社会開発調査部報告書

REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS & HIGHWAYS

Feasibility Study
on
The Rural Road Network Development Project

FINAL REPORT (Volume I)

EXECUTIVE SUMMARY

OCTOBER, 1990

JAPAN INTERNATIONAL COOPERATION AGENCY

REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS & HIGHWAYS

Feasibility Study
on
The Rural Road Network Development Project

FINAL REPORT (Volume I)

EXECUTIVE SUMMARY

OCTOBER, 1990

JAPAN INTERNATIONAL COOPERATION AGENCY

PREFACE

In response to the request from the Government of the Republic of the Philippines, the Japanese Government decided to conduct a study on the Feasibility Study on the Rural Road Network Development Project and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to the Philippines a study team headed by Mr. Kunihiko Sawano, composed of members from the Katahira & Engineers Inc. and Nippon Engineering Consultant Co., Ltd., two times from October 1989 to October 1990.

The team held discussions with the concerned officials of the Government of the Philippines, and conducted field surveys. After the team returned to Japan, further studies were made and the present report was prepared.

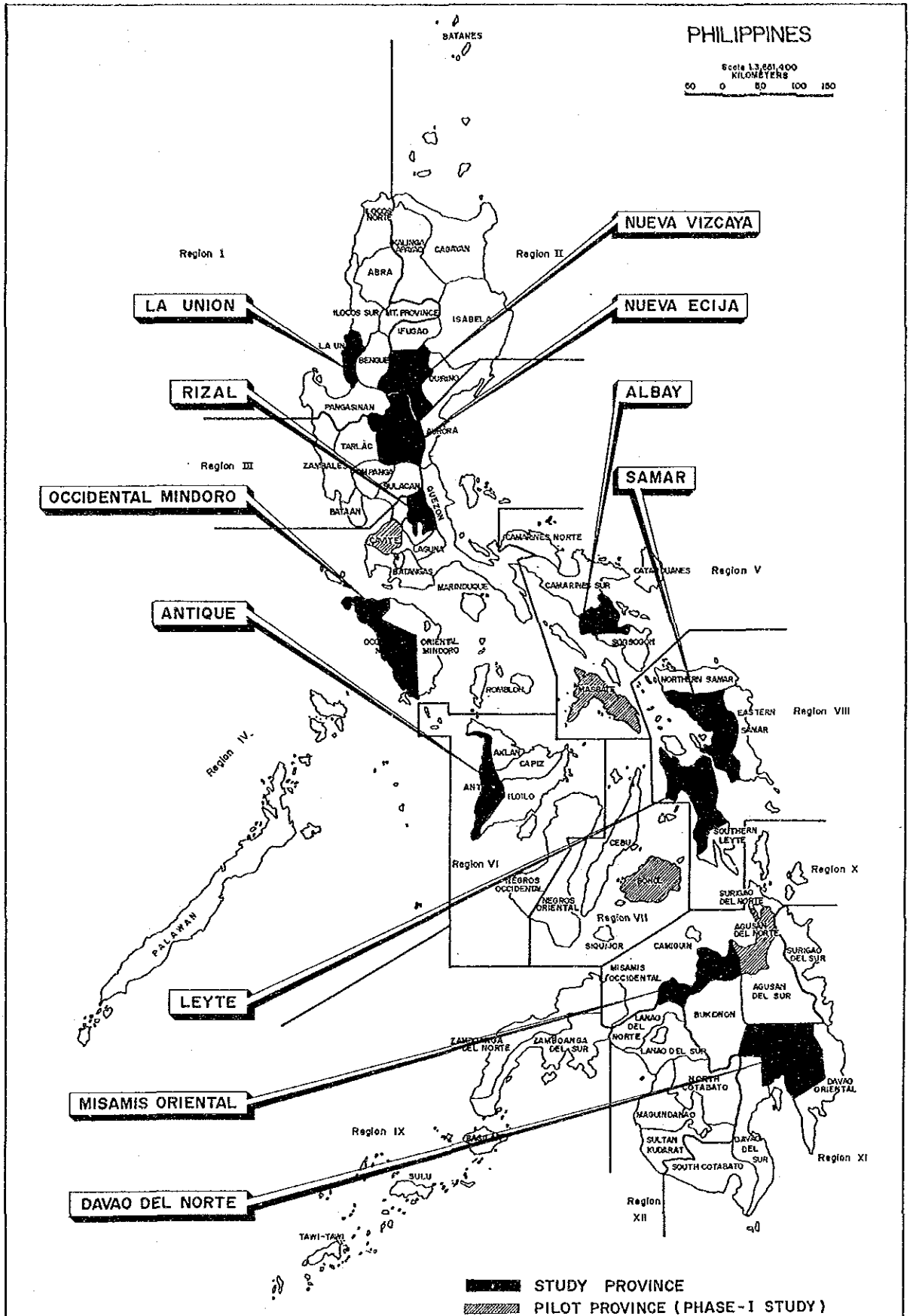
I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Philippines for their close cooperation extended to the team.

October, 1990

Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency



FEASIBILITY STUDY ON THE RURAL ROAD NETWORK DEVELOPMENT PROJECT	LOCATION MAP

Panabo-Tubod Road, Davao del Norte
PCC pavement in fair condition

Bacnotan-Luna-Balaoan Road, La Union
DBST pavement in fair condition

Mamburao South Road, Occidental Mindoro
Gravel road in fair condition

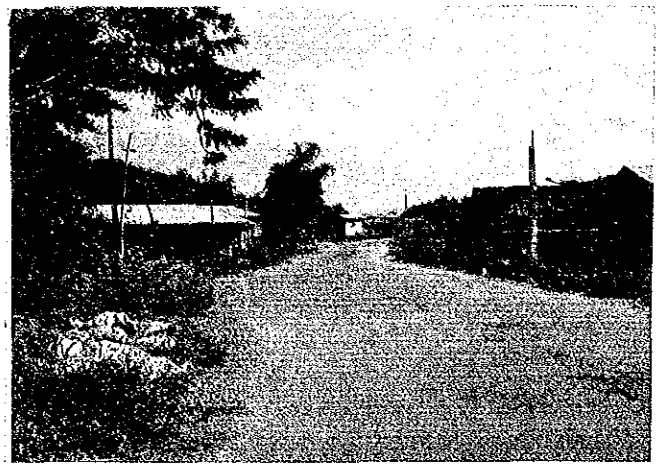
Kasibu-Quezon-Solano Road, Nueva Vizcaya
Gravel road in poor condition

Nueva Ecija-Aurora Road, Nueva Ecija
Gravel road at flooded section

San Juanico-Sohoton Road, Samar
Earth road

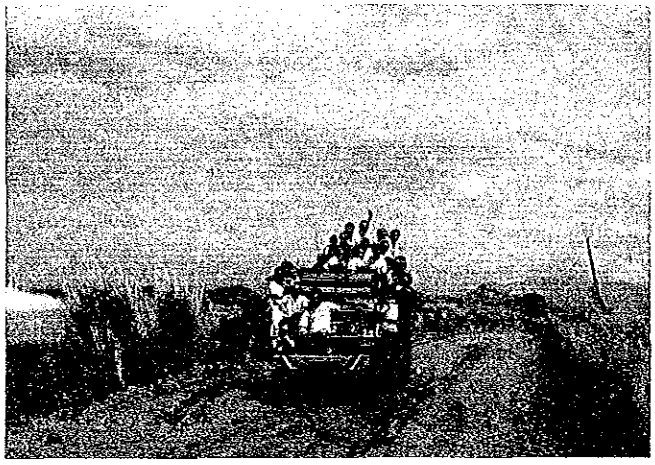
RURAL ROADS IN THE PHILIPPINES

National Road



Morong-Bonbongan Road, Rizal
DBST pavement in fair condition

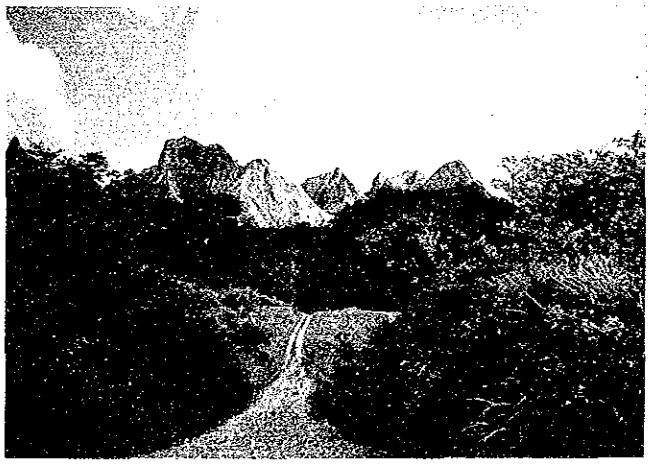
San Jorge-Matalud Road, Samar
Gravel road in fair condition



Guimba-Talugtog Road, Nueva Ecija
Gravel road in bad condition

Aringay-San Jose Road, LaUnion
At slope failure section

Ben-San Antonio road, Autique
At flooded section



Sto, Nino-Aguas Road, Occidental Mindoro
At impassable section

RURAL ROADS IN THE PHILIPPINES

Provincial Road

Camalig-Taladong Road, Albay
Gravel road in bad condition

Binuangan-Kidampis Road, Misamis Oriental
Gravel road in very bad and narrow section

New Bataan-Camanlagan Road, Davao del Norte
At ford crossing

Mationg-San Jose de Buan Road, Samar
At steep section

San Mariano Road, Leyte
Earth road in poor condition

Balac-Balac Road, Antique
Earth road impassable for vehicles

RURAL ROADS IN THE PHILIPPINES

Barangay Road

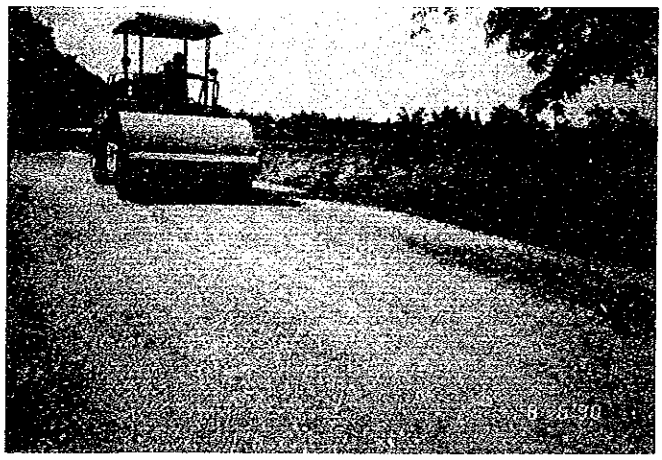
Spreading of sandy gravel subbase course materials for compaction

Compaction of subbase course materials

Conducting of field density tests on a prepared subbase course

Spreading of crushed stone base course materials for compaction

Watering of base course for compaction

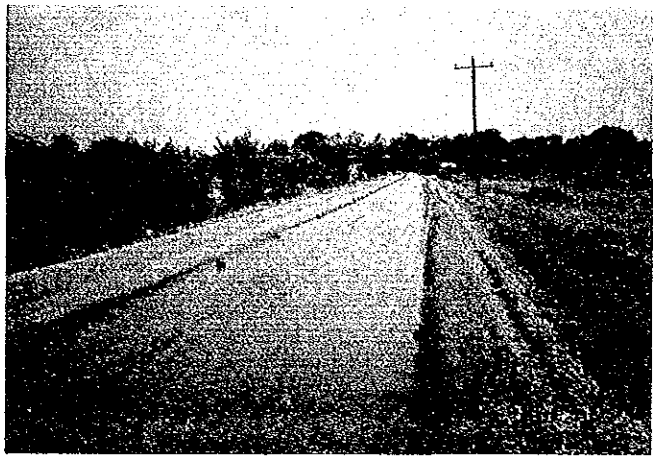


Compaction of base course materials

EXPERIMENTAL PAVEMENT CONSTRUCTION

Subbase Course and Base Course

Prepared base course before prime coating



Base course after prime coating

Double bituminous surface treatment,
asphalt binder spraying by asphalt distributor

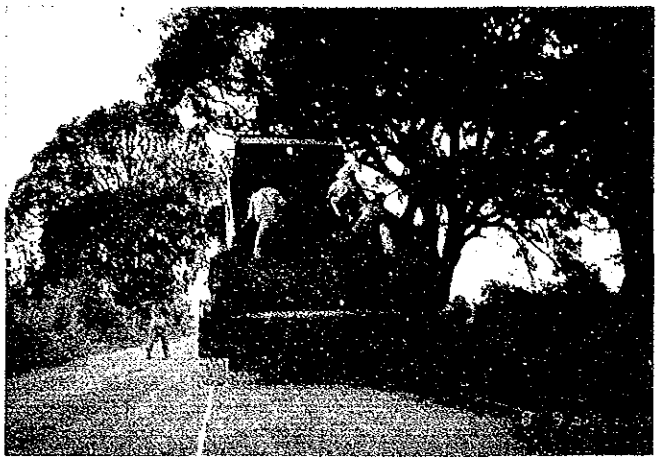
Double bituminous surface treatment,
cover aggregate spreading by aggregate spreader

Final rolling of double bituminous surface treatment

Finished double bituminous surface treatment (left)
and stone layer rolling (right)

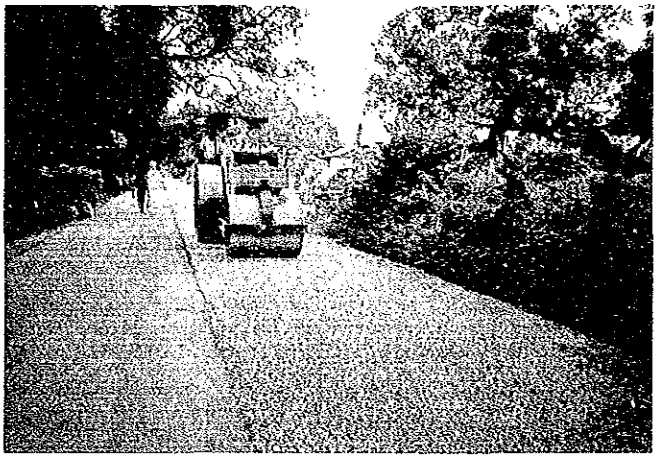
EXPERIMENTAL PAVEMENT CONSTRUCTION

Double Bituminouse Surface Treatment

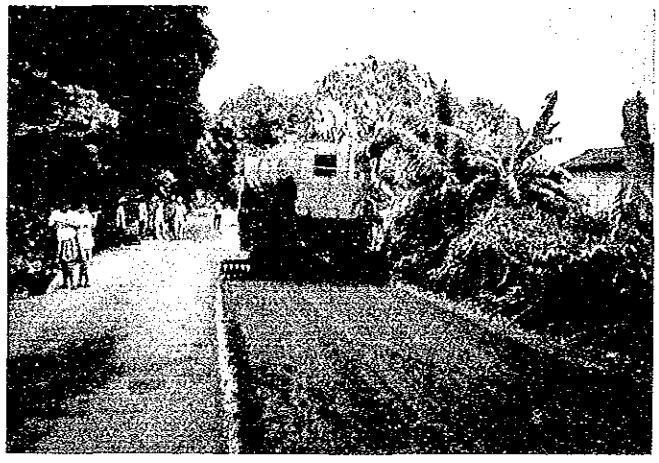


Bituminous penetration macadam,
base layer aggregate spreading by aggregate spreader

Bituminous penetration macadam,
base layer aggregate spreading by hand



Bituminous penetration macadam, base layer compaction



Bituminous penetration macadam,
asphalt binder spraying by asphalt distributor

Bituminous penetration macadam,
cover aggregate spreading

Finished bituminous penetration macadam (left)
and stone layer rolling (right)

EXPERIMENTAL PAVEMENT CONSTRUCTION

Bituminous Penetration Macadam

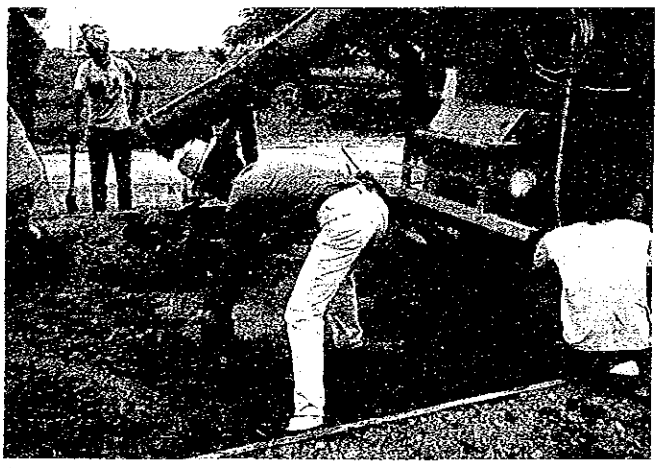
Laying of asphalt concrete by asphalt finisher

Rolling of asphalt concrete (left)
and finished asphalt concrete surface course (right)

Setting of wooden side forms for portland cement concrete surface course

Compaction of trimmed subbase course

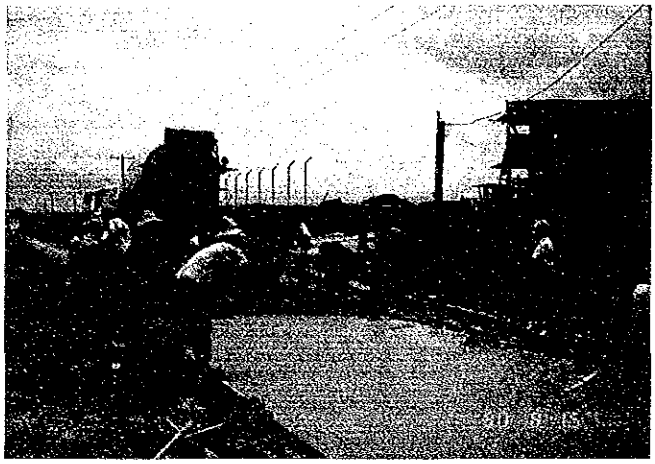
Conducting of field density tests for compacted subbase course



Starting of placement of cement concrete and slump tests

EXPERIMENTAL PAVEMENT CONSTRUCTION

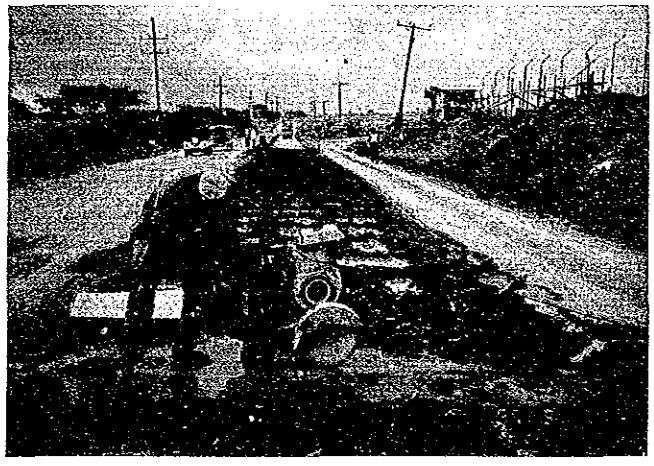
Asphalt Concrete Surface Course and Portland Cement Concrete Surface Course



Placing of cement concrete

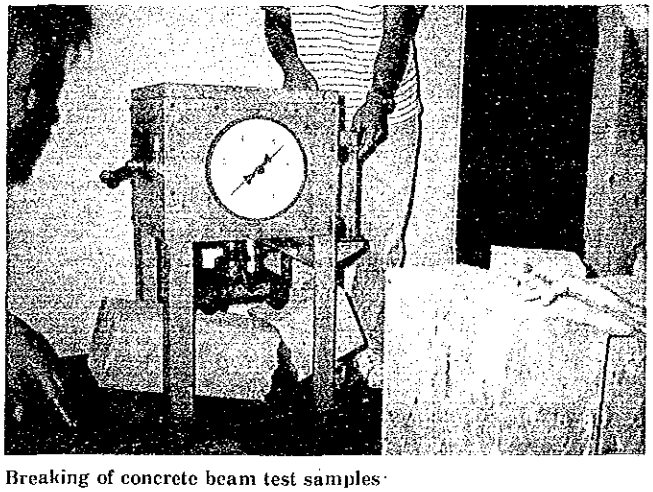
Finishing of cement concrete surface

Water curing of hardened concrete



Saw cuting for transverse contraction joints

Curing of concrete beam-test samples in curing tank



Breaking of concrete beam test samples

EXPERIMENTAL PAVEMENT CONSTRUCTION

Portland Cement Concrete Surface Course

TABLE OF CONTENTS

I INTRODUCTION

1. Background of the Study 1
2. Objectives of the Study 2
3. Scope of the Study 3
4. Reports 5

II FINDINGS AND RECOMMENDATIONS

1. Basic Information 7
2. Recommendations 11

III SUMMARY

PART A FEASIBILITY STUDY ON RURAL ROAD PROJECTS

A.1 Selection of Study Provinces 13

A.1.1 Basic Data and Indicators by Province 13
A.1.2 Classification of Provinces 14
A.1.3 Selection of Study Provinces 15

A.2 Project Identification and Screening 16

A.2.1 Procedure for Project Identification and Screening 16
A.2.2 Methodology for Project Identification and Screening 17
A.2.3 Project Identification and Screening in the Study Provinces 18

A.3 Project Evaluation 19

A.3.1 Procedure for Project Evaluation 19
A.3.2 Methodology for Project Evaluation 20
A.3.3 Project Evaluation in the Study Provinces 21

A.4 Simplified Evaluation Method 22

A.5 Implementation Program 23

PART B STUDY ON LOW-CLASS PAVEMENTS

B.1 Low-Class Pavements in the Philippines 24

B.1.1 Type of Low-Class Pavements 24
B.1.2 Pavement Surface Condition Survey and Evaluation 25
B.1.3 Analysis of Low-class Pavement Deterioration 26

B.2 Experimental Pavement 27

B.2.1 Planning and Design of Experimental Pavement 27
B.2.2 Construction of Experimental Pavement 28
B.2.3 Plan of Follow-up Survey 29

B.3 Standard Structural Design of Low-Class Pavements 30

B.4 Recommendations on Design and Construction of Low-Class Pavements 32

I INTRODUCTION

I INTRODUCTION

1. BACKGROUND OF THE STUDY

As of 1986, the public road network of the Philippines has a total length of about 162,325 km consisting of about 26,230 km of national roads which form the main trunkline system; 45,216 km of provincial, municipal and city roads; and 90,879 km of barangay roads.

The development program regarding the national road system of the country has been pursued with increased momentum starting in the early 1970's following the completion of the Philippine Transport Survey (PTS). Presently, the extent and coverage of the network of primary roads may be considered adequate especially in built-up areas, major municipalities and population centers, except for some rural areas where road network systems are still deemed inadequate, thereby, constraining growth and progress in these areas. The updated highway program stressed the urgent need of rural road improvement in these areas and has given high priority to such projects.

In line with this policy, the Pilot Study for the Rural Road Network Development Project (the Phase I Study) was conducted with the technical assistance of the Japan International Cooperation Agency (JICA), which is the official agency responsible for the implementation of technical cooperation programs of the Government of Japan (GOJ), as an initial step in formulating a systematic plan for providing the basic road network with emphasis placed on the development of rural road network in selected provinces. In order to verify and enlarge the result of the Phase I Study, and to further promote the rural road network development project, the Government of the Republic of the Philippines (GRP) through the Department of Public Works and Highways (DPWH) sought technical assistance from GOJ for the conduct of the Feasibility Study on the Rural Road Network Development Project (the Study).

In response to the request of GRP, GOJ decided to conduct the Study. JICA organized a team of ten experts to be engaged in the Study. The JICA Study Team, in close collaboration with the DPWH Counterpart Team, commenced work in October 1989 and completed its tasks in October, 1990.

2. OBJECTIVES OF THE STUDY

Objectives of the Study are to:

(1) Conduct the feasibility study on the rural road network development to verify and enlarge the result of the Phase I Study.

  (a) Establish basic technical and administrative procedures and methods for the functional development of road network in the rural areas of about ten provinces:

  (b) Recommend a system and investment program for the implementation of rural road projects:

(2) Investigate performance of low-class pavements and recommend structural design for the economical implementation of the above projects.

(3) The Study Team shall exercise maximum technology transfer to the Filipino engineers in the course of the Study.

3. SCOPE OF THE STUDY

The Study which consists of two parts (PART-A and PART-B) were carried out in three main stages as follows :

PART-A: Feasibility Study on the Rural Road Projects

Stage 1 : Selection of Study Provinces

Eleven provinces were selected for the Study, taking into consideration the socio-economic characteristics, adequacy of road network, etc. of provinces.

Stage 2 : Project Identification and Screening

For the provinces selected in Stage 1, the road projects were identified and high priority projects were selected for detailed evaluation.

Stage 3 : Project Evaluation

For the road projects selected in Stage 2,
feasibility studies were conducted, including :

* Project Evaluation
* Verification of simplified evaluation method
* Development of implementation program

PART-B: Study on Low-Class Pavements

Stage 1 : Preparation of the Study

The road sections and the experimental pavement models to be constructed were selected.

Stage 2 : Analysis and Designing

Engineering study on each variation of the pavements selected in Stage 1 was undertaken.

Stage 3 : Experimental Pavement Construction

The experimental pavements designed in Stage 2 were constructed.

The manual for the follow-up survey of the above pavements to be conducted by DPWH for the following five years was formulated.

The effectiveness of the structural design recommended in Stage 2 was verified through the above experimental construction.

Since major activities for project evaluation in Stage 3 of Part A was completed at the end of June 1990, the damages brought about by the earthquake on July 16, 1990 is not reflected in the Report.

4. REPORTS

The following reports were prepared during the Study:

Inception Report	(October 1989)
Progress Report	(November 1989)
Interim Report	(March 1990)
Draft Final Report	(August 1990)

The Final Report is organized as follows:

Volume	1 :	Executive Summary
Volume	2 :	Main Report
Volume	3 :	Appendix
Volume	4 :	Project Evaluation in the Province of La Union
Volume	5 :	Project Evaluation in the Province of Nueva Vizcaya
Volume	6 :	Project Evaluation in the Province of Nueva Ecija
Volume	7 :	Project Evaluation in the Province of Rizal
Volume	8 :	Project Evaluation in the Province of Occidental Mindoro
Volume	9 :	Project Evaluation in the Province of Albay
Volume	10 :	Project Evaluation in the Province of Antique
Volume	11 :	Project Evaluation in the Province of Samar
Volume	12 :	Project Evaluation in the Province of Leyte
Volume	13 :	Project Evaluation in the Province of Misamis Oriental
Volume	14 :	Project Evaluation in the Province of Davao del Norte
Volume	15 :	Drawings for Road Projects in the Province of La Union
Volume	16 :	Drawings for Road Projects in the Province of Nueva Vizcaya
Volume	17 :	Drawings for Road Projects in the Province of Nueva Ecija
Volume	18 :	Drawings for Road Projects in the Province of Rizal
Volume	19 :	Drawings for Road Projects in the Province of Occidental Mindoro
Volume	20 :	Drawings for Road Projects in the Province of Albay
Volume	21 :	Drawings for Road Projects in the Province of Antique
Volume	22 :	Drawings for Road Projects in the Province of Samar
Volume	23 :	Drawings for Road Projects in the Province of Leyte
Volume	24 :	Drawings for Road Projects in the Province of Misamis Oriental
Volume	25 :	Drawings for Road Projects in the Province of Davao del Norte
Volume	26 :	Guide for Simplified Project Evaluation
Volume	27 :	Specifications for Experimental Pavement Construction
Volume	28 :	Drawings for Experimental Pavement Construction
Volume	29 :	Manual for Follow-up Survey of Experimental Pavement
Volume	30 :	Manual for Design and Construction of Low-Class Pavement

The Study was undertaken jointly by the JICA Study Team and the DPWH Counterpart Team. Technical guidance in the conduct of the Study was provided through periodic review by the Steering Committee of GRP and the JICA Advisory Committee.

II FINDINGS AND RECOMMENDATIONS

II FINDINGS AND RECOMMENDATIONS

1. BASIC INFORMATION

Classification of Provinces and Selection of Study Provinces

Socio-economic development	Adequacy of road	Geography/Topography		
		Flat	Mountainous	Island
Developed	Average	(4) Cavite (3) Pampanga (3) Bulacan (4) Laguna	(1) Benguet (3) Zambales (1) La Union	
Less developed	High	(4) Rizal (4) Batangas	(3) Bataan (2) Nueva Vizcaya (1) Ilocos Norte (12) Lanao del Sur (1) Ilocos Sur (1) Abra (10) Misamis Oriental (8) Southern Leyte (10) Misamis Occidental	(2) Batanes (7) Bohol (4) Romblon (7) Siquijor (10) Camiquin
	Average	(1) Pangasinan (2) Nueva Ecija (2) Tarlac (8) Leyte (5) Albay (6) Iloilo (5) Camarines Sur (6) Capiz (6) Negros Occidental (5) Sorsogon	(10) Bukidnon (2) Cagayan (11) South Cotabato (1) Mountain Province (10) Agusan del Norte (12) Lanao del Norte (2) Ifugao (6) Aklan (5) Camarines Norte (9) Zamboanga del Norte (10) Surigao del Norte (6) Antique	(7) Cebu (5) Catanduanes (4) Marinduque
	Poor	(2) Isabela (11) Davao del Norte (12) Maguindanao (10) Agusan del sur (12) North Cotabato	(4) Occidental Mindoro (3) Quirino (12) Sultan Kudarat (2) Kalinga-Apayao (9) Zamboanga del Sur (11) Davao del Sur (11) Davao Oriental (11) Surigao del Sur (7) Negros Oriental (8) Samar (4) Oriental Mindoro (4) Quezon (8) Northern Samar (8) Eastern Samar (4) Aurora	(9) Sulu (9) Tawi-Tawi (4) Palawan (9) Basilan (5) Masbate

4 Pilot Provinces (Phase I Study)

11 Study Provinces (This Study)

Region Number in ( )

Road Length and Cost Proposed for Improvement
Initial Stage (IRR 15% or more)

Province	MAJOR ROADS		MINOR ROADS		TOTAL	
	Length (km)	Cost (MP)	Length (km)	Cost (MP)	Length (km)	Cost (MP)
La Union	68.0	172.4	40.9	49.8	108.9	222.2
Nueva Vizcaya	22.4	68.5	25.0	24.1	47.4	92.6
Nueva Ecija	214.2	761.1	131.4	209.3	345.6	970.4
Rizal	44.8	94.5	25.8	29.8	70.6	124.3
Occ. Mindoro	42.3	108.8	40.5	46.1	82.8	154.9
Albay	86.6	211.2	157.8	199.0	244.4	410.2
Antique	18.8	85.7	100.6	76.6	119.4	162.3
Samar	30.2	46.4	201.9	144.9	232.1	191.3
Leyte	85.6	163.5	162.5	193.8	248.1	357.3
Misamis Oriental	55.0	211.3	125.9	113.5	180.9	324.8
Davao del Norte	46.1	124.4	118.5	94.7	164.6	219.1
Total	714.0	2,047.8	1,130.8	1,181.6	1,844.8	3,229.4

Road Length and Cost Proposed for Improvement
Secondary Stage (IRR 7.5% – 15%)

Province	MAJOR ROADS		MINOR ROADS		TOTAL	
	Length (km)	Cost (MP)	Length (km)	Cost (MP)	Length (km)	Cost (MP)
La Union	17.9	11.7	79.8	76.9	97.7	86.6
Nueva Vizcaya	23.1	46.4	96.7	68.7	119.8	115.1
Nueva Ecija	49.4	122.5	61.9	84.7	111.3	207.2
Rizal	-	-	7.4	8.3	7.4	8.3
Occ. Mindoro	29.1	109.5	43.0	51.3	72.1	160.8
Albay	12.1	20.4	69.2	110.5	81.3	130.9
Antique	87.2	220.2	48.3	71.6	135.5	291.8
Samar	86.1	276.3	96.0	98.9	182.1	375.2
Leyte	99.5	266.1	175.2	215.8	274.7	481.9
Misamis Oriental	-	-	148.2	207.7	148.2	207.7
Davao del Norte	128.6	302.6	98.9	114.1	227.5	416.7
Total	533.0	1,375.7	924.6	1,108.5	1,457.6	2,484.2

Fund Requirement for Rural Road Development Program
Initial Stage (IRR 15% or more)

(Unit = MP, 1990 Price)

		Construction Cost	Engineering Services	Total
Project Component I	JICA-F/S 4-Provinces	950.9		
	11-Provinces	3,229.4		
	Sub-Total	4,180.3		
	Average 1-Province	278.7		
	73-Provinces	20,345.1	2,034.5	22,379.6
Project Component II	Relevant Studies Type A	3,570.0	305.5	3,875.5
	Type B	2,984.1	363.7	3,347.8
	Sub-Total	6,554.1	669.2	7,223.3
Gross Total Project Componet I and II		26,899.2	2,703.7	29,602.9

OVERALL IMPLEMENTATION SCHEDULE OF RURAL ROAD DEVELOPMENT PROGRAM

	Annual Fund	No. of Provinces Covered	Annual Average Fund per Provinces	Initial Improvement Stage IRR>15% 1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	Secondary Improvement Stage 15>IRR>7.5
Locally Funded Projects	P1,853 M	73	P25.4 M	← 6-year Total P11,118 M →						
Foreign Assisted Projects	P3,147 M	73	P43.1 M	← P18,882 M →						
Total	P5,000 M	73	P68.5 M	← P30,000 M →						
Locally Funded Projects										←
Foreign Assisted Projects										←
Total										

Experimental Pavement

Section	AADT	Pavement Type	Design Subgrade CBR	Design Performance Period (Year)	Thickness (cm)				Length (m)
					Surface	Base	Subbase	Total	
1	150	GR	4	5	15	-	5	20	200
		SBST	4	3	0.5	15	8	23.5	200
		DBST	4	5	1.5	15	9	25.5	200
		BMP	4	7	5	15	5	25	200
2	150	GR	3	5	15	-	8	23	200
		SBST	3	3	0.5	15	12	27.5	200
		DBST	3	5	1.5	15	14	30.5	200
		BMP	3	7	5	15	10	30	200
3	900	DBST	3	5	1.5	15	30	46.5	200
		BMP	3	7	5	15	26	46	200
		AC	8	8	4	12	8	24	200
		AC	8	10	5	12	6	23	200
4	900	DBST	8	5	1.5	15	13	29.5	200
		BMP	5	7	5	15	16	36	200
		AC	3	8	4	15	23	42	200
		AC	3	10	5	15	21	41	200
5	2,100	AC	5	5	5	15	19	39	200
		PCC	5	8	18	-	20	38	200

2. RECOMMENDATIONS

1) Consistent with the Government's development policy of attaching importance to rehabilitation, improvement and expansion of the feeder and secondary network, it is recommended that the promotion of rural road network development contribute to the national development goals, viz., alleviation of poverty, generation of more productive employment, promotion of equity and social justice, and the attainment of sustainable economic growth.

2) In the implementation of the project, the following should be investigated:

- Strengthening of project institution by organizing a project management office for the project,
- Introduction of a community participation system,
- Introduction of a labor-based/equipment-supported construction system,
- Development of standardized technology,
- Implementation by administration for small size projects, and
- Application of sector loan system for foreign assisted projects.

3) Regarding design and construction of low-class pavements to be used for the project, the following are recommended:

On administration,

- Development of standard pavement types in consideration of both monetary and non-monetary factors,
- Establishment of pavement rehabilitation criteria incorporating an appropriate indicator therein, and
- Guidelines for construction of pavement in rainy season.

On design,

- Provision of guidelines for preparation and/or selection of the inputs required for design,
- Provision of guidelines for selection of initial and terminal serviceabilities, and
- Introduction of planned rehabilitation strategy including upgrading of initial pavement type.

On construction,

- Conformity with design and specification requirements at reasonably estimated cost,
- Establishment of systematic construction schedule supported by equipment schedule, material schedule, manpower schedule and financial schedule, and
- Introduction of various techniques including stabilization methods for subbase and base course and the like.

III SUMMARY

III SUMMARY

PART A FEASIBILITY STUDY ON RURAL ROAD PROJECTS

A.1 SELECTION OF STUDY PROVINCES

A.1.1 Basic Data and Indicators by Province

The data-base prepared in the Phase I study was updated.
The updated data-base includes the following basic data and indicators by province :

TABLE A.1.1-1 BASIC DATA

Physical and Demographic Data	: Total land area, arable area, distance from Manila/Cebu/Davao whichever is nearest, urban/rural/total population
Economic Data	: GRDP, per capita income, number of workers by industrial sector, un-/under-employment rate
Agricultural Data	: Cultivable area (cultivated/unutilized/ total), crop area and production of palay, corn, sugarcane and coconut
Social Data	: Number of elementary classrooms, number of hospital beds, incidence of poverty
Road Data	: Length of road by administrative classification and by type of pavement

TABLE A.1.1-2 INDICATORS

Physical and Demographic Indicators	: Topographic classification, arable area ratio, population density, arable area population density, urban population ratio, population growth rate
Economic Indicators	: Per capita GRDP, land productivity, per capita income, primary / secondary / tertiary sector worker ratio, un-/under-employment ratio
Social Indicators	: Elementary classroom ratio, hospital bed ratio, social facility ratio, incidence of poverty
Agricultural Indicators	: Major crops, yield by crop, unutilized agricultural area ratio, accessibility to Manila/Cebu/Davao, agricultural productivity
Road Development Indicators	: Road density per unit area, road density per unit area/population, road density per unit area/population/per capita income, fair condition road ratio

A.1.2 Classification of Provinces

Factors used in classification

1) Socio-economic development represented by incidence of poverty
2) Adequacy of road represented by road density, $L'/\sqrt{P \cdot A}$ (L'=fair condition road length, P = population, A = Land area)
3) Geography/topography

Classification of Provinces

Provinces were classified in different ways using each independent factor or two or three factors combined. Table A.1.2-1 shows the classification of provinces using the three factors.

TABLE A.1.2-1 CLASSIFICATION OF PROVINCES

Socio-economic development	Adequacy of road	Geography/Topography		
		Flat	Mountainous	Island
Developed	Average	(4) Cavite (3) Pampanga (3) Bulacan (4) Laguna	(1) Benguet (3) Zambales (1) La Union	
Less developed	High	(4) Rizal (4) Batangas	(3) Bataan (2) Nueva Vizcaya (1) Ilocos Norte (12) Lanao del Sur (1) Ilocos Sur (1) Abra (10) Misamis Oriental (8) Southern Leyte (10) Misamis Occidental	(2) Batanes (7) Bohol (4) Romblon (7) Siquijor (10) Camiguin
	Average	(1) Pangasinan (2) Nueva Ecija (2) Tarlac (8) Leyte (5) Albay (6) Iloilo (5) Camarines Sur (6) Capiz (6) Negros Occidental (5) Sorsogon	(10) Bukidnon (2) Cagayan (11) South Cotabato (1) Mountain Province (10) Agusan del Norte (12) Lanao del Norte (2) Ifugao (6) Aklan (5) Camarines Norte (9) Zamboanga del Norte (10) Surigao del Norte (6) Antique	(7) Cebu (5) Catanduanes (4) Marinduque
	Poor	(2) Isabela (11) Davao del Norte (12) Maguindanao (10) Agusan del sur (12) North Cotabato	(4) Occidental Mindoro (3) Quirino (12) Sultan Kudarat (2) Kalinga-Apayao (9) Zamboanga del Sur (11) Davao del Sur (11) Davao Oriental (11) Surigao del Sur (7) Negros Oriental (8) Samar (4) Oriental Mindoro (4) Quezon (8) Northern Samar (8) Eastern Samar (4) Aurora	(9) Sulu (9) Tawi-Tawi (4) Palawan (9) Basilan (5) Masbate

A.1.3 Selection of Study Provinces

In the Phase I Study, the following four provinces were selected as pilot provinces :

Pilot Provinces	:	Cavite	(Region IV)
		Masbate	(Region V)
		Bohol	(Region VII)
		Agusan del Norte	(Region X)

In this Study, the following considerations were given in selecting study provinces :

- To select at least one (1) province from each category of province classification
- To include provinces where improvement of access roads to the Pan-Philippine Highway is expected
- To widely distribute the study provinces over the country
- To exclude provinces with more than 150 km of on-going and/or committed road projects, and remote and small island provinces.

In view of the above, the following 11 provinces were selected :

Study Provinces	:	La Union	(Region I)
		Nueva Vizcaya	(Region II)
		Nueva Ecija	(Region III)
		Rizal	(Region IV)
		Occidental Mindoro	(Region IV)
		Albay	(Region V)
		Antique	(Region VI)
		Samar	(Region VIII)
		Leyte	(Region VIII)
		Misamis Oriental	(Region X)
		Davao del Norte	(Region XI)

A.2 PROJECT IDENTIFICATION AND SCREENING

A.2.1 Procedure for Project Identification and Screening

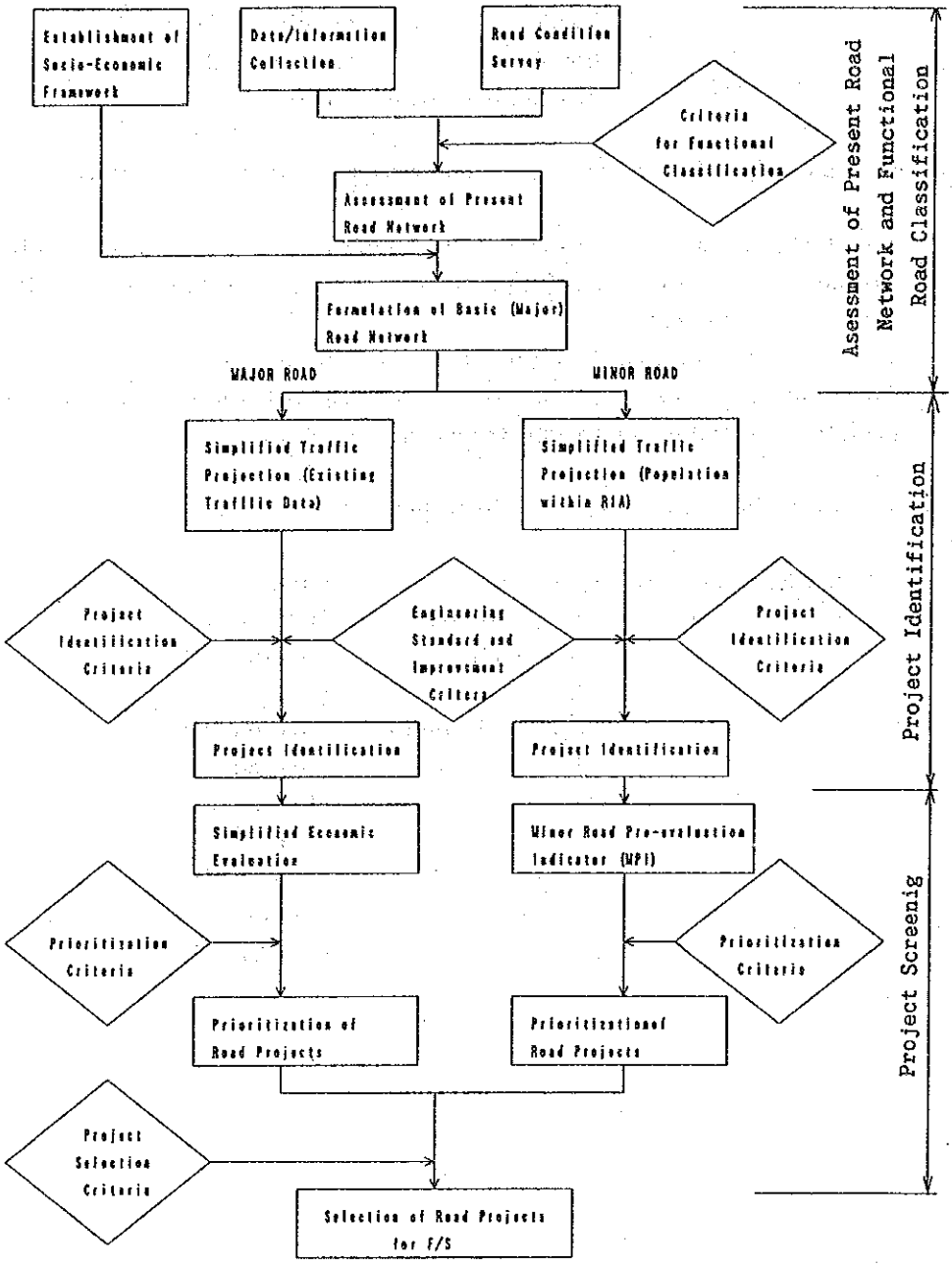


FIGURE A.2.1-1 PROCEDURE FOR PROJECT IDENTIFICATION AND SCREENING

A.2.2 Methodology for Project Identification and Screening

Assessment of Present Road Network

Present road network was assessed from the viewpoint of quantity of road (road density), quality of road (surface type and condition) and network pattern. Based thereon, the general direction for road network development was set up.

Functional Road Classification

In order to formulate a systematic road development plan, the following functional road classification was made:

- Major Roads
  - Primary Major Roads : Major inter-provincial or intra-provincial roads
  - Secondary Major Roads : Roads linking municipal towns
- Minor Roads
  - Collector Roads : Collector roads of two or more feeder roads
  - Feeder Roads : Feeder roads to one or more barangays

Project Identification

Studied Roads : Roads surveyed on present condition by the Study Team (all major roads and some minor roads), and roads requested by the local officials to be studied (minor roads) were included.

Simplified Traffic Projection :

Major Roads : Estimated by traffic assignment method.

Minor Roads : Estimated based on population within the road influence area.

Engineering Standards : Geometric standards and pavement type depending on road class, traffic volume and topographic condition.

Project Identification : Roads of substandard criteria/conditions regarding pavement type, surface condition and width were identified as road projects.

Project Screening

Simplified Evaluation :

Major Roads : Simplified economic evaluation was carried out based on roughly estimated construction cost and traffic benefits.

Minor Roads : Minor road pre-evaluation indicator (MPI) was employed. MPI is calculated based on surface condition, terrain, population and road length.

Project Screening : Road projects were categorized according to three factors : 1) class of road, 2) simplified evaluation results, and 3) urgency. Based on such categorization and some engineering considerations for balanced distribution of projects, the road projects for feasibility study were selected.

A.2.3 Project Identification and Screening in the Study Provinces

Out of the 21,720km of existing roads, 12,109km of roads were taken up as study roads for pre-screening. Of the 12,109km, 9,217 km of roads were identified as road projects, out of which 5,291km of roads were selected for feasibility Study. See Table A.2.3-1.

TABLE A.2.3-1 SUMMARY OF PROJECT IDENTIFICATION AND SCREENING

	La Union	Nueva Vizcaya	Nueva Ecija	Rizal	Occidental Mindoro	Albay	Antique	Samar	Leyte	Misamis Oriental	Davao del Norte	Total
1. Population (1987)	532,000	295,000	1,245,000	718,000	269,000	944,000	486,000	529,000	1,478,000	955,000	852,000	8,124,000
2. Land Area (sq. km)	1,459	3,984	5,284	1,309	5,880	2,553	2,552	5,591	6,268	3,570	8,139	46,534
3. No. of Cities/Municipalities	20	15	32	14	9	18	18	21	43	26	18	234
4. Road Length (1987 DPWH Data)												
• National Road	216	313	427	244	585	385	383	232	959	453	352	4,533
• Provincial/City Road	252	378	730	67	322	402	97	145	582	566	744	4,285
• Barangay Road	639	1,434	1,740	283	791	684	754	388	1,913	2,220	1,641	12,982
Total	1,107	2,117	2,905	1,094	1,705	1,471	1,214	877	3,454	3,239	2,737	21,720
5. Proposed Major Road Network												
• National Road	199	244	493	288	274	294	354	351	759	343	269	3,788
• Provincial/City Road	68	45	242	-	116	16	-	136	42	5	256	926
• Barangay Road	-	-	-	-	-	-	6	8	40	-	-	54
Total	267	289	735	288	390	310	360	495	841	348	525	4,768
6. Studied Road Length												
• Major Road	267	289	735	288	390	310	360	495	841	343	525	4,768
• Minor Road	377	698	593	203	452	668	436	495	1,290	809	1,321	7,341
Total	644	987	1,328	411	842	978	796	990	2,131	1,156	1,846	12,109
7. Identified Road Projects												
• Major Road	112	193	368	120	148	225	246	186	317	74	224	2,189
• Minor Road	368	567	593	165	429	566	398	482	1,243	788	1,394	7,024
Total	480	770	961	285	577	791	644	668	1,560	862	1,598	9,217
8. Selected Road Projects for F/S												
• Major Road	112	54	362	112	144	225	246	142	388	74	238	2,048
• Minor Road	202	327	330	67	260	310	154	345	681	426	361	3,243
Total	314	381	692	179	404	535	400	527	781	599	594	5,291

A.3 PROJECT EVALUATION

A.3.1 Procedure for Project Evaluation

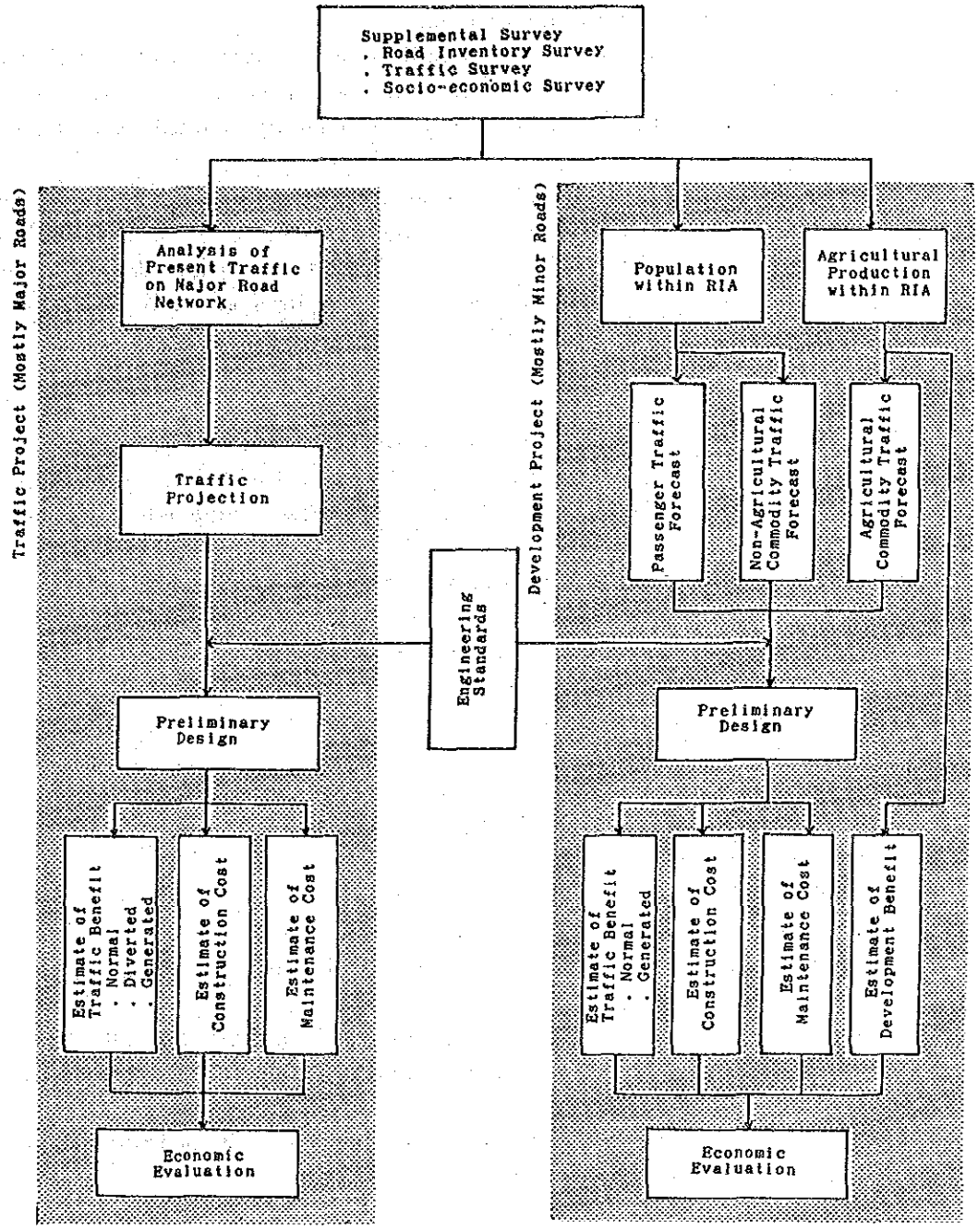


FIGURE A.3.1-1 PROCEDURE FOR PROJECT EVALUATION

A.3.2 Methodology for Project Evaluation

Project Classification

The project roads were grouped into two types :

Traffic Project (mostly major road) : Involving the rehabilitation/upgrading of the existing road which is accessible to motorized vehicle, where the impact of the investment would be generally confned to the transport sector.

Development Project (mostly minor road) : Providing all-weather access to an area which has either no motorized access or only seasonal access, where the impact of the investment would affect not only the transport sector but also other sectors in the local economy, especially the agricultural sector.

Traffic Forecast

Traffic Project : The present traffic on the overall major road network system in the province was analyzed, and based thereupon the changes in traffic flow after completion of the projects were estimated.

Development Project : Traffic demand was analyzed independently as a feeder road based on population and agricultural production in the area served by the road.

Preliminary Design and Cost Estimate

Preliminary design was prepared including :

- Road improvement with adequate drainage
- Bridge construction/replacement
- Special treatment

Steep gradient section	:	PCC paving
Flood section	:	Embankment with slope protection by grouted riprap
Slope protection	:	Recutting/concrete spraying for cut slope, and stone masonry for embankment slope

The construction cost was estimated based on the unit cost analyses and quality estimates for major construction items.

Economic Evaluation

The economic analysis was conducted in the form of an economic cost-benefit analysis. The costs and benefits taken into account were as follows :

- Costs : Initial construction/improvement costs
  Periodic maintenance costs
- Benefits : Traffic benefits composed of :
  Normal traffic benefit
  Diverted traffic benefit (only for traffic project)
  Generated traffic benefit
  Development benefits (only for development project)
  Maintenance cost savings

A.3.3 Project Evaluation in the Study Provinces

Table A.3.3-1 summarizes the results of project evaluation, showing road length by range of IRR.

TABLE A.3.3-1 SUMMARY OF PROJECT EVALUATION

(Length in km)

Road Class	IRR Range	La Union	Nueva Vizcaya	Nueva Ecija	Rizal	Occ. Mindoro	Albay	Antique	Samar	Leyte	Misamis Ori.	Davao del N.	Total
Primary Major	15<	-	-	129.7	8.2	26.0	34.3	18.7	-	-	-	-	216.9
		(-)	(-)	(8)	(2)	(1)	(2)	(1)	(-)	(-)	(-)	(-)	(14)
	10-15	-	-	-	-	-	-	33.0	-	-	-	-	33.0
		(-)	(-)	(-)	(-)	(-)	(-)	(3)	(-)	(-)	(-)	(-)	(3)
	7.5-10	-	-	-	-	34.2	-	17.7	62.3	-	-	-	114.2
		(-)	(-)	(-)	(-)	(1)	(-)	(1)	(2)	(-)	(-)	(-)	(4)
	<7.5	-	-	-	-	-	16.8	46.3	20.1	-	-	-	83.2
		(-)	(-)	(-)	(-)	(-)	(1)	(4)	(2)	(-)	(-)	(-)	(7)
	Total	-	-	129.7	8.2	60.2	51.1	115.7	82.4	-	-	-	447.3
		(-)	(-)	(8)	(2)	(2)	(3)	(9)	(4)	(-)	(-)	(-)	(28)
Secondary Major	15<	90.1	29.8	181.9	71.1	16.3	106.0	18.8	30.2	97.3	70.0	46.1	757.6
		(8)	(3)	(19)	(9)	(4)	(4)	(2)	(1)	(7)	(2)	(6)	(65)
	10-15	-	5.8	35.4	-	7.0	-	37.6	32.2	48.0	-	108.5	272.5
		(-)	(1)	(3)	(-)	(1)	(-)	(4)	(4)	(5)	(-)	(9)	(27)
	7.5-10	21.5	18.2	15.4	-	-	12.1	-	-	56.0	-	22.1	145.3
		(1)	(2)	(1)	(-)	(-)	(1)	(-)	(-)	(4)	(-)	(3)	(12)
	<7.5	-	-	-	32.2	60.8	56.1	74.0	36.7	98.5	4.2	63.2	425.7
		(-)	(-)	(-)	(1)	(3)	(3)	(5)	(2)	(8)	(1)	(6)	(29)
	Total	111.6	53.8	232.7	103.3	84.1	174.2	130.4	99.1	299.8	74.2	237.9	1,601.1
		(9)	(6)	(23)	(10)	(8)	(8)	(11)	(7)	(24)	(3)	(24)	(133)
Minor (National/ Prov'l)	15<	30.9	37.9	52.5	16.8	22.3	156.5	35.8	7.5	126.1	47.6	97.3	631.2
		(3)	(3)	(6)	(4)	(2)	(23)	(9)	(1)	(13)	(6)	(11)	(81)
	10-15	3.9	72.7	39.3	4.5	22.2	38.2	18.8	16.0	101.0	69.7	36.2	422.5
		(1)	(3)	(4)	(1)	(6)	(8)	(7)	(2)	(10)	(6)	(4)	(52)
	7.5-10	23.8	9.3	13.5	-	8.0	12.9	22.5	2.3	54.7	39.9	43.9	230.8
		(3)	(1)	(2)	(-)	(1)	(3)	(5)	(1)	(7)	(6)	(6)	(35)
	<7.5	38.2	151.8	84.6	13.4	94.4	49.9	4.4	39.7	61.8	114.0	86.1	738.3
		(8)	(15)	(8)	(3)	(17)	(7)	(2)	(3)	(8)	(18)	(11)	(100)
	Total	96.8	271.7	189.9	34.7	146.9	257.5	81.5	65.5	343.6	271.2	263.5	2,022.8
		(15)	(22)	(20)	(8)	(26)	(41)	(23)	(7)	(38)	(36)	(32)	(268)
Minor (Brangay)	15<	10.3	-	96.2	13.0	18.2	26.8	65.4	198.0	70.6	81.6	22.4	600.5
		(2)	(-)	(9)	(3)	(4)	(8)	(5)	(16)	(11)	(10)	(3)	(71)
	10-15	35.9	9.6	7.7	-	8.2	17.0	7.0	45.4	-	7.7	24.2	162.7
		(6)	(1)	(1)	(-)	(3)	(3)	(1)	(4)	(-)	(2)	(1)	(22)
	7.5-10	19.1	5.1	15.1	4.6	11.4	2.5	-	38.6	30.3	36.1	-	162.8
		(3)	(1)	(1)	(1)	(2)	(1)	(-)	(4)	(3)	(6)	(-)	(22)
	<7.5	40.0	46.8	20.7	15.0	75.1	5.8	-	-	16.7	29.0	50.8	293.9
		(10)	(11)	(4)	(2)	(18)	(3)	(-)	(-)	(3)	(5)	(4)	(60)
	Total	105.3	55.5	139.7	32.6	112.9	52.1	72.4	280.0	117.6	154.4	97.4	1,219.9
		(21)	(13)	(15)	(6)	(27)	(15)	(6)	(24)	(17)	(23)	(8)	(175)
Total	15<	131.3	67.7	460.3	109.1	82.8	323.6	138.7	233.7	294.0	199.2	165.8	2,206.2
		(13)	(6)	(42)	(18)	(11)	(37)	(17)	(18)	(31)	(18)	(20)	(231)
	10-15	39.8	88.1	82.4	4.5	37.4	55.2	96.4	93.6	149.0	77.4	166.9	890.7
		(7)	(5)	(8)	(1)	(10)	(11)	(15)	(10)	(15)	(8)	(14)	(104)
	7.5-10	64.4	32.6	44.0	4.6	53.6	27.5	40.2	103.2	141.0	76.0	66.0	653.1
		(7)	(4)	(4)	(1)	(4)	(5)	(6)	(7)	(14)	(12)	(9)	(73)
	<7.5	78.2	192.6	105.3	60.6	230.3	126.6	124.7	96.5	177.8	147.2	200.1	1,541.1
		(18)	(26)	(12)	(6)	(38)	(14)	(11)	(7)	(19)	(24)	(21)	(196)
	Total	313.7	381.0	692.0	178.8	404.1	534.9	400.9	527.0	761.0	499.8	598.8	5,291.1
		(45)	(41)	(66)	(26)	(63)	(67)	(49)	(42)	(79)	(62)	(64)	(604)

Note. ( ) : Number of Road Links

A.4 SIMPLIFIED EVALUATION METHOD

General

In the Phase I Study and this study, road projects in fifteen (15) Provinces were evaluated, totalling 933 in number and some 7,300km in length. The evaluation results were statistically analyzed with the objective of developing a series of prediction models of costs and benefits based on a set of input data. Thus, the simplified evaluation method was developed.

Input Data

Input data are limited to those reliable and easily obtainable. They are :

- Road name and class
- Road data, containing length, width, existing surface type and condition, terrain and information on slope and flooding
- Structure data, containing type, length and condition
- Traffic data (only for traffic project)
- Population and cultivated area within road influence area (only for development project)

Objective Variables

- AADT in development project
- Road construction cost
- Additional cost for slope protection
- Additional cost for grade raising in flood section
- Structure cost
- Traffic benefits
- Development benefits
- Maintenance cost savings
- Internal rate of return

Preparation of the Guide

The Guide contains input data sheets, worksheets, step-by-step instructions for their use, and all necessary information to obtain unit costs and unit benefits in the form of tables and/or charts.

A.5 IMPLEMENTATION PROGRAM

Rural Road Development Program

- Total fund requirements for initial stage containing road projects with IRR more than 15% in all 73 provinces are estimated to be about P 29,600 M.
- The available fund for rural road projects is roughly estimated to be P 5,000 M per year based on 1991 Highway Investment Plan.
- 6 years program for overall implementation is proposed.

Implementation Strategy

Project Institution : The setting up of a project management office for the project is recommended.

Community Participation System : Community participation is recommended in each step of project implementation.

Labor-Based/Equipment-Supported (LB-ES) Construction System : Organization of community construction teams is recommended for small-size projects.

Coordination between International Lending Agencies:
The coordination between agencies is required to pursue systematic implementation within standardized technology.

Project Type : In connection with the community participation system and LB-ES construction system, implementation of administrative type may be adopted for small size projects, as well as contract type for large size projects.

Sector Loan : A sector loan system is recommended for the project due to its characteristics of covering numerous roads with a short length.

Implementation Priority of Provinces

- Provinces were rated based on the present level of socio-economic development and adequacy of road and development priority, and grouped into six categories.
- In addition to the above rating, other factors such as equal distribution to regions, maturity and environment of construction site shall be considered in determining the implementation priority.

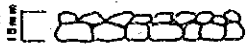
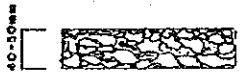
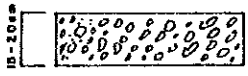
PART B STUDY ON LOW-CLASS PAVEMENTS

B.1 LOW-CLASS PAVEMENTS IN THE PHILIPPINES

B.1.1 Type of Low-Class Pavements

This study covers six types of pavement as shown in Table B.1.1-1.

TABLE B.1.1-1 GENERAL DESCRIPTION OF LOW-CLASS PAVEMENTS

Surface Course (Illustration)	Pavement Structure (Examples)	Traffic Volume	Descriptions
Gravel Surfacing  Base	GR Surface 12-20cm / Sub-base (10cm) / Subgrade	Low	• On a prepared sub-base, a course of selected sandy gravel or crushed rock/ gravel is laid and compacted • Finished thickness: usually 12-20cm
Single Bituminous Surface Treatment  Base	SBST Surface 6mm / Base 10-15cm / Sub-base (12cm) / Subgrade	Low	• A single layer of liquid asphalt is sprayed and immediately uniform size stone chippings are spread and rolled • Not so durable under wet climatic condition • Finished thickness: usually 6-10mm.
Double Bituminous Surface Treatment  Base	DBST Surface / Base 10-15cm / Sub-base (15cm) / Subgrade	Low to Medium	• Two course surface treatments are placed. The size of second treatment chippings is about the one-half of the first one. • Finished thickness: 12-16mm about the nominal size of the first course • Durable under certain climatic condition.
Bituminous Penetration Macadam  Base	BMP Surface 40 mm / Base 10-15cm / Sub-base (15cm) / Subgrade	Low to Medium	• First, base stone course is placed. Then liquid asphalt is sprayed and penetrates into base stone course and key stones are spread and rolled. Asphalt sprayed and cover stones spread, rolled. Seal coat is followed. • Finished thickness: usually 30-60mm depend on the first base stone course thickness. • Durable under certain climatic condition
Asphalt Concrete  Base	HAC Surface 50 mm / Base 10-15cm / Sub-base (15cm) / Subgrade	Medium to Heavy	• Smooth and durable surface is attained for all seasons. • Surface thickness; 40mm or 50mm
Portland Cement Concrete  Sub-base	PCC Surface 18 cm / Sub-base (15cm) / Subgrade	Medium to Heavy	• Stable pavement is attained. • Surface thickness: 15 - 20 cm

B.1.2 Pavement Surface Condition Survey and Evaluation

Pavement Surface Condition Survey

Survey Section : 12 sections in Cavite, Laguna and Batangas with total length of 208.6 km, consisting of gravel DBST, BMP and AC.

Survey Items : Present Serviceability Rating (PSR)
Rehabilitation Requirement Rating (RRR)
Roughness
Pavement Distress (cracking, patching, pothole)

Evaluation of Surface Condition

Two indices, present serviceability index (PSI) and rehabilitation requirement index (RRI) were formulated as indicators to predict the present serviceability rating and rehabilitation requirement rating, respectively, from certain physical measurements. Characteristics of both indices are summarized in Table B.1.2-1. The PSI/RRI equations are presented in B.1.2-2.

TABLE B.1.2-1 CHARACTERISTICS OF PSI AND RRI

Evaluation Indicator	Objectives	Rating Panel	Dominant Factors
Present Serviceability Index (PSI)	Subjective assessment on comfort/riding quality	General public Road users	Roughness
Rehabilitation Requirement Index (RRI)	Engineering judgement on physical condition	Highway/maintenance/ construction engineers	Pavement Distress

TABLE B.1.2-2 PROPOSED PSI/RRI EQUATIONS

PSI	Gravel	$PSI = 7.49 - 2.06 \cdot \log R$	(r=0.542)
	DBST	$PSI = 7.76 - 1.99 \cdot \log R - 0.11 \cdot \sqrt{P}$	(r=0.739)
	BMP	$PSI = 9.80 - 2.46 \cdot \log R - 0.25 \cdot \sqrt{P}$	(r=0.917)
	AC	$PSI = 7.32 - 1.68 \cdot \log R - 0.14 \cdot \sqrt{P}$	(r=0.817)
RRI	DBST	$RRI = 6.22 - 1.29 \cdot \log R - 0.51 \cdot \sqrt{P}$	(r=0.874)
	BMP	$RRI = 5.80 - 0.89 \cdot \log R - 0.42 \cdot \sqrt{P}$	(r=0.917)
	AC	$RRI = 6.04 - 1.12 \cdot \log R - 0.39 \cdot \sqrt{P}$	(r=0.859)

where, R = Roughness (cm/km)
P = Patching plus pothole (%)
r = Correlation coefficient

B.1.3 Analysis of Low-Class Pavement Deterioration

Survey Section

Fifteen (15) sections were selected in Cavite, consisting of three (3) gravel, six (6) DBST, three (3) BMP and three (3) AC sections, with a length of 50m per section.

Survey Items

- Construction and maintenance records
- General condition (cross section, terrain, drainage condition)
- Traffic (traffic volume by vehicle type, axle load distribution)
- Pavement structure (thickness and material of each layer)
- Pavement deterioration (roughness, crack, patching, etc.)
- Structural adequacy (deflection)
- Test pit excavation and laboratory test (water content, sieve analysis, LL, PL, CBR)

Main Causes of Pavement Deterioration

Gravel Surfacing

- Poor grading (oversize gravel, excess amount of silt)
- Weak subgrade

DBST

- Weak subgrade
- Weak subbase material
- Insufficient binder and cover aggregate application

BMP

- Weak subgrade
- Insufficient structural capacity due to absence of subbase
- Aging and oxidization of asphalt due to insufficient asphalt application

AC

- Weak subgrade
- Binder aging and oxidization
- Fatigue of pavement structure

B.2 EXPERIMENTAL PAVEMENT

B.2.1 Planning and Design of Experimental Pavement

Selection of Sections and Pavement Types

Five sections were selected in Cavite. Table B.2.1-1 summarizes selected pavement types of each section.

TABLE B.2.1-1 EXPERIMENTAL PAVEMENT MODELS

Section	Traffic (AADT)	Subgrade Condition	No. of Models	Pavement Type	Total Length (m)
1	Low (150)	Good	4	GR,SBST,DBST,BMP	800
2	Low (150)	Poor	4	GR,SBST,DBST,BMP	800
3	Medium (900)	Good	4	DBST,BMP,AC(4cm), AC(5cm)	800
4	Medium (900)	Poor	4	DBST,BMP,AC(4cm), AC(5cm)	800
5	High (2,100)	Good	2	AC (5cm), PCC (18cm)	400
Total			18		3,600

Surveys

The following surveys were conducted:

Traffic Survey : Traffic count and loadometer survey
Engineering Survey : Topographic survey, soil investigation, and material survey

Structural Design

Structural design was carried out in accordance with AASHTO Guide for Design of Pavement Structures, 1986, selecting the following design performance period:

TABLE B.2.1-2 DESIGN PERFORMANCE PERIOD

Section	Pavement Type	Design Performance Period (Year)
1-4	GR	5
	SBST	3
	DBST	5
	BMP	7
	AC (4 cm)	8
	AC (5 cm)	10
5	AC (5 cm)	5
	PCC (18 cm)	8

Execution Plan

Contract documents, construction schedule, equipment schedule, cost estimates and organization of construction supervision were discussed and prepared.

B.2.2 Construction of Experimental Pavement

Construction Policies

Experimental pavement models should be so constructed as to represent quality of ordinarily constructed pavements in the Philippines in order to test their performances. To achieve this objective, the following policies were established :

- To adopt the existing DPWH Standard Specifications
- To be constructed by Filipino Contractors
- To require no special equipment nor materials
- To provide enough data for analysis during follow-up survey period, material testing shall be conducted more frequently than required by Standard Specifications.

Contracts

Two contracts were involved due to two (2) funding sources:

Sections No. 1 to No. 4

Funding	:	JICA
Contractor	:	Fisher Engineering and Maintenance Co. INC.(FEMCO)
Contract Amount	:	₱6,551,005.38
Original Contract Period	:	45 calendar days

Section No. 5

Funding	:	DPWH
Contractor	:	Atari Construction and Development Corporation
Contract Amount	:	₱1,355,750.47
Original Contract Period	:	60 calendar days

Quality of Work

All works were constructed in compliance with the requirements of the DPWH Standard Specification.

B.2.3 Plan of Follow-up Survey

Follow-up survey items, frequencies and timing were proposed as summarized in Table B.2.3-1.

TABLE B.2.3-1 FOLLOW-UP SURVEY ITEMS

Survey Items	Frequency	Timing
1. Inspection and Data Collection which includes meteorological data, road maintenance data, drainage condition data, and rehabilitation data.	Monthly	Second week of each month
2. Traffic Survey		
2.1 Traffic Count Survey	Quarterly	January, April, July and October
2.2 Loadometer Survey	Once a Year	October
3. Surface Condition Survey	Quarterly	January, April, July and October
3.1 Roughness Survey 3.2 Cracking Survey 3.3 Patching Survey 3.4 Rutting Survey 3.5 Pothole Survey 3.6 Present Serviceability Rating (PSR) 3.7 Rehabilitation Requirement Rating (RRR)		
4. Deflection Survey	Twice a Year	April and October
5. Gravel Loss Survey	Quarterly	January, April, July and October
6. Photo Taking	Quarterly	January, April, July and October

B.3. STANDARD STRUCTURAL DESIGN OF LOW-CLASS PAVEMENTS

Traffic Loading Class

For the purpose of simplicity and convenience, traffic loadings are classified into ten (10) classes using number of ESAL applications in the initial year, as shown in Table B.3-1.

TABLE B.3-1 TRAFFIC LOADING CLASS FOR RURAL ROADS

Traffic Loading Class			ESAL 1st Year	Assumed AADT
Light Loading Traffic	R1	R1-1	0 - 1,300	0 - 100
		R1-2	1,300 - 3,000	100 - 200
	R2	R2-1	3,000 - 8,000	200 - 400
		R2-2	8,000 - 14,000	400 - 600
	R3	R3-1	14,000 - 21,000	600 - 800
		R3-2	21,000 - 30,000	800 - 1,000
Heavy Loading Traffic	A	A-1	30,000 - 60,000	1,000 - 1,500
		A-2	60,000 -100,000	1,500 - 2,000
	B	B-1	100,000 -150,000	2,000 - 3,000
		B-2	150,000 -200,000	3,000 - 4,000

Performance Period

Performance periods are recommended as shown in Table B.3-2, based on the life-cycle costs analysis.

TABLE B.3-2 RECOMMENDED PERFORMANCE PERIOD OF INITIAL PAVEMENT

Pavement Type	Gravel	SBST	DBST	BMP	AC	PCC
Performance Period (Year)	3-4	3-5	5-8	8-10	10-15	15-20

Standard Design

Standard design was prepared for each pavement type, each of ten (10) classes of traffic loading, and each of seven (7) kinds of subgrade strength.

Recommended Pavement Type

Recommendation on selection of pavement type was made as shown in Table B.3-3.

TABLE B.3-3 RECOMMENDED PAVEMENT TYPE

Traffic Loading Class	R1-1	R1-2	R2-1	R2-2 to R3-2	A-1 to B-2
Primary Major Rd.	GR	DBST/BMP	DBST/BMP	AC	PCC
Secondary Major/ Minor Roads	GR	GR	DBST/BMP	AC	PCC

B.4 RECOMMENDATION ON DESIGN AND CONSTRUCTION OF LOW-CLASS PAVEMENTS

Recommendation on Pavement Project Administration

- Development of Standard Pavement Types

  Standard design and recommendation on selection of pavement type were discussed in Chapter 9 as an example, based only upon the life-cycle costs analysis.

  Similar study is recommended to be conducted by the Government to establish the standard type of pavement taking into consideration non-monetary factors as well as monetary factors.

- Establishment of Pavement Rehabilitation Criteria

  In addition to the present serviceability index (PSI) developed by AASHTO, the rehabilitation requirement index (RRI) was introduced to assess the necessity of rehabilitation. RRI is recommended to be incorporated in establishing the pavement rehabilitation criteria.

- Pavement Construction in Rainy Season

  It is recommended that the Government establish an appropriate guideline regarding construction of pavement in rainy season.

Recommendation of Pavement Design

- Structural Design of Pavement

  The use of AASHTO Guide for Design of Pavement Structures, 1986 may be recommended for establishment of guidelines on how to prepare and/or select inputs such as reliability, performance period, soil support value, layer coefficient and drainage coefficient to attain uniform design.

- Serviceability of Pavement

  Guidance on the selection of initial and terminal serviceabilities shall be established by the Government.

- Upgrading of Initial Pavement Type

  Planned rehabilitation by not only simple overlay but also by upgrading initial pavement type (the construction of lower class pavement at initial stage and upgrading to higher type at rehabilitation stage) is recommended.

Recommendation on Construction

- Conformity with Design and Specification Requirements

  The construction of pavement shall conform to the design and specification requirements, and the costs for this shall be reasonably estimated.

- Construction Management

  To ensure the establishment of a systematic and realistic construction schedule, the following sub-item schedules shall be completed i.e. equipment schedule, material schedule, manpower schedule and financial schedule.

- Recommendation on Construction Procedures

  Recommended are positive introduction of stabilization methods for subbase and base courses, component of gravel surface course and standard set of equipment and work force for DBST/BMP construction in both equipment and labor based methods.