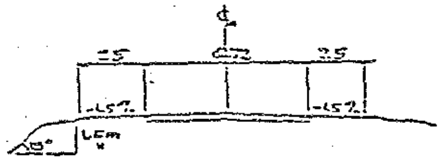


FIGURE 8.2-1 (2) DETERIORATION CONDITION OF N_1-F SLAB



SCALE 1:400.M

1. Cracking = Wide crack (total length) = 13.80 m
   Fine crack (total length) = 1.90 m
2. Settlement = Observed at (1) and (2)
3. Sealant Failure = No sealant at contract joints. Broken sealant at longitudinal joint.
4. Spalling = Observed in almost part of cracks.



CROSS SECTION
SCALE = 1:300 m

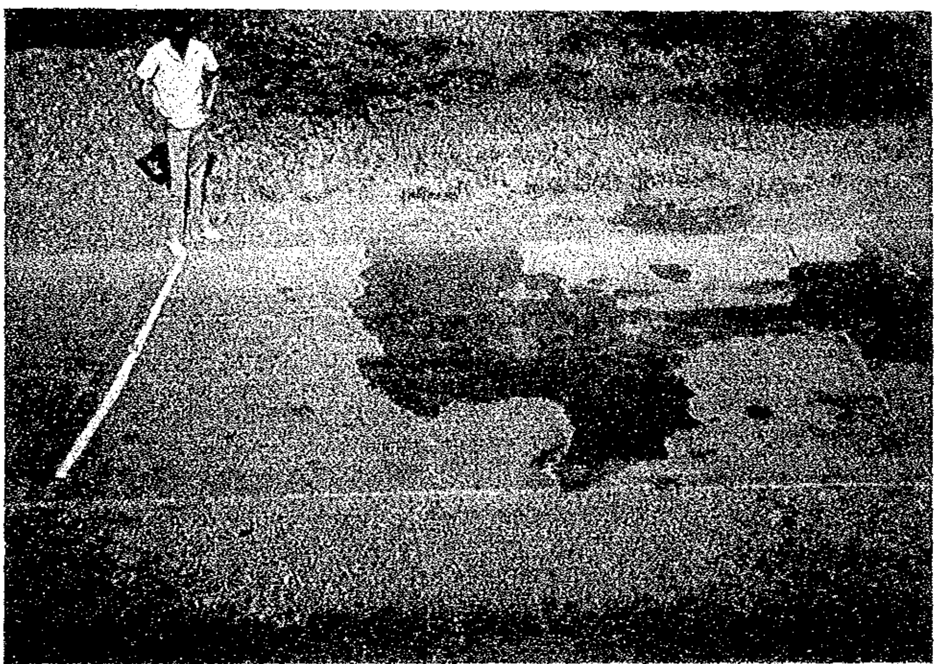
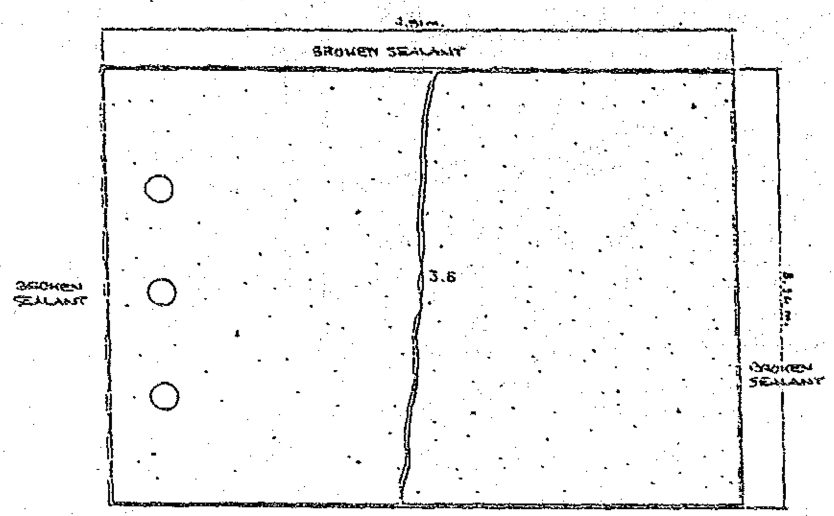
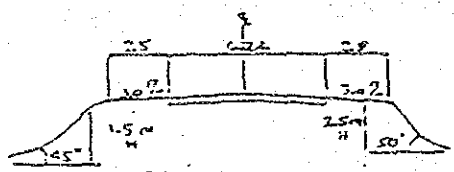


FIGURE 8.2-1 (3) DETERIORATION CONDITION OF N_1-B SLAB



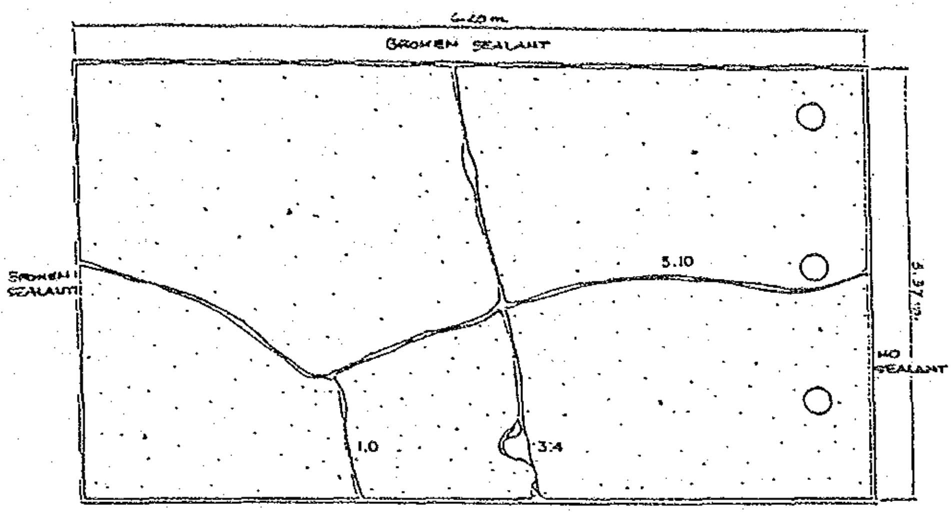
SCALE 1:400 M.

1. Cracking = Wide crack total length = 3.60 m
   No fine crack.
2. Sealant Failure = Broken sealant at all joints.



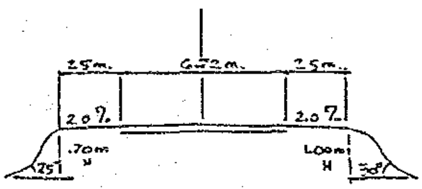
CROSS SECTION
SCALE 1:300 m.

FIGURE 8.2-2 (1) DETERIORATION CONDITION OF N_2-G SLAB



SCALE 1:400 M:

1. Cracking = Wide crack (total length) = 10.90 m
   No fine crack.
2. Sealant Failure = Broken sealant at all joints.
3. Spalling = Observed at (1).



CROSS SECTION
SCALE 1:300m.

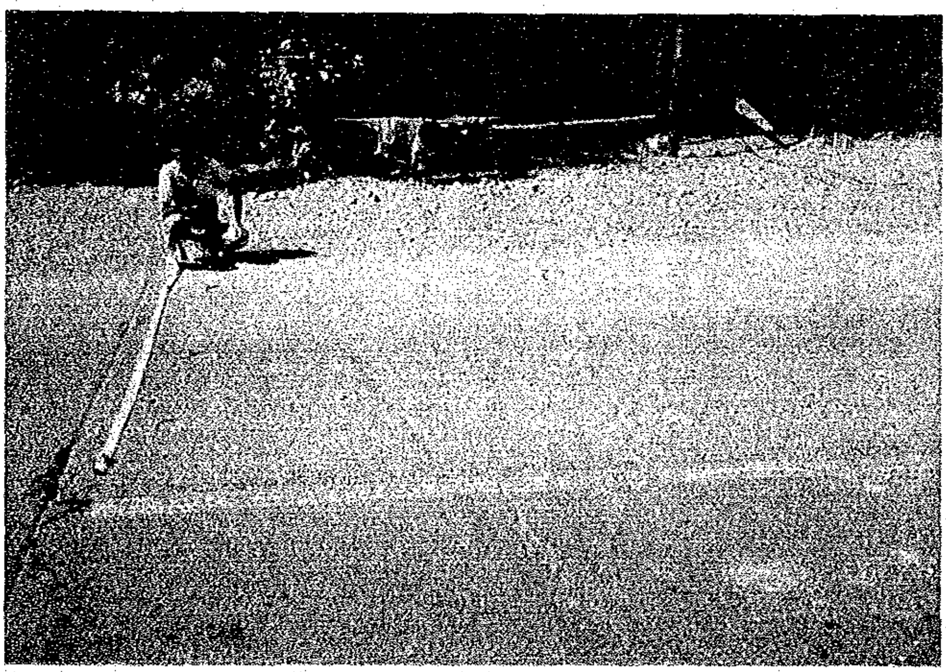
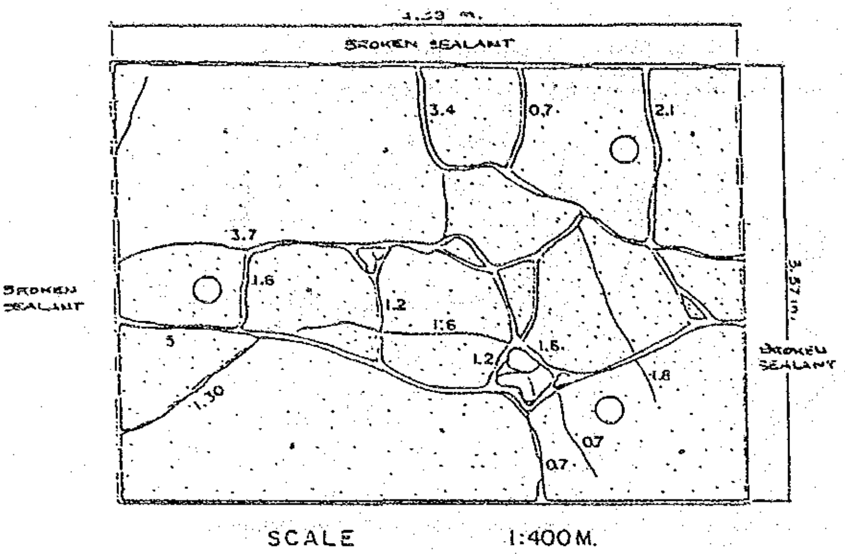
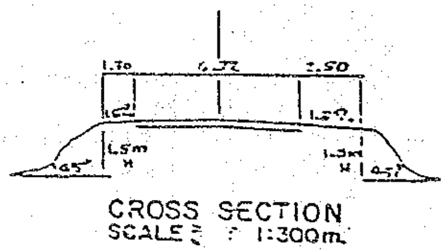


FIGURE 8.2-2 (2) DETERIORATION CONDITION OF N_2-F SLAB



1. Cracking = Wide crack (total length) = 20.30 m
   Fine crack (total length) = 7.30 m
2. Sealant Failure = Broken sealant at all joints.
3. Spalling = Observed at some cracks.
4. Patching = Observed in most part of cracks.



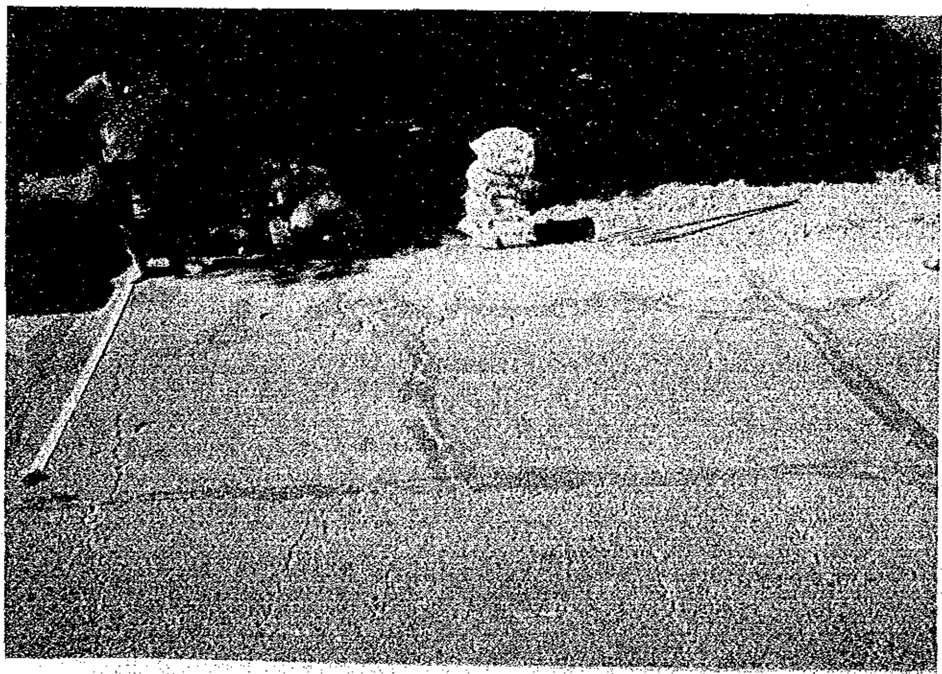
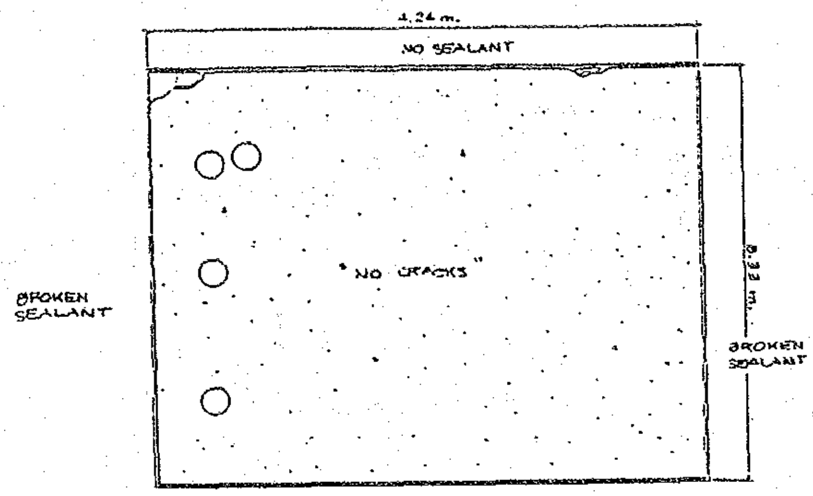
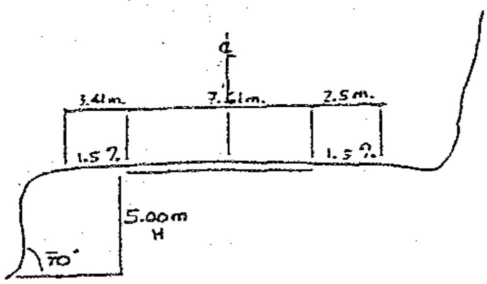


FIGURE 8.2-2 (3) DETERIORATION CONDITION OF N_2-B SLAB



SCALE 1:400 M.

1. Cracking * Few fine crack.
2. Sealant Failure * Broken sealant in all joints. Lack of sealant at longitudinal joint.



CROSS SECTION
SCALE 1:300m.

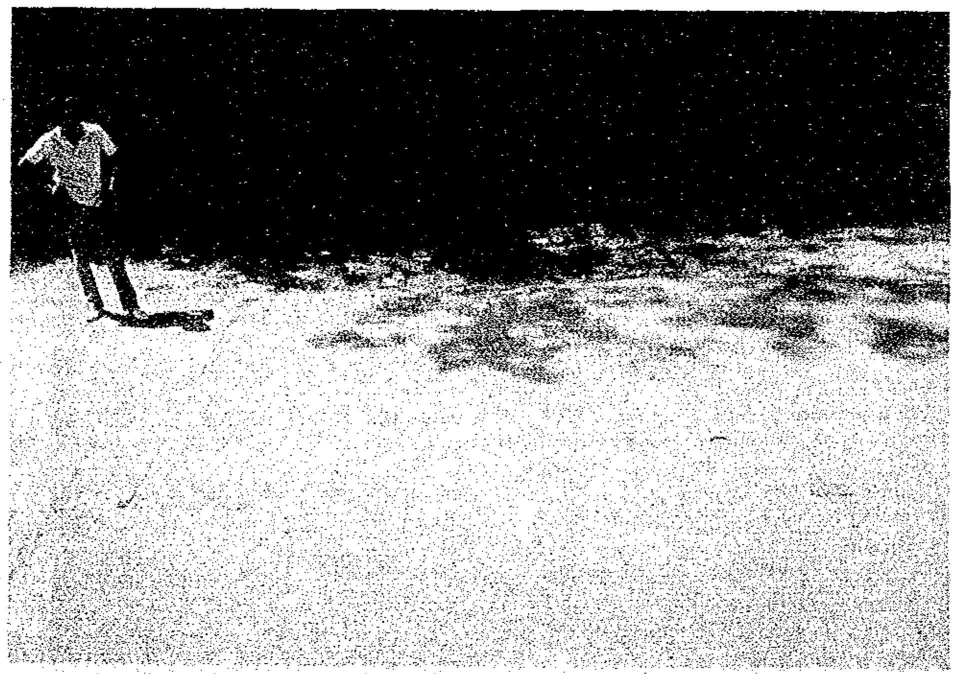
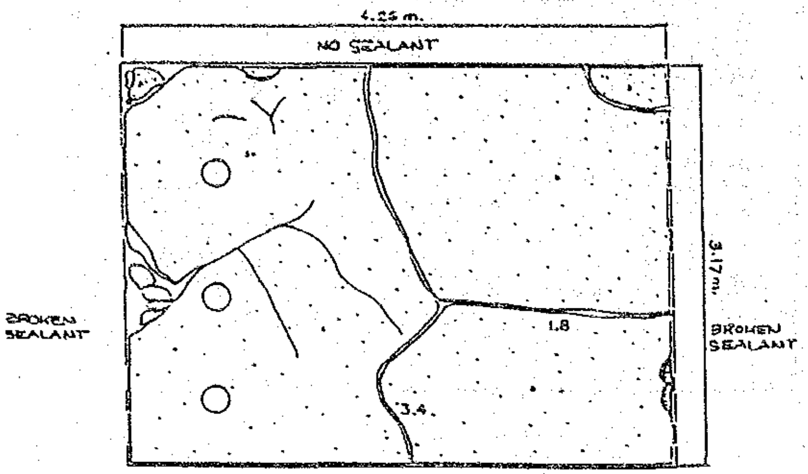
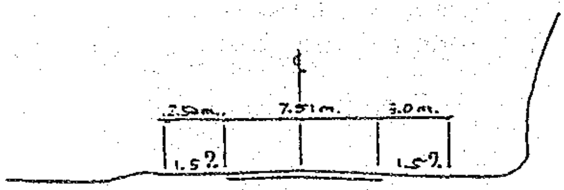


FIGURE 8.2-3 (1) DETERIORATION CONDITION OF N_3-G SLAB



SCALE 1:400 M.

1. Cracking = Wide crack (total length) = 8.10 m
   Fine crack (total length) = 3.40 m
2. Sealant Failure = Broken sealant at contract joints.
   No sealant at longitudinal joint.
3. Pumping = Observed at (1) crack.
4. Spalling = Observed at (2) crack.



CROSS SECTION
SCALE 1:300m.

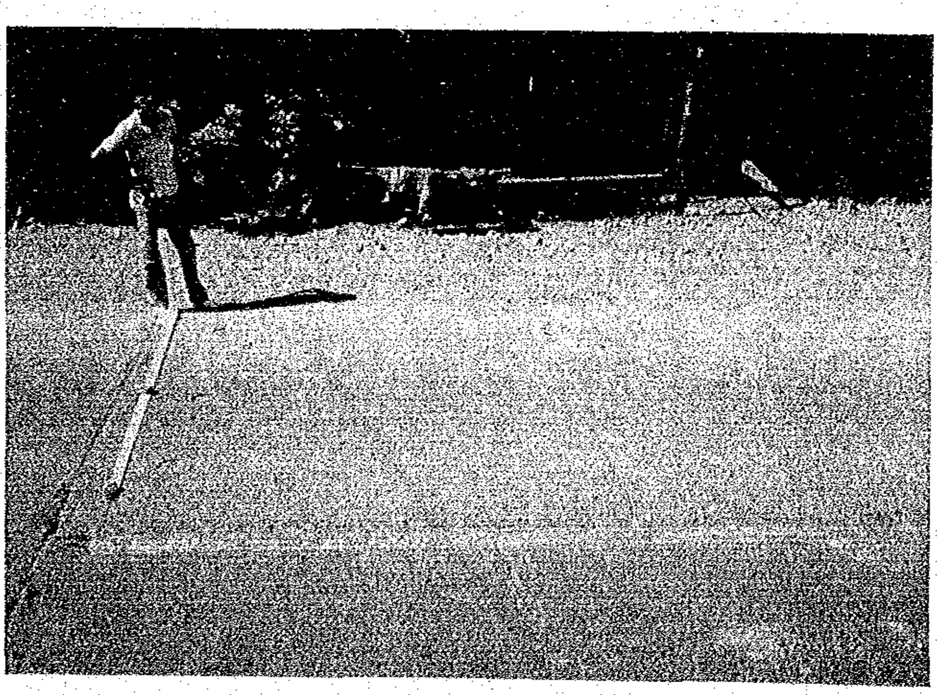
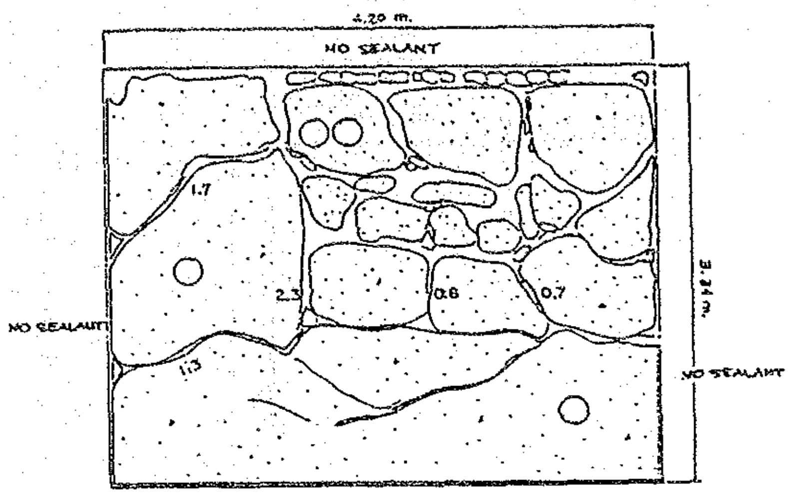
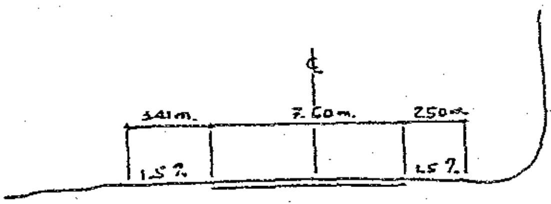


FIGURE 8.2-3 (2) DETERIORATION CONDITION OF N_3-F SLAB



SCALE 1:400 M.



CROSS SECTION
SCALE 1:300m.

1. Cracking = Wide crack (total length) = 22.10 m
   Fine crack (total length) = 3.30 m
2. Settlement = Observed at (1), (2) and (3) cracks.
3. Pumping = Observed between (2) and (3) cracks.
4. Sealant Failure = No sealant in all joints.
5. Joint Shattering = Observed at longitudinal joint.

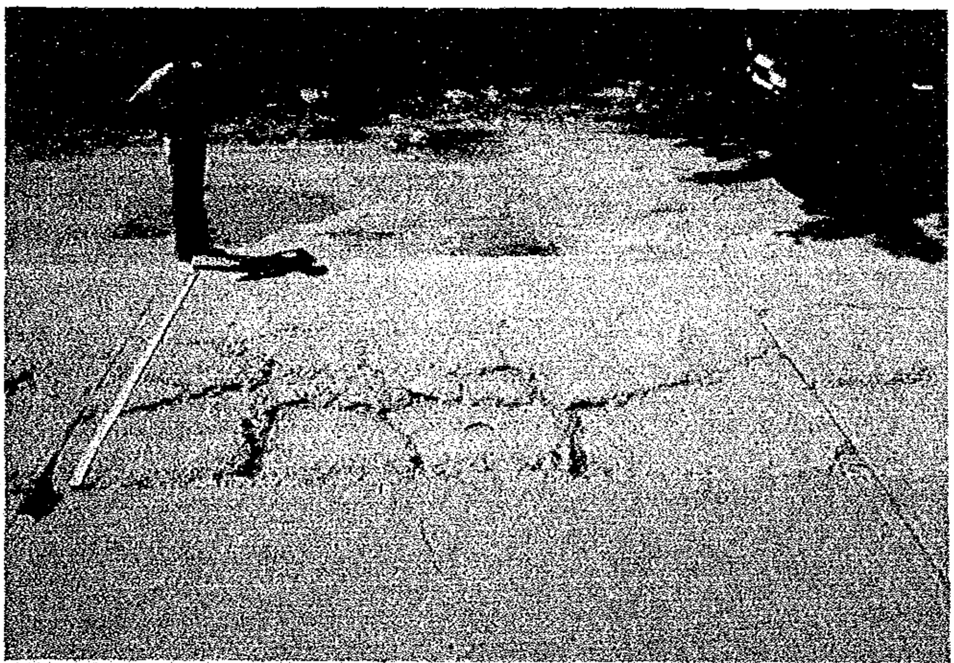
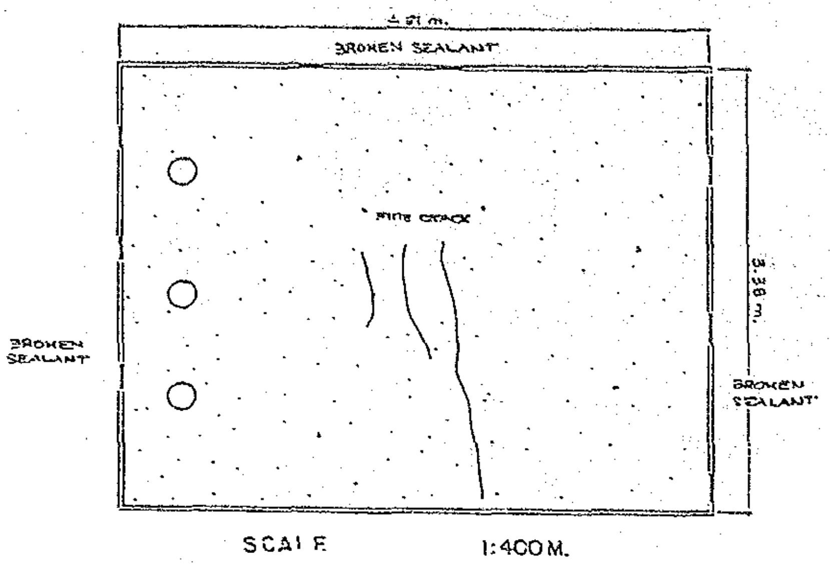
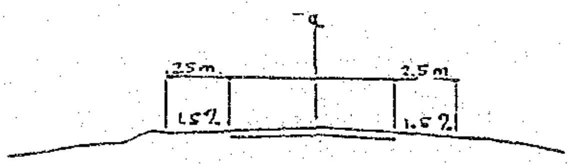


FIGURE 8.2-3 (3) DETERIORATION CONDITION OF N_3-B SLAB



1. Cracking = Few fine crack.
2. Sealant Failure = Broken sealant in all joints.



CROSS SECTION
SCALE 1:300m.

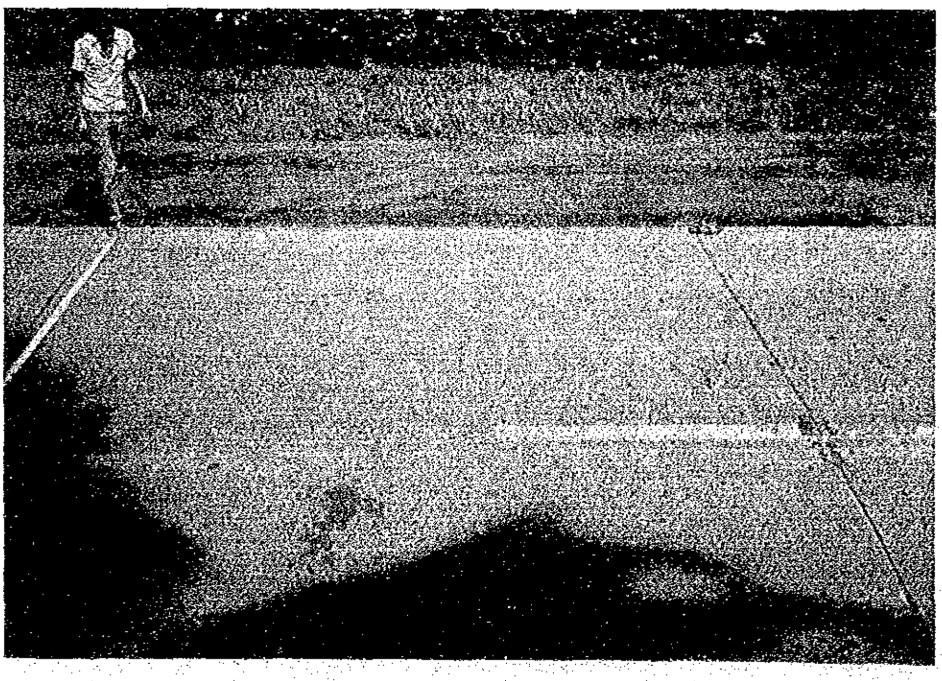
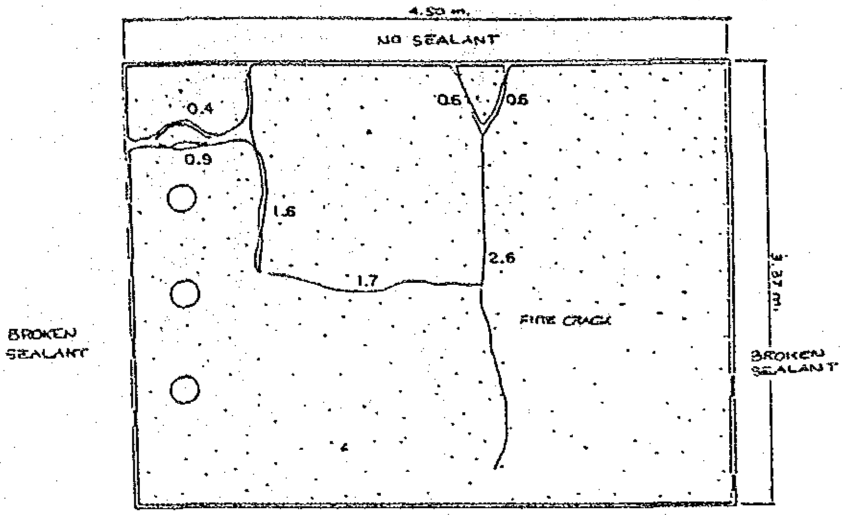


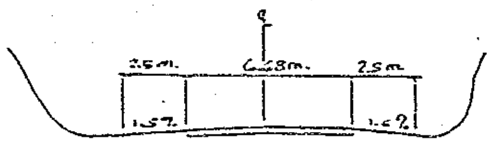
FIGURE 8.2-4 (1) DETERIORATION CONDITION OF S_1-G SLAB



SCALE 1:400 M.

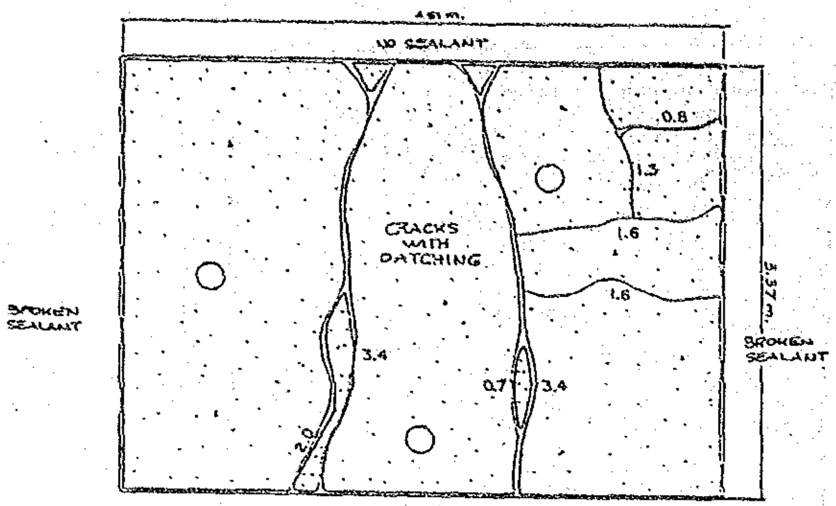
CORNER CRACK

1. Cracking = Wide crack (total length) = 4.10 m
   Fine crack (total length) = 4.30 m
2. Sealant Failure = Broken sealant in both contract joints. No sealant at longidutinal joint.
3. Pop-outs = Minor pop-outs was observed.

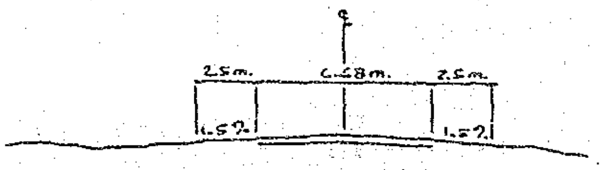


CROSS SECTION
SCALE 1:300m.

FIGURE 8.2-4 (2) DETERIORATION CONDITION OF S_1-F SLAB



SCALE 1:400 M.



CROSS SECTION
SCALE 1:300m.

TRANSVERSE CRACK

1. Cracking = Wide crack (total length) = 9.50 m
   Fine crack (total length) = 5.30 m
2. Settlement = Observed at (1)
3. Sealant Failure = Broken sealant in both expansion joints. No sealant at longitudinal joint.
4. Pop-outs = Minor pop-outs was observed.
5. Patching = Most cracks were patched.

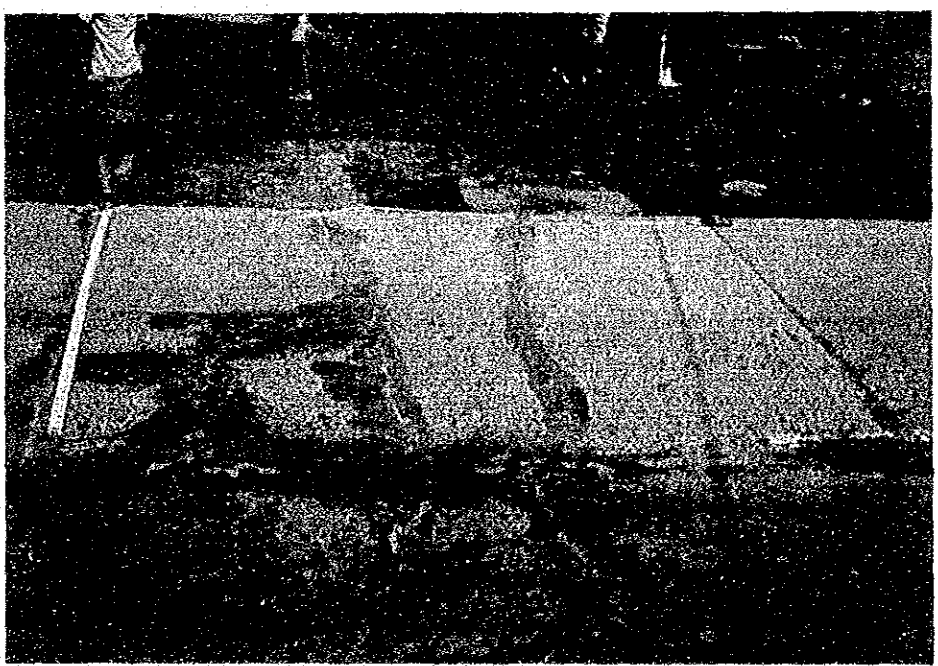
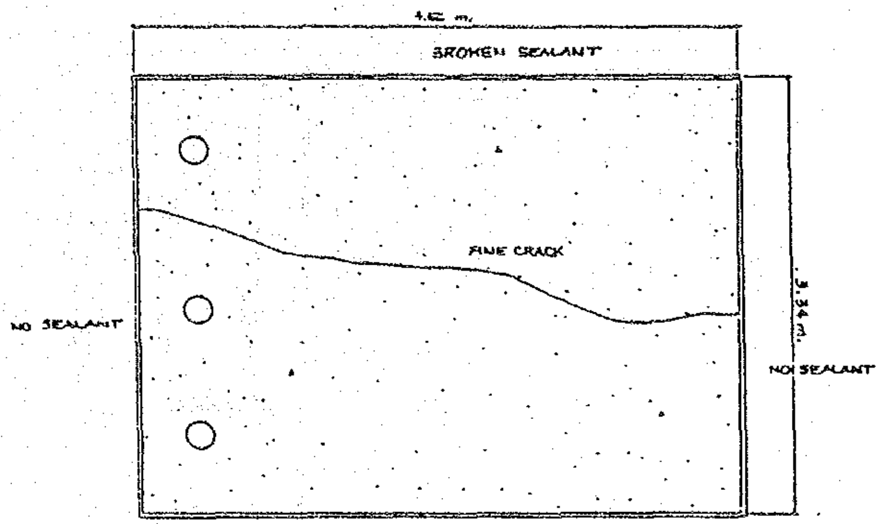
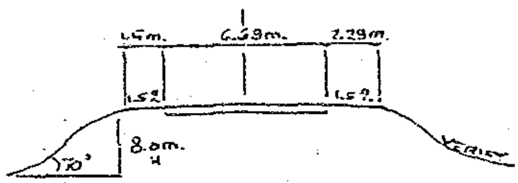


FIGURE 8.2-4 (3) DETERIORATION CONDITION OF S_1-B SLAB



SCALE 1:400 M.

1. Cracking = No wide crack.
   Fine crack (total length) = 4.50 m
2. Sealant Failure = No sealant on both contract joints.
   Broken sealant on longitudinal joint.



CROSS SECTION
SCALE 1:300m.

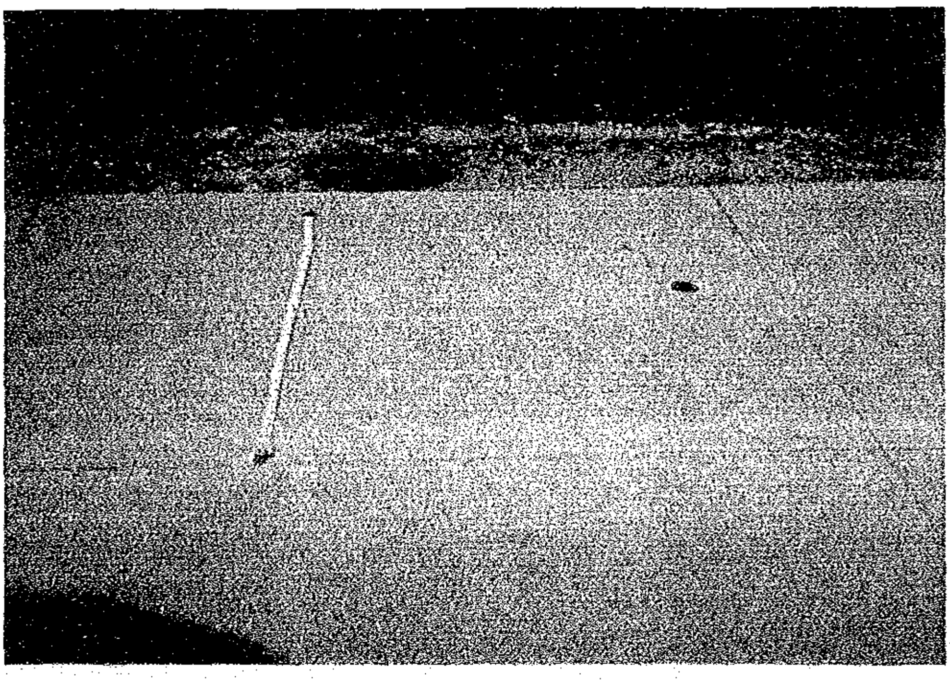
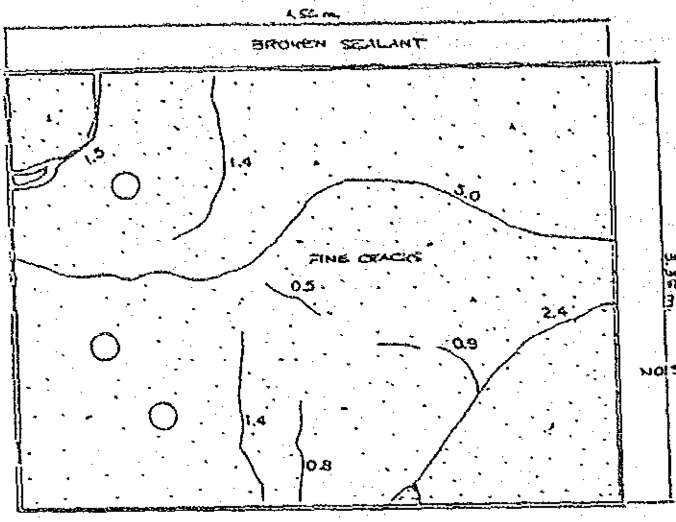
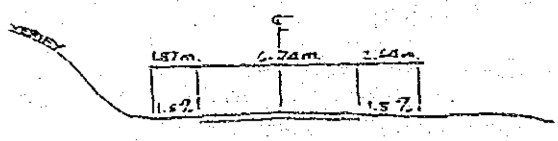


FIGURE 8.2-5 (1) DETERIORATION CONDITION OF S_2-G SLAB



SCALE 1:400M.



CROSS SECTION
SCALE 1:300m.

1. Cracking = Wide crack (total length) = 3.00 m
   Few fine crack.
2. Settlement = Observed in most of the cracks.
3. Pumping = Observed at cracks (5)-(6)
4. Slab Rocking = Observed at cracks (5)-(6)
5. Spalling = Observed in some cracks.
6. Sealant Failure = No sealant in all joints.

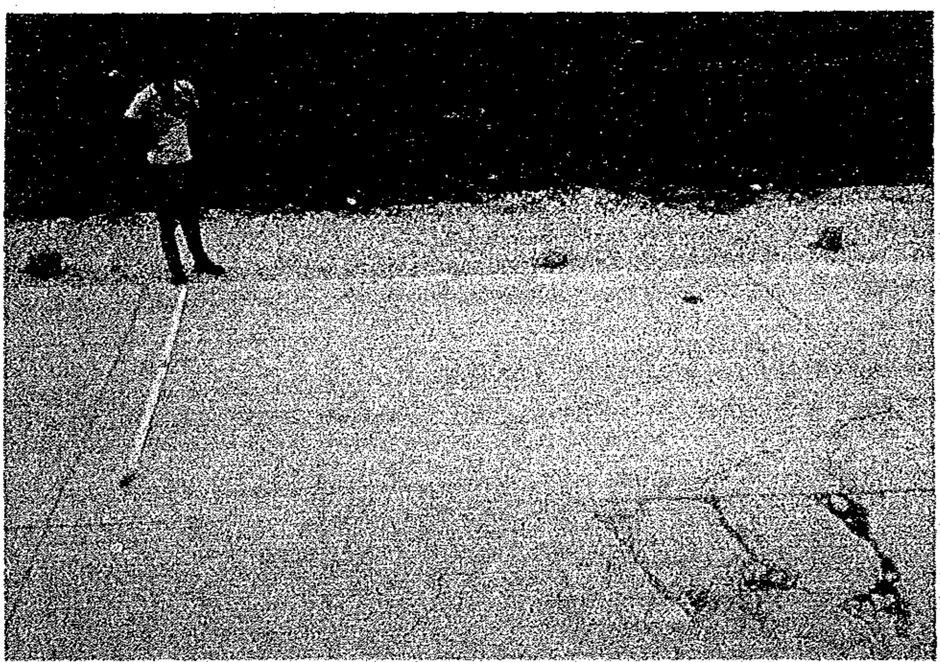
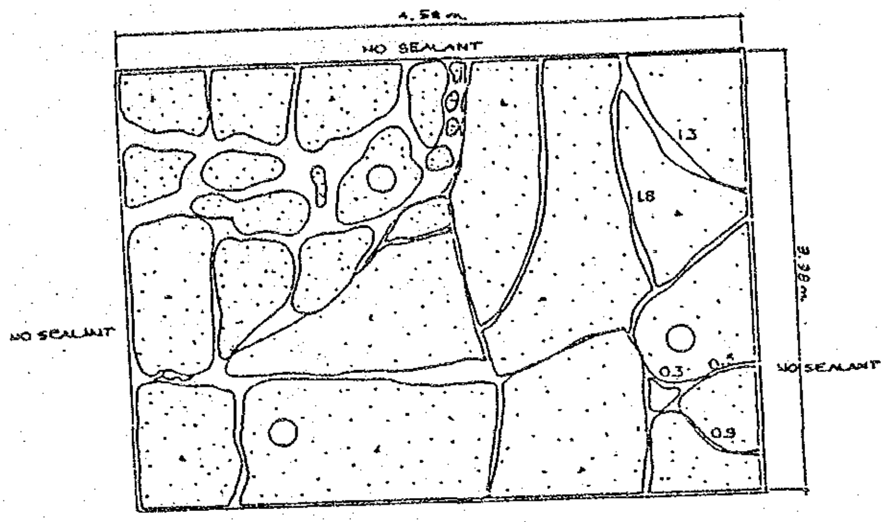
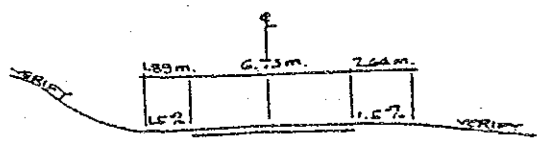


FIGURE 8.2-5 (2) DETERIORATION CONDITION OF S_2-F SLAB



SCALE 1:400 M.

1. Cracking = Wide crack (total length) = 6.70 m
   Fine crack (total length) = 7.20 m
2. Settlement = Observed at (1)
3. Sealant Failure = Broken sealant most part of joints.
   No sealant in some part.



CROSS SECTION
SCALE 1:300 m.

FIGURE 8.2-5 (3) DETERIORATION CONDITION OF S_2-B SLAB