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PHILIPPINES

Feasibility Study on the Rural Network Development Project

Road

(Volume 26)

GUIDE

FOR SIMPLIFIED

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REPUBLIC OF THE PHILIPPINES DEPARTMENT OF PUBLIC WORKS & HIGHWAYS

# **Feasibility Study**

on

# The Rural Road Network Development Project

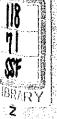
FINAL REPORT (Volume 26)

## GUIDE FOR SIMPLIFIED PROJECT EVALUATION

OCTOBER, 1990

JAPAN INTERNATIONAL COOPERATION AGENCY







REPUBLIC OF THE PHILIPPINES DEPARTMENT OF PUBLIC WORKS & HIGHWAYS

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	tan tan	TABLE OF CONTENTS	
	CHAPTER	1 INTRODUCTION	PAGE
		<ul> <li>1.1 Background</li> <li>1.2 Scope of the Guide</li> <li>1.3 Limitation of the Guide</li> </ul>	1-2
	CHAPTER	2 ROAD CLASSIFICATION	
	ی جانب کار بر این	<ul><li>2.1 Administrative Road Classification</li><li>2.2 Functional Road Classification</li></ul>	2-1 2-3
	CHAPTER	3 ENGINEERING STANDARDS AND TYPICAL ROAD SECTIONS	
	a da sera a A	<ul> <li>3.1 Design Concept</li> <li>3.2 Engineering Standards</li> <li>3.3 Typical Road Sections</li> </ul>	3 - 1
	CHAPTER	4 INPUT DATA FOR PROJECT EVALUATION	
		<ul><li>4.1 Input Data Sheet</li><li>4.2 Instructing for Entry</li></ul>	4-1 4-2
·	CHAPTER	5 PROJECT EVALUATION -PROJECT WITHOUT TRAFFIC DIVERSION-	
		<ul> <li>5.1 General</li> <li>5.2 Procedures for Traffic Project Evaluation</li> <li>5.3 Procedures for Development Project Evaluation</li> </ul>	5-2
	CHAPTER	6 PROJECT EVALUATION -PROJECT WITH TRAFFIC DIVERSION	6~1
	CHAPTER	7 ADJUSTMENT FOR PRICE ESCALATION	
		<ul> <li>7.1 Construction Cost</li> <li>7.2 Traffic Benefit</li> <li>7.3 Bridge Benefit</li> <li>7.4 Development Benefit</li> <li>7.5 Maintenance Cost Savings</li> </ul>	7-1 7-2 7-2 7-2 7-3
	CHAPTER	8 SAMPLE CALCULATIONS	8-1

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APPENDIX	A		EQUATIONS IN PROVINCE		FOR	PROJECT
	В		EQUATIONS IN PROVINCE		FOR	PROJECT
	C		EQUATIONS IN PROVINCE		FOR	PROJEC
	D		EQUATIONS IN PROVINCE		FOR	PROJEC
	E		EQUATIONS IN PROVINCE		FOR	PROJECT
	F		EQUATIONS IN PROVINCE	AND DATA GROUP -F	FOR	PROJECT
	G	-	EQUATIONS IN PROVINCE	AND DATA GROUP -G	FOR	PROJEC

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#### CHAPTER 1 INTRODUCTION

### 1.1 Background

With a view to promoting a functional development of road network in the rural areas, the Pilot Study for the Rural Road Network Development Project was conducted in 1987-1989, including the evaluation of the road projects in the four (4) pilot provinces, followed by the Feasibility Study on the Rural Road Network Development Project in 1989-1990, in which the road projects in the 11 study provinces were evaluated. The road projects evaluated in the both studies are as follows:

<u></u>		Number of	Total Length
Study	-	d Projects Studied	(km.)
	Cavite	138	665.4
The Pilot Study	Masbate	61	523.3
	Bohol	78	551.8
	Agusan del Norte	52	291.1
	La Union	45	313.7
	Nueva Vizcaya	41	381.0
	Nueva Ecija	66	692.0
	Rizal	26	178.8
	Occidental Mindoro	63	404.1
The Feasibility	Albay	67	534.9
Study	Antique	49	400.0
	Samar	42	527.0
	Leyte	79	761.0
	Misamis Oriental	62	499.8
	Davao del Norte	64	598.8
	Total	933	7,322.7

The evaluation results were statistically analyzed with the objective of developing a series of estimation models to be used for estimating the project costs and economic viability based on easily obtainable data. The procedures and methodologies of this Guide were developed based on the above analysis.

#### 1.2 Scope of the Guide

Chapter 2 discusses road classification, focusing on functional road classification which is necessary to attain a systematic development of road network.

Chapter 3 provides the engineering standards and typical road sections.

Chapter 4 presents the input data sheet for project evaluation and instructions for entry.

Chapter 5 provides the basic assumptions in the project evaluation in this Guide and procedures for project evaluation.

Chapter 6 provides the procedures for evaluation of the projects in which traffic diversion is expected.

Chapter 7 discusses the way of updating costs and benefits for the future use.

Chapter 8 presents sample calculations.

#### 1.3 Limitations of the Guide

The studies mentioned in 1.1 did not cover national primary roads defined in Executive Order No. 113 "Establishing the Classification of Roads" nor roads serving as streets within built-up population centers. This Guide is, therefore, not applicable to national primary roads and streets.

### CHAPTER 2 ROAD CLASSIFICATION

2.1 Administrative Road Classification

Roads are classified, mainly based on the administrative responsibilities and jurisdiction of the agencies concerned in the funding, planning, construction/improvement and maintenance, into the following five (5) classes:

- . National Roads
- . Provincial Roads
- . City Roads
- . Municipal Roads
- . Barangay Roads

These classes are defined as follows and show conceptually in Figure 2-1.

National Roads are all roads that form part of the main trunkline system continuous in extent; all roads leading to national airports, national seaports, national parks or coast-to-coast roads.

Provincial Roads are those roads connecting one municipality with another municipality, the termini to be public plazas; all roads extending from a municipality or from a provincial or national road to a public wharf or railway station; and any other road to be designated as such by the Sangguniang Panlalawigan.

City Roads

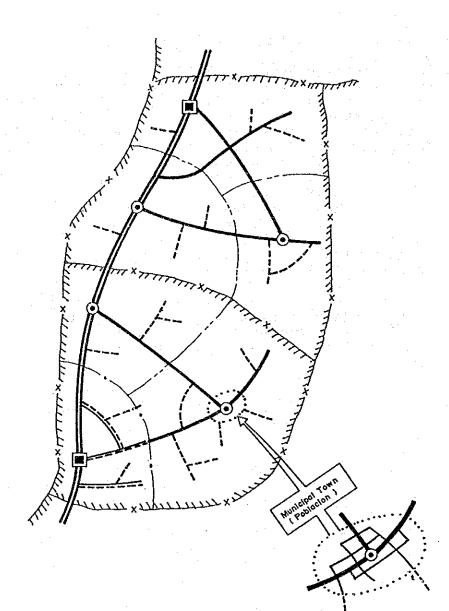
Municipal Roads

are those roads/streets within the urban area of the city to be designated as such by the Sangguniang Panglungsod.

Is are those roads/streets within the poblacion area of a municipality to be designated as such by the Sangguniang Bayan.

Barangay Roads are rural roads located either outside the urban area of a city or outside industrial, commercial or residential subdivisions which act as feeder or farm-to-market roads, and which are not otherwise classified as national, provincial, city or municipal roads. Roads located outside the poblacion area of a municipality and those roads located outside the urban area of a city are to be designated as such by the Barangay Council concerned.

and the second second second



	NATIONAL ROAD	mm <sup>x</sup> mm	PROVINCIAL BOUNDARY
<del>ور شده در مرکز میکرد.</del>	PROVINCIAL ROAD		CITY BOUNDARY
	CITY ROAD		MUNICIPAL BOUNDARY
	MUNICIPAL ROAD		BARANGAY BOUNDARY
*** *** *** *** ***	BARANGAY ROAD		PROVINCIAL CAPITAL
		Θ	MUNICIPAL TOWN ( POBLACION)

FIGURE 2.1

# CONCEPTUAL ROAD NETWORK BY ADMINISTRATIVE CLASSIFICATION

2.2 Functional Road Classification

For planning and developing an efficient road network, roads should be classified according to importance and the character of services they are intended to provide. Individual road links of similar importance and quality of services are organized into systems so that a road network in accordance with the hierarchy of functions can be planned and formed. Thus they can be efficiently managed with consistent policies, design and operation.

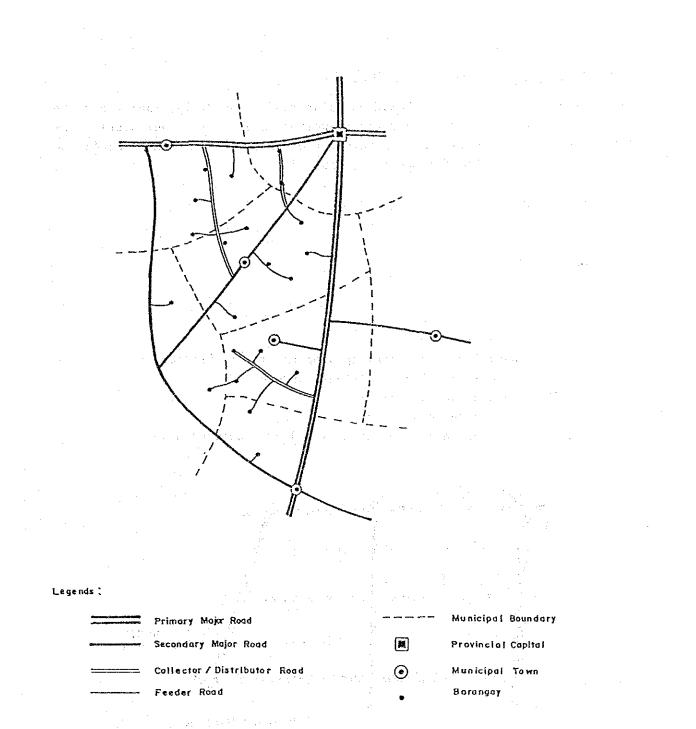
From this point of view, the functional road classification criteria are proposed as shown in Table 2-1. Roads are classified into the following five (5) classes as shown conceptually in Figure 2-2.

Major Roads :

Primary Major Roads Secondary Major Roads

Minor Roads :

Collector Roads Feeder Roads Streets TABLE 2-1 PROPOSED FUNCTIONAL CLASSIFICATION FOR RURAL ROAD NETWORK Relationship with Administrative Classification Barangay Road Municipal Road City Road National Provincial Road Road major roads Mobility and land access functions be harmonized Primarily provides access to abut-ting land with little or no through traffic Primarily provides access to abut-ting land in urban areas Land access is given high conside-ration Provides the highest level of service at the high speed for the long uninterrupted distance Through traffic usage discouraged Serves for medium distance trips Mobility is given high considemobility Serves for short distance trips Collects traffic from feeder roads and connects them with Serves for long distance trips Mobility is given the highest Provides high level of service General Characteristics and Provides rather low level of Services Provided Serves for local traffic consideration ration Roads within built-up population centers (Poblacion) with essen-Roads linking a municipal town to the Provincial Capital Roads linking one {1} or more tially urban rather than rural their respective barangay centers or to the higher level municipal towns to the primary linking two (2) or more muni-Roads linking secondary major road with a secondary road Roads linking two (2) or more Roads linking municipal towns roads each other or a primary cipal towns to the Provincial Major inter-provincial roads Intra-provincial roads which barangay centers to the higher level network Roads linking farm areas to town or to the higher level form a skelton road network barangays to the municipal Roads linking one or more General Definition Intra-provincial roads major road network of a province each other functions Capital network network • Collector Road Primary Major Road Feeder Road Classification reet Secondary Major Road Functional ىھ Ś Major Road Minor Road



#### FIGURE 2-2 CONCEPTUAL ROAD NETWORK BY FUNCTIONAL CLASSIFICATION

### Verification of Major Road Density

In order to establish a well-balanced major road network, two indicators are introduced to examine the balance of network size. If indicators show imbalanced values, addition or deletion of major road links should be considered. Two indicators are as follows:

a)Network Value

$$N_V = \frac{L}{\sqrt{PA}}$$

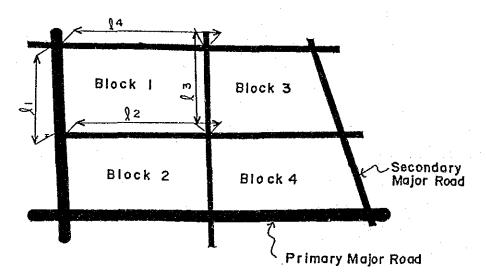
where:

 $N_{\rm w}$  = Network value

- P = Population in a block

A = Land area in a block

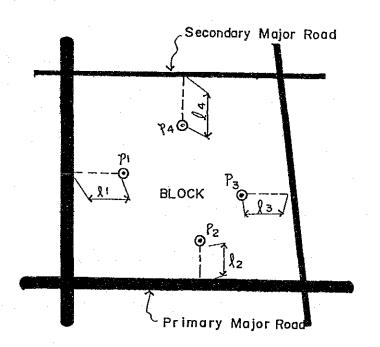
Block = Area delineated by primary and/or secondary major road



Accessibility 
$$Ac = \sum p \cdot l$$
  
Average accessibility  $A_{ave} = \frac{\sum p \cdot l}{p}$ 

#### where:

- p = Population of a barangay
- P = Total Population in a block



⊙ Barangay center

Accessibility =  $p_1 l_1 + p_2 l_2 + p_3 l_3 + p_4 l_4$ Average accessibility =  $\frac{Accessibility}{p_1 + p_2 + p_3 + p_4}$ 

#### CHAPTER 3 ENGINEERING STANDARDS AND TYPICAL ROAD SECTIONS

#### 3.1 Design Concept

The principal objective of the rural road network development project is to provide all-weather transport facilities to depressed areas. In line with this objective, the basic design concept is formulated as follows:

- Improvement of surface condition shall be the principal concern of design.

Improvement of horizontal and vertical alignment shall be limited to the required minimum.

- In the case where all-weather access is not attained only by improvement of surface condition, special consideration shall be given, e.g., PCC paving for steep gradient sections to enable vehicles to climb up even in the wet season; slope protection; and grade raising in flood sections.
- Adequate cross and side drainage shall be provided.
- Permanent structures shall be provided in accordance with the improvement criteria for bridges.
- 3.2 Engineering Standards

See Table 3-1.

3.3 Typical Road Sections

The improvement works are categorized into five types according to the type and degree of road deficiencies; as shown in Table 3-2,

Typical road sections are shown in Table 3-3 and Figures 3-1 to 3-6.

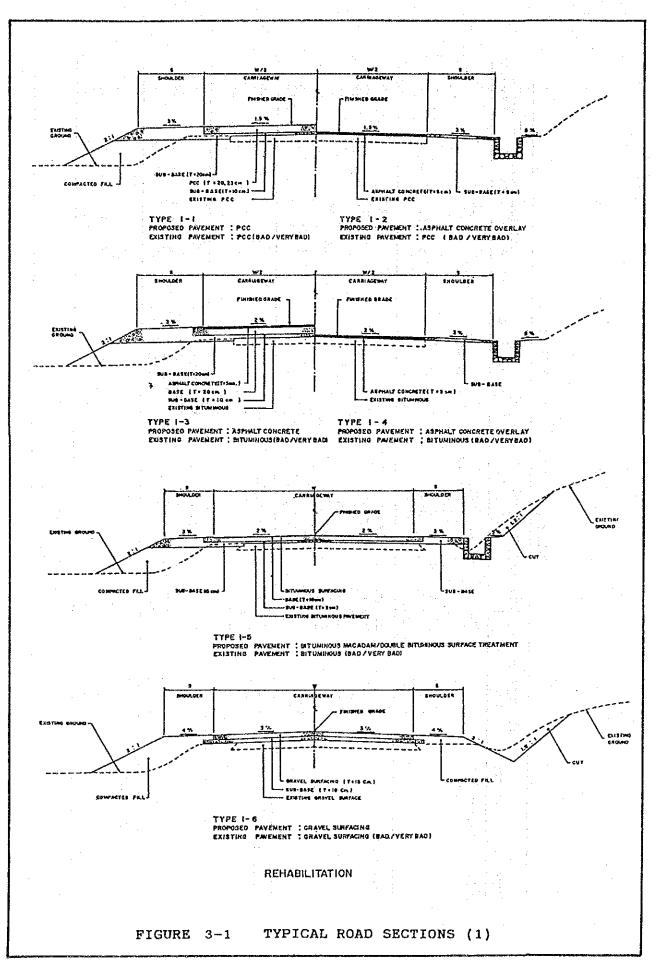
		Prima	Iry Mau	<u>Primary Major Koad</u>				Seconde	V.Y. Kaj	Secondary Major Road	 	0 J	lector	Collector Poad			feeder	foad	
Administration			3					)IteN,	nal /P	rovinci	7	đ	ονιατί	al/City		ć			
		LTEN	National Road	090	<u> </u>			040	<u>1117</u>	LITY KOZD			Barang			313	UITY/BALANGAY XOAD		
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Rolling	0 <del>7</del>	9	3	60	60	202	; ;	05	3	20	09	30	40	9	205	30	30		40
	: 30	30	07	40	95	50	30	40	04	40	3	30	30	30	0E	30	30	8	38
2) Carriageway Width (m)	. 6.0	6,0	5.0		6.7	6.7	0.9	6.0	6.0	6.0	6.7	5.2	ци, с ил с	5.5	0 3	0 7	0 u 1.4 u	5.0	6.0 :
3) Shoulder Width (m)			- - 																
Flat	۲ <b>۲</b>	1.5	2.0	2.0	2.5	3.0	1 0	1.5	2.0	2,5	2.5	1.0	1.0	ن 1	5	50.2	0	0.1	5
Rolling	: 1.0	1.0		5	1.5	2.0	: 0.5	1.0	1.5	÷5	1.5	: 0.5	0	1.0	1.0	0.5	0.5	0.5	
Fountaines.	1.0.5	0.5	1.0	1.0	1.0	5	0.5	1.0	1.0	1.0	1.0	0.5	0.0	1.0	1.0	: 0.5	0.5		0.5
) ROW Width (m)	: 20	20	20	30	30	30	20	20	30	30	30	20	8	20	8	10	10	5	12
5) Radius (m)																			
Flat	1 120	120	160	160	220	280	83	120	120	160	220	5	ដ	120	120	22	55	85	8
Rolling	. 55	33	50	120	120	160	55	85	85	85	120	30	3	55	8	25	30	ន	53
Mountainous	1 30	30	40	50	80	120	30	20	20	50	80	02	30	30	30	25	30	30	30
6) Grade (%)																			
Flat	: 6.0	6.0	6.0	5.0	4.0	4 0	5.0.3	6.0		5.0	4 0	8.0	7.0	6.0	6.0	0 B (	8		7.0
Rolling	8.0	0.0 0	7.0	6. O	0.0 .0	20	8.0	1.0		7.0	5.0	:10.0	08	8.0 8		10.0	10.0	8 0 8	٠. م
Mountaingus	10.0	10.0	9.0	8.0	7.0	7.0	10.0	9.0	8.0	8.0	7.0	10.0	10.0	10.0		10.0	10.0	10.0 10	10.0
7) Acceptable Pavement Type	1.5 or	.S or	AC.	. PCC	JJ2-	202	:.S or	.AC		. PCC	PCC.		B	.5 GT	ΥC.	.Nat	Nat .5 or	S or .AC	 
	: DBST	DBST	DBST	.AC	.AC	٩C AC	: DBST	, DBST	AC.	.AC	AC.	je Je	ò	DBST	DBST	or	0L.	<b>BST</b> .	. DBST :
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	EMT	TME					ENT.									5			~ •
	2	Ł					Ł									, i	BMT		*-
8) Pavement Tvoe Recommended	- Br	1	=	. AC	224	334	5	1	AC	PCC	PCC	. Br	5	. AC	AC	- êr	9	AC AC	 ب
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	Portland cement concrete payement	nent co	ncrete	pavenel	Ť										·				

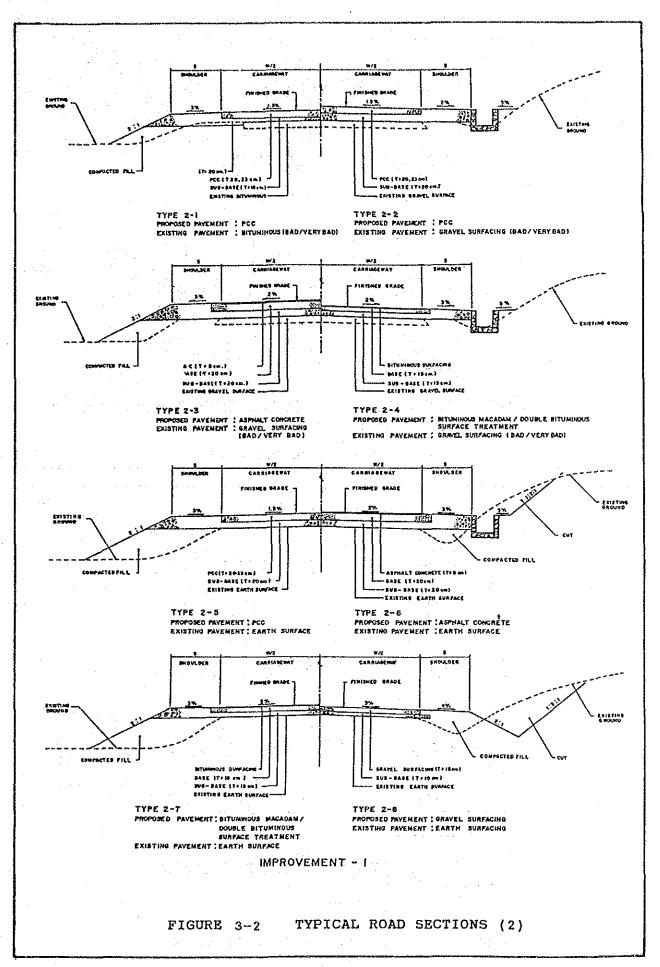
		a general second second	
Туре	Existing Pavement Type	Existing Surface Condition	e Proposed Improvement Work
Rehabilitation	Standard or Superior	· · · · · · · · · · · · · · · · · · ·	Improvement of Surface Condition
Improvement-1	Substandard	Bad/ Very Bad	Upgrading of Surface Type
Improvement-2	Substandard	Good/Fair	Upgrading of Surface Type
Widening (	Standard carriageway is narrowe than standard)		Widening of Existing Road
New Construction	Impassable/Abando Non-existing		Construction New Road

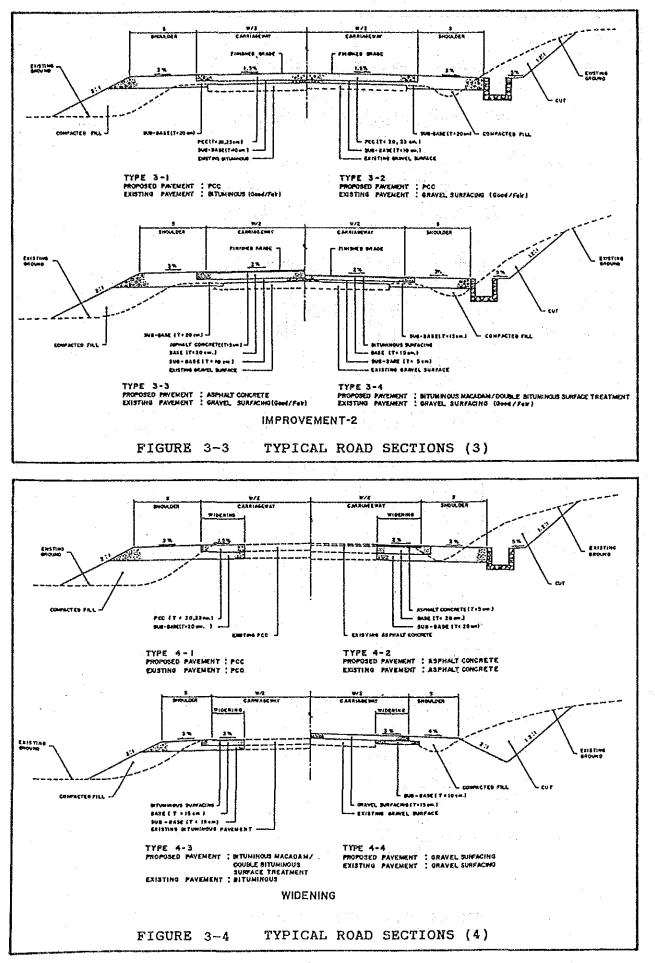
# TABLE 3-2 TYPE OF IMPROVEMENT

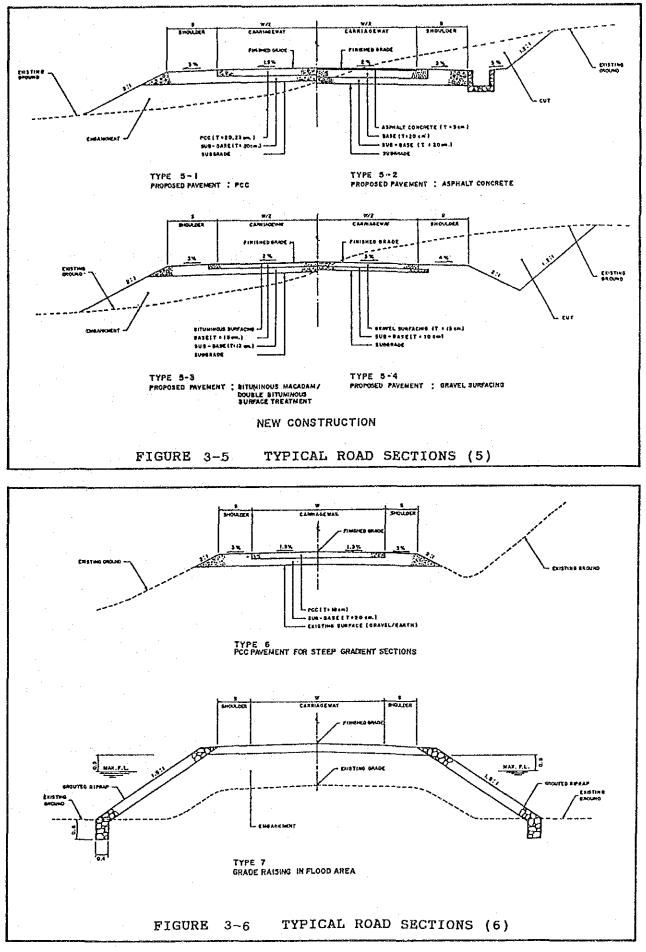
				TA	TABLE 3.3 TYPICAL	TYPICAL ROAD SECTION			
	 Type of ]	Improvement	Road Section Type	<u>Existing</u> Type	<u>Pavement</u> condition	<u>Proposed</u> Pavement Type	Pavement S Surface Course	<u>Structure</u> se Base	e (cm) Subbase
	Rehabilitation	tation		PCC PCC Bituminous Bituminous Bituminous Gravel	Bad/very bad Bad/very bad -do- -do- -do- -do- -do-	PCC AC Overlay AC Overlay AC Overlay BMP/DBST Gravel	20 - 23 5 5.5/1.6 15	12 12 12	10110
3-4	Improvement	ent - 1		Bi tumi nous Gravel Gravel Gravel Earth Earth Earth Earth	Bad/very bad -do- -do- -do- -do- -do- -do- -do-	PCC PCC AC BMP/DBST PCC AC BMP/DBST Gravel	20 - 23 20 - 23 5.5/1.6 20 - 23 20 - 23 5.5/1.6 15	12012011	10200200 1120025000
	 Improvement	ent - 2		Bi tumi nous Gravel Gravel Gravel	Good/fair -do- -do- -do-	PCC PCC AC BMP/DBST	20 - 23 20 - 23 5.5/1.6	20 15	1001
	Widening		4444 1111 1224	PCC Bi tumi nous Bi tumi nous Gravel	Good/fair -do- -do- -do-	Widening W/PCC Widening W/AC Widening W/BMP/DBST Widening W/Gravel	20 - 23 55/1.6 15	15 15	20 20 15 10
	New Cons	Construction	ភ្លេក 1 1 1 1 4 3 3 2 1	8 8 1 1	E 3 3 3	PCC AC BMP/DBST Gravel	20 - 23 5.5/1.6 15	- 50 15	20 20 15
	Special	Treatment	6	PCC pavement Grade raising	for steep in flood	gradient section area			

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CHAPTER 4 INPUT DATA FOR PROJECT EVALUATION

- 4.1 Input Data Sheet See Page 4-9.
- 4.2 Instruction for Entry
  - 1. Road Name and Class
  - <u>Road</u> Name
    - Enter the official road name or names of places at both ends of the road.

Province

Enter the name of the province where the road is located.

- <u>Province</u> Group
  - Select from Table 4-1 and encircle the corresponding letter.

#### Administrative Classification

Select among 1. National, 2. Provincial, 3, City, 4. Barangay and encircle the corresponding number.

#### Functional Classification

According to the criteria for functional road classification discussed in Chapter 2 (Table 2-1), select a class among 1. Primary Major, 2. Secondary Major, 3. Collector, and 4. Feeder and encircle the corresponding number.

#### Project Classification

Project are classified, mainly by the method of economic analysis required, into the following two (2) types:

Traffic Projects: In projects involving the restoration/reconstruction/upgrading of the existing road which is accessible to motorized vehicles at all times, the impact of the investment would be generally confined to the transport sector. The effect of such projects would have a limited impact on the overall structure of the economy in the area served by the road.

Province		Province	Province Group
Region I Abra Benguet Ilocos Norte Ilocos Sur La Union	E   E   A   G   G	Region VII Bohol Cebu Negros Oriental Siquijor	G D C G
Mountain Province Pangasinan Region II Batanes	E   E 	Region VIII Leyte Southern Leyte Eastern Samar Northern Samar	E G D C
Cagayan Ifugao Isabela Kalinga-Apayao Nueva Vizcaya Quirino	E E C C C C C C C C C C C C C C C C C C	Samar    Region IX   Basilan   Sulu   Tawi-Tawi   Zamboanga del Norte	C C C C D
Region III Bataan Bulacan Nueva Ecija Pampanga Tarlac Zambales	B   A   E   A   E   A	Zamboanga del Sur    Region X   Agusan del Norte   Agusan del SUr   Bukidnon   Camiguin	D D C E G F
Region IV Aurora Batangas Cavite Laguna Marindugue Occidental Mindoro Oriental Mindoro Palawan	C G A A F C C C C C C	Misamis Occidental Misamis Oriental Surigao del Sur Region XI Davao del Norte Davao del Sur Davao Oriental South Cotabato Surigao del Sur	F D C E C
Quezon Rizal Romblon	I C I B I G	Region XII Lanao del Norte Lanao del Sur	D G
Region V Albay Camarines Norte Camarines Sur Catanduanes Masbate Sorsogon	   F   F   F   C   F	Maguindanao North Cotabato Sultan Kudarat	C C C
Region VI Aklan Antique Capiz Iloilo Negros Occidental	   D   F   F   E   F		

Development Projects: In projects for providing allweather access or only seasonal access, to the area which has either presently no motorized access the impact Ωf the investment would affect not only the transport sector but also sectors in the local economy, especially the agricultural sector.

> Roads located in the area of high agricultural potential served by very rough but allweather roads are considered development project roads.

Major roads (primary and secondary major roads) are generally classified as traffic projects, while minor roads (collector and feeder roads) as development projects, except for some secondary major roads which are considered as development projects.

Select a project type and encircle the corresponding number.

2.Road data

The project road shall be divided into subsections, each of which is homogeneous in terrain, cross section, surface type and condition. Road data shall be prepared by subsection.

#### Total Length

Enter the total length of the project road.

#### Station

Enter the stations at both ends of the subsection.

#### <u>Subsection Length</u>

Enter the length of the subsection.

#### Surface Type

Select either of :

		portland cement concrete pavem	ent,	· · · · ·
. AC	•	asphalt concrete pavement,		
. BS7	: :	bituminous surface treatment	or	bituminous
		penetration macadam pavement,		
. G	:	gravel surface,		
. E	:	earth road, or		1 - 1 
. Nor	ne :	non-existing.		

### Surface Condition

Select either of :

- . G (Good) : No potholes or rutting or corrugation. Less than 5 potholes per 1000 meters. Cracking which does not affect driving condition may be ignored,
- . F (Fair) : More than 5 but less than 20 potholes per 1000 meters and/or slight cracking and/or rutting and/or corrugated (less than 50% of the section length). Passenger car speed will exceed 30 km. per hour,
- . B (Bad) : More than 20 potholes per 1000 meters and/or slightly rutted and/or corrugated (more than 50% of the section length) and/or corrugated over approximately the entire length. Pavements, if any, starting to break up. Maximum comfortable travel speed (car) is 30 km/hr,
- , VB (Very Bad) :

Pavement breaking up and gravel surface deteriorated into numerous potholes. Just passable for cars. Maximum comfortable travel speed (car) is about 20 km/hr,or

. Imp (Impassable) :

Impassable to motorized vehicles at all times or in the wet season, or nonexisting.

### Possibility of Rehabilitation by AC Overlay

Select either of :

Yes
 Subgrade, subbase, base course and drainage are in sound condition and pavement distress is primarily caused by traffic and by surface course material,
 No
 Other than above.

<u>Terrain</u>

Select either of :

.Fl (Flat) : Any combination of grades and horizontal and vertical alignment permitting heavy vehicles to maintain approximately the same speed as passenger cars,

. Rl (Rolling):

Any combination of grades and horizontal and vertical alignment causing heavy vehicles to reduce their speed substantially below that of passenger cars, but not causing heavy vehicles to operate at crawl speed for any significant length of time.

#### . Mt (Mountainous):

Any combination of grades and horizontal and vertical alignment causing heavy vehicles to operate a crawl speed for significant distances or at frequent intervals.

Width

Enter the width of carriageway and shoulder (average of both side). In case of non-existing, enter 0.

Length of Slope to be Protected

If there are disaster prone slope (a) needing protection measures, enter the length of the slope separately for cut and embankment slopes.

Flood Section to be Raised

If there is a flood area needing grade raising, enter the water depth above existing road surface and length of flood section.

#### 3.Structure Data

The places where river crossing facility is absent and needed shall be included as well as the existing bridges. The permanent bridge in sound condition may be omitted.

#### <u>Station</u>

Enter the Station.

Type

Select among :

Derect	among .
. St	: steel bridge
. Con	: concrete bridge
. Bail	: bailey bridge
. Tim	: timber bridge
. Sw	: spillway
. Fd	: ford crossing or no bridge

#### Length

Enter the length of the bridge. In case of no bridge, enter 0.

Width

Enter the width of the bridge. In case of no bridge, enter 0.

#### Structural Condition

Select either of :

. G (Good) : Bridges that have been carrying normal traffic for a longer length of time, no sign of distress/deterioration and their load carrying capacity is considered adequate; no work or improvement to be done.

. F (Fair) : Bridges that show sign of deterioration on the superstructure and substructure such as spalling on concrete deck, light cracks on concrete surfaces, rusty steel trusses, scouring on piers, damaged slope protection.

. B (Bad) : Bridges that show signs of heavy deterioration on the structure such as showing heavy longitudinal cracks/random cracks, splitting of concrete at tension reinforcement level, heavy spalling of concrete surfaces, exposed rusty reinforcing bars at girders and bridges that are extensively damaged and structurally unsafe for vehicular traffic.

.VB(Very Bad) : Bridges incapable of carrying future traffic, structurally and hydraulically deficient, and liable to collapse. In case of no bridge, remain blank.

Proposed Bridge Length

Enter the proposed bridge length.

4.Traffic Data

Traffic data are omissible for development projects. <u>Present</u> <u>Traffic</u>

Enter AADT by vehicle type; car/van, jeepney, bus, and truck and compute the total of them.

#### Potential Traffic Diverted

If traffic is expected to divert to the project road from other route, enter the diverted traffic by vehicle type and the total.

#### Date of Survey

Enter the date of traffic survey.

#### Road from which diversion is expected

If traffic diversion is expected, enter the name, length, surface type and condition of the road from which traffic diversion is expected, into the corresponding columns.

#### 5. Socio-economic Data

Socio-economic data are required only for development project.

#### Population within Road Influence Area (RIA)

Enter the population within the RIA. The RIA is defined as the area from which local existing or potential traffic (whether vehicle, animal-drawn or pedestrian) using the road derives.

#### Cultivated Area within RIA

Enter the total cultivated area within the RIA.

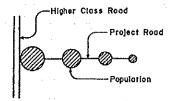
#### Population Distribution Pattern

Distribution of population along the road is generally categorized into the following three (3) patterns :

.Pattern -A: Population is distributed, gradually decreasing from the connection point with higher class road as going to the terminal. The average travel distance of the road users is about one third of the entire length of the road.

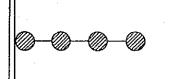
.Pattern -B: Population is evenly distributed over the whole length of the road. The average travel distance is about one half of the entire length of the road. .Pattern -C: Population is concentrated at the tip of the road. The average travel distance is almost equal to the entire length of the road.

The population distribution patterns are conceptually shown in Figure 4-1.



Pattern-A: Gradually Decreasing

Pattern





Pattern-B: Evenly Distributing Pattern Pattern-C: Tip Concentration

Figure 4-1 Population Distribution Pattern

The selection of pattern may be done according to the average travel distance of the road users, or center of gravity of population, as follows :

Average travel distance divided by entire length	Pattern
0 - 0.4	A
0.4 - 0.6	B
0.6 - 1.0	С

6. General Remarks

Describe specific matters on the project if any.

Attachment

Attach the map showing the project road with subsectioning and location of bridges, preferably on 1:50,000 topographic map.

### INPUT DATA SHEET FOR PROJECT EVALUATION

ROAD NAME AND CL	ASS			an trans		21. s 			
ROAD NAME									
PROVINCE	· · · · · · · · · · · · · · · · · · ·	PROVINC	E GROUP	A	8	¢	DE	F	G
ADMINISTRATIVE CLASSIFICATION	I. NATIONAL	2. PROVINCIAL	3.	BARANG	AY			<u></u>	
FUNCTIONAL CLASSIFICATION	I. PRIMARY MAJOR	2. SECONDARY MAJ	)R 3. (	COLLECT	FOR	4	FEEC	ER	
PROJECT CLASSIFICATION	I. TRAFFIC PROJECT	2. DEVELOPMENT P	ROJECT		12				

### 2. ROAD DATA

ATA				· ·		TOTAL LENGTH	km
FROM							1
то							1
NGTH (km.)		· · · · · · · · · · · · · · · · · · ·					
PCC/AC/BST/G/E/NONE)				n beland og f			
ON (G/F/B/VB/IMP.)		·		· · · · ·			
REHABILITATION (YES/NO)							
(FL/RL/Mt)				× .			
CARRIAGEWAY (m)	in de la de	al de set	st .				
SHOULDER (m)							
CUT SLOPE (m)							
EMBANKMENT (m)							
FLOOD DEPTH (m)							
LENGTH (km)							1
JRE DATA		<u></u>		<u> </u>	Active and a concentration of the second		
	TO NGTH (km.) PCC/AC/BST/G/E/NONE) ON (G/F/B/VB/IMP.) REHABILITATION (YES/NO) (FL/RI/MI) CARRIAGEWAY (m) SHOULDER (m) CUT SLOPE (m) EMBANKMENT (m) FLOOD DEPTH (m) LENGTH (km)	FROM         TO         ENGTH       (km.)         PCC/AC/BST/G/E/NONE)         ON (G/F/B/VB/IMP.)         REHABIL(TATION (YES/NO)         (FL/RI/MI)         CARRIAGEWAY (m)         SHOULDER       (m)         CUT SLOPE       (m)         EMBANKMENT SLOPE       (m)         FLOOD DEPTH       (m)         LENGTH       (km)	FROM       TO       NGTH     (km.)       PCC/AC/BST/G/E/NONE)       ON (G/F/B/VB/IMP.)       REHABIL(TATION (YES/NO)       (FL/RI/MI)       CARRIAGEWAY (m)       SHOULDER       CUT SLOPE       (m)       EMBANKMENT       SLOPE       FLOOD DEPTH       LENGTH	FROM       TO       NGTH       (km.)       PCC/AC/BST/G/E/NONE)       ON (G/F/B/VB/IMP.)       REHABIL(TATION (YES/NO)       (FL/RI/MI)       CARRIAGEWAY (m)       SHOULDER       CUT SLOPE       (m)       EMBANKMENT (m)       FLOOD DEPTH (m)       LENGTH	FROM       TO       NGTH       (km.)       PCC/AC/BST/G/E/NONED       ON (G/F/B/VB/IMP.)       REHABIL(TATION (YES/NO)       (FL/RI/Mt)       CARRIAGEWAY (m)       SHOULDER       CUT SLOPE       (m)       EMBANKMENT (m)       FLOOD DEPTH (m)       LENGTH	FROM         TO           TO         Image: State Sta	AIA     LENGTH       FROM

## 3. STRUCTURE DATA

STATION					
TYPE (St/Con/Boll/Tim/Sw/	'Fd)				
LENGTH	(m)				 
WIDTH	(m)				
STRUCTURAL CONDITION (G/F/B	/VB)	. 1			
PROPOSED BRIDGE LENGTH	(m)		 		 

### 4. TRAFFIC DATA (OMISSIBLE FOR DEVELOPMENT PROJECT)

	PRESENT	POTENTIAL TRAF-	DATE OF SURVEY
CAR/VAN			
JEEPNEY			
BUS		· .	
TRUCK			1 1 1 1
TOTAL			

ROAD FROM WHICH	DIVERSION IS EXF	ECTED	
NAME :	an a	-	
LENGTH	(km)		
SURFACE TYPE (PC	C/AC/BST/G/E)		
SURFACE CONDITION	(G/F/B/VB)		 
REMARKS :			 

### 5. SOCIO-ECONOMIC DATA ( ONLY FOR DEVELOPMENT PROJECT )

POPULATION WITHIN ROAD INFLUENCE AREA (RIA) CULTIVATED AREA WITH RIA

POPULATION
DISTRIBUTION
PATTERN

A. GRADUALLY DECREASING PATTERN B. EVENLY DISTRIBUTING PATTERN C. TIP CONCENTRATION PATTERN

### 6. GENERAL REMARKS

NOTE : ATTACH MAP INDICATING GENERAL LOCATION OF PROPOSED PROJECT, PREFERABLY IN 1:50,000 TOPOGRAPHIC MAP.

ha,

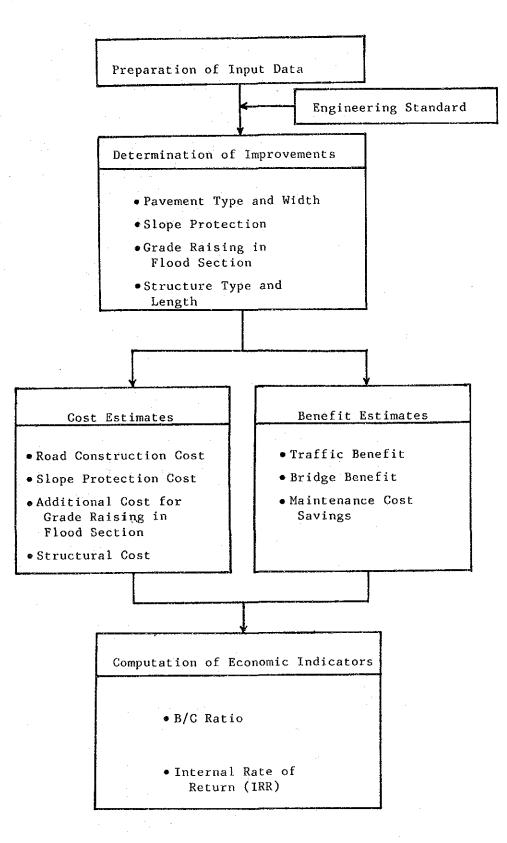
CHAPTER 5 PROJECT EVALUATION -PROJECT WITHOUT TRAFFIC DIVERSION-Worksheets for project evaluation and equations together with tabular and graphic information needed to complete a project evaluation are provided in Appendices A to G for province group A to G, respectively. This chapter presents step-by-step instructions for project evaluation computations. 5.1 General 1) Basic Assumptions - Analysis Period 1st Year -Detailed engineering 2nd Year -Construction 3rd Year -1 . - Project life (25 years) - [ 1 27th Year -- Discounted Rate : 15% p.a. - Quantified Cost 1) .Initial construction/improvement costs 2) - Quantified Benefit .Traffic benefit (only normal and generated traffic benefits) 3) .Bridge benefit benefit (only for development .Development project) 4) 5) .Maintenance cost savings - Price Level 6) 1990 price level

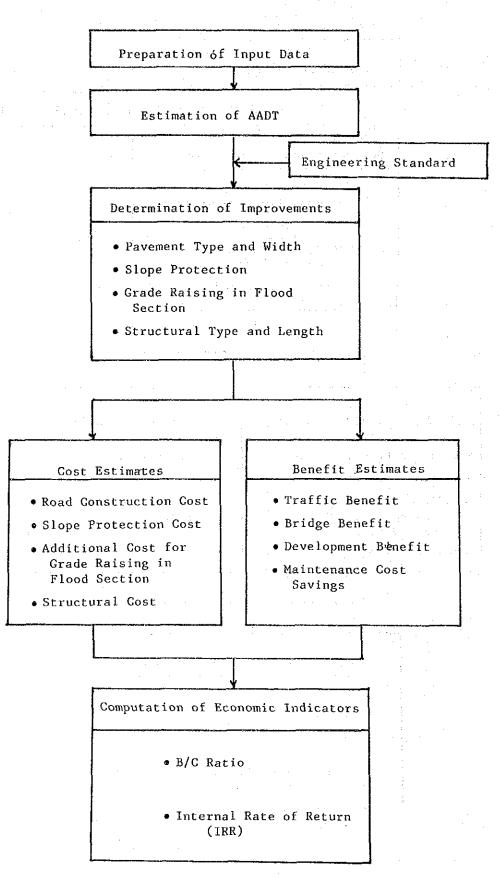
Note: 1) Initial construction/improvement costs calculated in accordance with this Guide are undiscounted financial costs not including the costs for detailed engineering and construction supervision. The discounted economic costs are, however, used in the computation of economic indicators with the following conversion.

Year	Item	Economic Cost	Discounted Eco. Cost
icui	1 COM	0051	1001 0050
lst	Detailed Engineering	4.0%	4.0%
2nd	Construction cost		
	less 15% tax	85.0%	73.9%
2nd 👘	Construction Supervis	ion 6.0%	5.2%
	Total	95.0%	83.1%

- 2) All benefits calculated in accordance with this Guide are total discounted benefits for 27-year analysis period.
- 3) Bridge benefit is, in this Guide, defined as traffic benefit accruing from bridge construction/replacement, which is segregated from traffic benefit accruing from improvement of road surface type and condition.
- 4) Development benefit is generated by the road improvement as a whole and cannot be divided in to the effects of improvements of individual subsections. In this Manual, however, development benefit is computed as a sum of benefits calculated in individual subsections. It is only for the convenience of computation.
- 5) In addition to the savings in routine maintenance costs, the periodic maintenance costs, or rehabilitation costs, such as overlay, regravelling and reconstruction which will be needed after completion of the project to prolong the pavement life are included in "Maintenance Costs Savings" as a negative benefit. As a consequence, the maintenance costs savings become negative in most cases.
- 6) Adjustment for price escalation will be needed for future use. See Chapter 7.

#### 2) General Procedure for Traffic Project Evaluation





#### 3) General Procedure for Development Project Evaluation

#### 4) Selection of Worksheet

In the step of preparing input data (chapter 4), the province group and project classification have been determined. The appendix containing the worksheet, equations and information to be used is selected depending on province group and project classification as follows :

rovince Group	Project Classification	   Traffic   Project	Development Project
	Α	Appendix -A.I	Appendix -A.I
		Appendix -B.I	Appendix -B.I
÷ .	$\overline{\mathbf{c}}$	Appendix -C.I	Appendix -C.I
, s t ,	D	Appendix -D.I	Appendix -D.I
	Ē	Appendix -E.I	Appendix -E.I.
		Appendix -F.I	Appendix -F.I
		Appendix -G.I	Appendix -G.I.
·			

#### 5.2 Procedures for Traffic Project Evaluation

The information entered in INPUT DATA SHEET FOR PROJECT EVALUATION is used as input data for project evaluation. The worksheet prepared for each province group is used to summarize computations for project evaluation (see Figure 5-1.)

 Road Name and Class Name of Road, Province and Functional Classification are taken directly from INPUT DATA SHEET.

#### 2) AADT

#### Present AADT

Based on Traffic Data in INPUT DATA SHEET, the numbers of light vehicles and heavy vehicles and their percentages are calculated. Light and heavy vehicles are defined as follows :

> Light vehicle = car/van + jeepney Heavy vehicle = bus + truck

> > 5-5

TOTAL è ଇ NUMBERS OF YEARS TO THE OPENHAA TEAN AADT IN OPENHA TEAN IOXILOSTI TEAR OPENING 4) PROPOSED IMPROVEMENT AND COST (STRUCTURE) ausserton ko. where the structure is under the structure cost of the structure in the structure is under the structure in the structure is in in the structu \$ × 1.001 C Nav DD (TRAFFIC PROJECT Э LIGHT VEHICLE [ CAR/VAN/JEEPHEY ]. ছ ছ 33 b  $\overline{v}$ 30 জ ন্ত 30 Б Ð  $\odot$ m D TOTAL CONSTRUCTION COST ( Se HEAVY VEHICLE ( BUS / TRUCK) ( REF. A.I - It ) 6) ECONOMIC INDICATOR coar ( 🐑 « ເຊິ່າ – 11 ) ECONOMIC COST & B K 0.4311 UNIT COST/M UNIT COST/M C (C)1 MINOWALL & AFROM TOTA, COST TOTA, COST TOTA, COST 10/0) UNIT COST/M ( REF. A.1-4.1 ( ())(()) I-CELL ON 2-CELT ( O'E+(W) ATTYRSN ) NO. OF SPANS TOTAL COST LENGTH (M)-NO. OF LANES NO. OF LARES LENGTH (M) COMMENT 1214 TOTAL COST (N+) IC SATIO 2) AADT 1.7.9 CHHIT20 CO2L (H4) PROJECT EVALUATION WORKSHEET TOAA TOAA 3.80128 5859 AVA THE PROVINCE GROUP - A ) TOTAL **g**) Ð 3. COLLECTON 4. FLEDER E. JECONDARY MAJOR 5 - 1 3) PROPOSED IMPROVEMENT AND COST (ROAD) I. PRIMARY MAJOR Figure UNIT COAT/A (5) 1.86E A.1-4) (5) (6015) (9) (6015) (9) (6016) (9) (78E A.1-4) (9) (6016) (10) WPROVEMENT (REMAN, JUPEN) ANEW CONST.) (REF. A.1-1) JURE COST/KM. (G UNIT COST/KM. (G ত CUT SLOPE LENGTH INI EMBANKMENT SLOPE  $\odot$ С O 9 Ø Э ŋ ত্র ୭ 5 Ξ T Ø 3 9 ĨÐ UHIT BEREFIT/KM/VEM. ŝ 2 I) ROAD NAME AND CLASS ( XXX ) LOOD DEPTH (PCC/AC/BMP/QRAVEL) A.1-1) EXISTINO SURFACE TYPE I PAVED/ORAVEL/EARTHI EZISTINO SURFACE CONDITION (GOOD/FAIR/BAD/VERY BAD) PLOOD SECTION CONSTANT "E" ( REP. A.E-7 ) TERRAIN (FLAT/ROLLING/HOUNTAINOUS) CARRIAGEWAY WIDTH (14) 1 REF. A.1-11 SHOULDER WIDTH (14) 3 BENEFIT ADT IN DERING YEAR (A) IN DERING YEAR (A) IN REAVY VEHICLES (C) I FUNCTIONAL CLASSIFICATION (REF. CHAPTER 2) CALL HTOIN LENGTH OF SUBSECTION cost (@.@) EKBANK SLOPE SHORE LENGTH (M) I REF. A.1-1) TOTAL WITH I ()+2 \* () TYPE OF WIROW WIDENING / NEW C POTAL SENERI TOTAL COST SURSECTION NO. HAKE OF ROAD NAINTE-NANCE COST SAVINGS PROTECTION PLOOD SECTION TRAFFIC. TITITITI FLOOD SECTION ROTECTION PROVINCE ROAD REF. LOPE TREATMENT. THENSING 1-1H1 1500 TIN D N H H

<u>Opening Year</u>

AADT in the opening year is calculated assuming 3% of annual traffic growth rate based on present traffic, as follows :

AADT in opening year = Present AADT X  $1.03^{n}$ Where, n = number of years to the opening year

3) Proposed Improvement and Cost (Road)

Subsection No.

Put sequential numbers to subsections.

Length of Subsection Existing Surface Type Existing Surface Condition Terrain Slope Protection : Cut Slope Length Slope Protection : Embankment Slope Length Flood Section : Flood Depth Flood Section : Flood Section Length

These are taken directly from INPUT DATA SHEET.

<u>Proposed Pavement : Type</u> <u>Proposed Pavement : Carriageway Width</u> <u>Proposed Pavement : Shoulder Width</u>

1)

These are selected from Table in Appendix X.I-1 based on functional road classification and AADT in the opening year. The Table only shows the standard and the actual proposal depends on engineer's judgment.

Note 1)

The first letter in Appendix number corresponds to the letter indicating province group. For instance, X.I-1 is used as A.I-1 for province group -A. The same rule is applied hereinafter.

#### Proposed Pavement : Total Width

Total width is calculated as the sum of carriageway width and shoulder width times 2.

#### Proposed Pavement : Type of Improvement

Type of improvement is selected from Table in Appendix X.I-1 based on :

- Existing and proposed types comparison

- Existing surface condition, and

- Existing and proposed widths comparison

#### <u>Cost : Road</u>

Unit Cost/Km is selected from Table in Appendix X.I-3, based on type of improvement, proposed pavement type, carriageway width, shoulder width and terrain.

Cost per subsection is calculated by multiplying the unit cost by length of subsection.

#### Cost : Slope Protection

Unit cost/m is given in Table in Appendix X.I-4.

Cost is computed as the product of unit cost and length of slope.

Calculation is made separately for cut slope and embankment slope.

#### Cost : Flood Section

This means the additional cost for grade raising in flood section.

Unit cost/km is calculated as : 1.976 X Flood depth + 0.173 X road width -0.850

Cost is computed by multiplying the unit cost by length of flood section.

<u>Total Cost</u>

Total cost of the subsection is computed as the sum of road cost, cut slope protection cost, embankment slope protection cost and additional cost for flood section.

Total cost of subsection are summed up to obtain total road cost of the project .

3) Proposed Improvement and Cost (Structure)

Subsection No. where the structure is located

Subsection number is found based on the station of the structure shown in INPUT DATA SHEET.

#### Existing Type

This is taken directly from INPUT DATA SHEET.

#### Proposed Type

Proposed type is selected from Table in Appendix X.I-2 based on existing type, functional road classification and in some cases, carriageway width of approach road and AADT. The Table shows only the standard and the actual proposal depends on engineer's judgement.

#### Bridges : No. of Lanes

Number of lanes was determined at a time of proposed type selection.

#### Bridges : Length

Proposed bridge length is taken directly from INPUT DATA SHEET.

#### <u>Number of Spans</u>

Number of spans should be decided based on site conditions. The standard number of spans is given by dividing bridge length in meter by 20 and rounding it, unless site conditions indicate that another number is appropriate.

#### <u>Bridge Cost : Superstructure</u>

Unit cost/m is given in Table in Appendix X.I-6. Cost is calculated as the product of the unit cost and length of bridge.

#### Bridge Cost : Abutment

Unit cost/each is given in table in Appendix X.I-6. Cost is computed as the unit cost times 2.

<u>Bridge Cost : Pier</u>

Unit cost/each is given in table in Appendix X.I-6.

Cost is computed as the unit cost times number of piers (number of spans minus 1).

#### <u>Bridge Cost : Total</u>

Total bridge cost is computed as the sum of costs of superstructure, abutment and pier.

#### Spillway : Number of Lanes

Number of lanes was determined at a time of proposed type selection.

#### Spillway : Length

Proposed length is taken directly from INPUT DATA SHEET.

#### Spillway Cost

Unit cost/m is given in Table in Appendix X.I-6. Cost is computed as the product of the unit cost and length.

#### RCBC : 1-cell or 2-cell

Selection criteria are as follows : Stream crossing width 3.0m or less : 1-cell 3.0m - 6.0m : 2-cell

#### <u>RCBC : Length</u>

The length depends on the road cross-section. Standard length is given as the road width plus 3.0m.

#### <u>RCBC Cost</u>

Unit cost/m is given in Table Appendix X.I-6. Cost is computed as the product of the unit cost and length.

#### RCBC Cost : Wingwall and Apron

Both sides total cost is given in Table in Appendix X.1-6.

#### <u>RCBC Cost : Total</u>

Total RCBC cost is computed as the sum of the costs of RCBC and Wingwall and apron.

<u>Total Cost</u>

Total cost is computed as the sum of bridge cost, spillway cost and RCBC cost.

4) Benefit

All benefits are expressed by total discounted benefit for 27-year analysis period.

#### AADT in Opening Year Percent Heavy Vehicles

These are taken directly from the entries in columns for 2) AADT.

#### Bridge Length

Bridge length to be entered here is the total length of proposed bridges and spillways which are located within the subsection considered.

#### <u>Traffic Benefit</u>

Unit traffic benefit/km/veh is given by the following equation :

TRBu =  $k + \alpha x H\nabla$ 

Where,	TRBu	=	unit traffic benefit/km/veh
	k	=	constant depending on proposed
			pavement type, existing surface
			type and condition and terrain.
	$\propto$	=	coefficient common within the
			province group
	ΗV	=	percent heavy vehicles

k is selected from Table in Appendix X.I-7
Then, unit traffic benefit/km/veh is computed in accordance with the equation shown in Appendix X.I-7.
Traffic benefit is calculated as the product of the unit traffic benefits, length of subsection and AADT in the opening year.

#### Bridge Benefit

Unit bridge benefit is computed as :

BRBU = 0.0660 X TRBU - 0.000351 Where, BRBU = unit bridge benefit/m/veh TRBU = unit traffic benefit/km/veh, obtained above.

Bridge benefit is obtained as the product of the unit bridge benefit, bridge length and AADT in the opening year.

#### Maintenance Cost Savings

Unit maintenance cost savings/km is found from chart in Appendix X.I-9, based on proposed pavement type and AADT in the opening year.

Maintenance cost savings are computed as the product of the unit maintenance cost savings and length of subsection.

#### <u>Total Benefit</u>

Total benefit of the subsection is computed as the sum of traffic benefit, bridge benefit and maintenance cost savings.

Total benefits of subsection are summed up to obtain total benefit of the project.

#### 6) Economic Indicator

A provide the second sec

#### Total Construction Cost

Total Construction Cost is computed as the sum of total road cost and total structure cost. This is the financial cost excluding the cost for detailed engineering and construction supervision.

#### Economic Cost

Economic cost is computed as the total construction cost times 0.831. This is the discounted economic cost including the costs for detailed engineering and construction supervision.

B/C Ratio

B/C ratio is computed by dividing the total benefit by the economic cost.

IRR

IRR is found from Chart in Appendix X.I-11, based on B/C ratio and proposed pavement type.

5.3 Procedures for Development Project Evaluation

The information entered in INPUT DATA SHEET FOR PROJECT EVALUATION is used as input data for project evaluation. The worksheet prepared for each province group is used to summarize computations for project evaluation (See Figure 5-2).

1) Road Name and Class

Same as in traffic project evaluation

2) Socio-economic Data and AADT

<u>Population within RIA : Pt</u> <u>Cultivated Area within RIA:At</u> <u>Population Distribution Pattern</u> <u>Total Road Length : Lt</u>

These are taken directly from INPUT DATA SHEET.

At/Lt

This is computed by dividing the cultivated area within RIA by the total road length.

Pt/Lt

This is computed by dividing the population within RIA by the total road length.

AADT

AADT in the opening year is found from Chart in Appendix X.II-1, based on Population within RIA.

3) Proposed Improvement and Cost (Road)

Same as in traffic project evaluation.

Figurt       Road NAME AND CLASS       Name of noad       PROPOSED IMPROVEMENT AND Subsection No.       PROPOSED IMPROVEMENT AND Subsection No.       Effect Charter & Assilthant AND Subsection No.       Events of noad       Fiber Charter & Subsection No.       State No.
-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

4) Proposed Improvement and Cost (Structure)

Same as in traffic evaluation.

5) Benefit

All benefits are expressed by total discounted benefit for 27-year analysis period.

Bridge Length

Bridge length to be entered here is the total length of proposed bridges and spillways which are located within the subsection considered.

#### <u>Traffic Benefit</u>

Unit traffic benefit/km is estimated based on existing surface type and condition, population AADT distribution pattern, and either or population within RIA. Six (6) charts for estimating unit traffic benefit are presented in population Appendix X.II-8; two each for distribution pattern -A,B and C consisting of one each based on AADT and population within Select the right chart depending on RIA. population distribution pattern and choice 0f parameter, weather AADT or population and using the chart, find the unit traffic benefit.

Then, traffic benefit is computed as the product of the unit traffic benefit and length of subsection.

Bridge Benefit

Unit bridge benefit/km is computed as :

BRBu = 0.0660 X TRBU - 0.000351 X VEH Where, BRBu = unit bridge benefit/km TRBu = unit traffic benefit/km, obtained above VEH = AADT

Bridge benefit is calculated as the product of the unit bridge benefit and bridge length.

#### Development Benefit deal a service state of the service of the ser

Unit development benefit/km is given by the following equation :

 $DVBu = k + \alpha xAt/Lt + BxPt/Lt$ 

k = Constant depending on existing pavement type and condition

At/Lt = Cultivated area within RIA divided by total road length Pt/Lt = Population within RIA divided by total road length

by cocar roud rengen

k is selected from Table in Appendix X.II-10.

Then, unit development benefit/km is computed using the equation shown in Appendix X.II-10.

Development benefit is calculated as the product of the unit development benefit and length of subsection.

Maintenance Cost Savings

Same as in traffic project evaluation

#### <u>Total Benefit</u>

Total benefit of the subsection is computed as the sum of traffic benefit, bridge benefit, development benefit and maintenance cost savings, and then summed up for all subsections to obtain total benefit of the project.

6) Economic Indicator 💷

Same as in traffic project evaluation.

#### CHAPTER 6 PROJECT EVALUATION

. . 3

-PROJECT WITH TRAFFIC DIVERSION-

Following are the procedures for evaluation of the projects in which traffic diversion is expected.

- 1) All computations are made applying the same method described in Chapter 5, except for traffic benefit estimates.
- 2) Traffic benefit is estimated in the following procedures :

Step 1: Calculate traffic benefit in the ordinary way (the way of evaluating the projects without traffic diversion), based on nondiverted traffic.

Step 2: Regarding the surface type and condition of the road from which diversion is expected as existing surface type and condition of the project road, calculate traffic benefit in the ordinary way, based on diverted traffic.

Step 3: Compute the following traffic value :

 $L'X \geq TC'_{vt}$  VEH vt

Where, L'=	Reduction	in	length
	resulting		traffic
	diversion,	in km.	
TC'vt =	Unit tra	ffic co	st, in
V L	Mt/km/veh,	of vehic	le type
1	vt, in	terms of	total
	discounted	cost for	27-year
	analysis pe	eriod, d	epending
	on surfa	ace typ	e and
	condition (	of the ro	ad from
	which dive	rsion is	expected
VEH =	diverted th	raffic of	vehicle
vt	type vt in	the open	ing year

6-1

L' is calculated by subtracting the length of the project road from the length of the road from which diversion is expected. If the former is longer than the latter, L' takes a negative value.

TC'vt is given in Table 6-1.

VEHvt is estimated based on present diverted traffic, assuming an appropriate traffic growth rate (usually 3% p.a.).

All necessary information is given in INPUT DATA SHEET.

Step4 : Traffic benefit is computed as the sum of the values obtained in Step 1, 2 and 3.

TABLE 6.1 Unit Traffic Cost "TC'vt" ( Discounted Total for 27-year Analysis Period )

								•		
Surface  Type	Surface Condition	Car/   Van	Jeep- ney	Bus	Truck	Tri- cycle	Motor cycle	Animal Drawn	Walk- ing	Banca Boat
PCC/AC	Good Fair Bad Very Bad	.0056 .0065 .0087 .0118	.0050 .0058 .0086 .0122	.0126 .0149 .0220 .0311	.0107 .0126 .0165 .0224	.0018 .0021 .0032 .0054	.0012 .0014 .0024 .0039		· ·	
BMP/ I DBST I	Good Fair Bad Very Bad	.0062 .0075 .0097 .0125	.0054 .0065 .0092 .0126	.0139 .0167 .0236 .0322	.0120 .0145 .0185 .0238	.0020 .0024 .0034 .0055	.0014 .0017 .0025 .0040	.0105	.0032	.0059
Gravel   	Good Fair Bad Very Bad Impassable	.0070 .0086 .0107 .0133 .0189	.0060 .0073 .0099 .0131 .0212	.0152 .0187 .0253 .0334 .0545	.0135 .0167 .0205 .0252 .0352	.0023 .0027 .0036 .0057 .0098	.0015 .0019 .0027 .0042 .0070	.0105	.0032	.0005
Earth	Bad Very Bad Impassable	.0133 .0181 .0189	.0131 .0207 .0212	.0334 .0532 .0545	.0252 .0336 .0352	.0057 .0096 .0098	.0042 .0068 .0070			

( unit : Mp/km/veh )

#### CHAPTER 7 ADJUSTMENT FOR PRICE ESCALATION

As mentioned in Chapter 5, all data on costs and benefits provided in this Guide are at 1990 price level. When using this Guide in the future, cost and benefits will be needed to be updated according to the price level at the time. This Chapter discusses the way of such adjustment.

#### 7.1 Construction Cost

Table 7-1 shows the breakdown of construction cost into costs of material, equipment and labor. Based on the escalation rate to the 1990 price level in each component, the adjustment factor is derived from the following equation :

Fc = fm X Gm + fe X Ge + fl X Gl
Where, Fc = adjustment factor for
construction cost
fm,fe,fl = cost components of
material, equipment and
labor, respectively, in
fraction, given in Table 7-
1.
Gm,Ge,GL = escalation rates of
material cost, equipment
cost and labor cost,
respectively, to the 1990
price, in fraction.

Table	7-1	Construction	Cost	Components
-------	-----	--------------	------	------------

		Material	Equipment	Labor
		fm	fe	f L
	I PCC	0.46	0.45	0.09
Road	IAC	0.37	0.54	0.09
Construction	BMP	0.35	0.53	0.12
Cost	Gravel	0.10	0.78	0.12
	Overlay	0.68	0.26	0.06
Slope Protecti	on Cost	0.35	0.48	0.17
Additional Cos	st for Grade	· <u></u> <u></u> <u></u> <u></u> <u></u> <u></u>		
Raising in Flo	od Section	0.38	0.35	0.27
Structure Cost	i	0.75	0.10	0.15

#### 7.2 Traffic Benefit and Compared and

Table 7-2 shows the breakdown of traffic benefit into running cost, fixed cost, time cost and non-motorized transport cost. Based on the escalation rate to the 1990 price level in each component, the adjustment factor is derived from the following equation :

	and the second	이 집에서 물건을 가지 않는 것이 같아요. 이 같은 것이 있는 것이 같아요. 이 것이 있는 것이 같아요.	
$Ft = fr \cdot Gr$	• + ft•Gf +	ft•Gt + fn•Gn	
Where, fr,	ft,ft,fn =	benefit component	of
		running cost, fixed	cost,
	e de la companya de l	time cost and	non-
	1	motorized transport	cost,
and a set	1	respectively,	in
	and the second second	fraction, given in	Table
	·	7-2.	
	· · · ·		

Gr,Gf,Gt,Gn = escalation rate of running cost, fixed cost, time cost and nonmotorized transport cost, respectively, to the 1990 price, in fraction.

a Estimate de la contra de la

Since running cost, fixed cost and time cost are updated time to time by the DPWH, Gr,Gf,and Gt are easily gotten. Gn is estimated based on the consumer price index for all items.

#### Table 7-2 Traffic Benefit Component

	Running Cost fr	Cost		Non-motorized Transport Cost fn
Traffic Project	0.49	0.25	0.26	
Development Proj.	0.25	0.21	0.25	0.29

7.3 Bridge Benefit

The same adjustment factor as for traffic benefit is applicable

7.4 Development Benefit

Adjustment factor is reasonably estimated based on the producer price index for agricultural products.

#### 7,5 Maintenance Cost Savings

One of the adjustment factors for road construction cost is applicable to the adjustment of maintenance cost savings. The selection of adjustment factor depends on proposed pavement type, as follows :

Proposed Pavement Type Adjustment Factor to be applied

PCC	Adjustment factor for
	road construction cost
	(for overlay)
AC	-do-
BMP	-do-
Gravel	(gravel)
Overlay	(overlay)

Calculation 1 : Traffic Project

Input data sheet, location map and project evaluation worksheet are presented on Page 8-2, 8-3 and 8-4, respectively.

Calculation 2 : Development Project

Input data sheet, location map and project evaluation worksheet are presented on Page 8-5, 8-6 and 8-7, respectively.

# INPUT DATA SHEET FOR PROJECT EVALUATION

#### I. ROAD NAME AND CLASS

ROAD NAME	P89 SAN ROQUE	- NUEVA	120 00	•						
PROVINCE	DAVAD DEL NORT	٤	PROVINCE GR	OUP	A	B	° (	<b>D</b> ε	F	G
ADMINISTRATIVE CLASSIFICATION	I. NATIONAL	PROVIN	ICIAL	3.8	ARANG	3AY				
FUNCTIONAL CLASSIFICATION	I. PRIMARY MAJOR	SECON	DARY MAJOR	3. C	OLLEC	TOR	4.	FEE(	DER	
PROJECT CLASSIFICATION	TRAFFIC PROJECT	2. DEVELO	PMENT PROJE	CT						

# 2 ΡΛΔΟ ΟΔΤΔ

. ROAD DA	ATA		· .			: :	TOTAL LENGTH	7.5 km
	FROM	0.0	5.9					
STATION	το	5.9	7.5					
SUBSECTION LE	ENGTH ('km.)	5.9	1.6					
SURFACE TYPE (I	PCC/AC/BST/G/E/NONE)	Ģ	G	1				
SURFACE CONDITI	ON (G/F/B/VB/IMP.)	8	Fi					
POSSIBILITY OF BY AC OVERLAN	REHABILITATION (YES/NO)	No	No					
TERRAIN	(FL/RL/Mt)	F	Ā					
WINTH	CARRIAGEWAY (m)	1.5	4.0					
WIDTH	SHOULDER (m)	0.15	0.75					
LENGTH OF	CUT SLOPE (m)	_	1					
SLOPE TO BE PROTECTED	EMBANKMENT (m)	-						
FLOOD	FLOOD DEPTH (m)	-						
SECTION TO BE RAISED	LENGTH (km)		:					

# 3. STRUCTURE DATA

STATION	<b>ల</b> , 5	5.9			
TYPE (St/Con/Bail/Tim/Sw/Fd)	Con	Tim			
LENGTH (m)	6.0	25.8			
WIDTH (m)	0.9	5.8	· .		
STRUCTURAL CONDITION (G/F/B/VB)	VB	Ŀ			
PROPOSED BRIDGE LENGTH (m)	6.0	26.0			

## 4. TRAFFIC DATA (OMISSIBLE FOR DEVELOPMENT PROJECT)

	PRESENT TRAFFIC	POTENTIAL TRAF-	DATE O SURVEY
CAR/VAN	102	. –	
JEEPNEY	. 99	-	
BUS	8	-	
TRUCK	<u>े</u> ८२	1	
TOTAL	261	-	

ROAD FROM WHICH DIVERSION IS	EXPECTED -
NAME :	
LENGTH (k	m)
SURFACE TYPE (PCC/AC/BST/G	/E)
SURFACE CONDITION (G/F/B/	/B) —
REMARKS :	

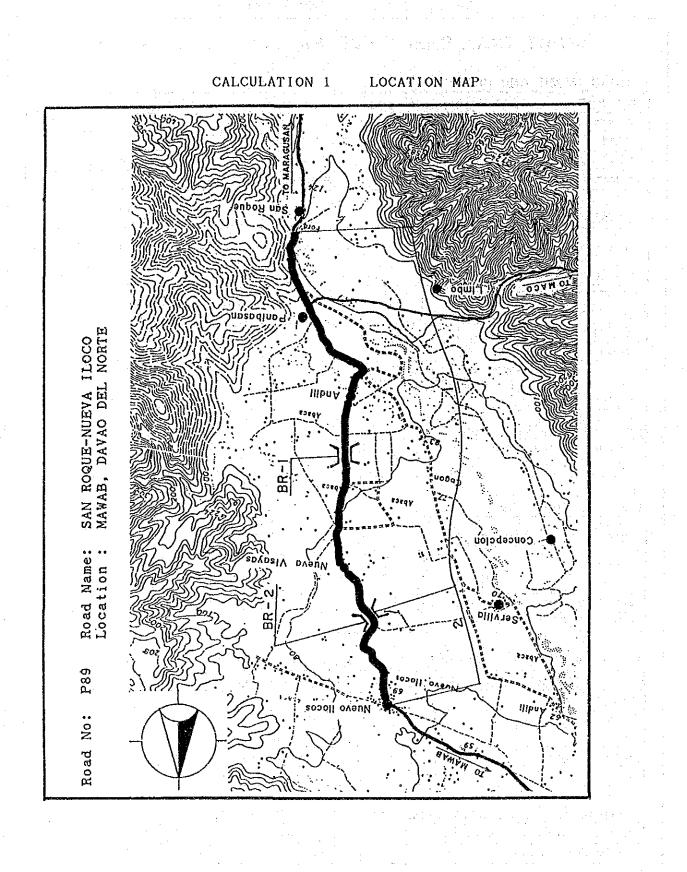
#### 5. SOCIO-ECONOMIC DATA ( ONLY FOR DEV

POPULATION WITHIN ROAD INFLUENCE AREA (RIA)		PO
CULTIVATED AREA WITH RIA	ħa.	PA

/ELOPMENT	PROJECT )	
POPULATION DISTRIBUTION PATTERN	A. GRADUALLY DECREASING PATTERN B. EVENLY DISTRIBUTING PATTERN C. TIP CONCENTRATION PATTERN	

#### 6. GENERAL REMARKS

NOTE : ATTACH MAP INDICATING GENERAL LOCATION OF PROPOSED PROJECT, PREFERABLY IN 1:50,000 TOPOGRAPHIC MAP.



8-3

## PROJECT EVALUATION WORKSHEET (TRAFFIC PROJECT) CALCULATION 1 PROJECT EVALUATION WORKSHEET

<u>2) AADT</u>

#### I) ROAD NAME AND CLASS

NAME OF ROAD	P89 SAN ROQUE - NUEVA 12000
PROVINCE	DAVAU DEL NURTE (PROVINCE GROUP - D)
FUNCTIONAL CLASSIFICATION (REF. CHAPTER 2)	I. PRIMARY MAJOR 2. BECONDARY MAJOR 3. COLLECTOR 4. FEEDER

E.	LIGHT VEHICLE (CAR/VAN/JEEPNEY)	20 / VEH.	77.01%	
RESE A A D T	HEAVY VEHICLE (BUS/TRUCK)	SO VEH	22. 99 ·10	
a a	TOTAL	Û <sub>ζб/</sub> ∨ен,	100 %	

#### 3) PROPOSED IMPROVEMENT AND COST (ROAD)

	SUBSECTION	NO.		( ب	/	2			1	TOTAL
LENGTH OF SUBSECTION (KM)			5.9	1.6	 			7.5		
	EXISTING SUP				G	G	 			
	EXISTING SU	RFACE CON	DITION		8	- Fi	······································			
	TERRAIN (FLAT/ROLLI)	IG/MOUNTAI	NOUS)		Ā	F		1		
E	SLOPE	CUT SLOP	E LENGTH (M)	6	_					
REATMENT	PROTECTION	EMBANKMI LENGTH	ENT SLOPE (M)	6	-	-				
TREA	FLOOD	FLOOD DE		0	<u> </u>					
	SECTION	FLOOD SE LENGTH	(M)	۲			 ļ	<u> </u>		
	(REF. D.1				BHP	BHP	 ļ			
ir.	CARRIAGE		(M)	0	6.0	5.0	 		<u> </u>	
PAVEMENT	( REF. D.I	-1)		) 8	1.5	1.5	 · · · · · · · · · · · · · · · · · · ·	<u> </u>		
	(9+2×(	91	(M) T (REHAB./1MPR	0	9.0	9.0	 			
-			) (REF. 0.1-1)		148-1	117.2				
	ROAD	COST		(2)	1.744	1.744	 :		· · · ·	
		(@x④)	UNIT COST/M	9	10.290	2.790	 <u></u>		ļ	13.080
é.			(REF. 0.1-4)	0	-					
ž		SLOFE	(H)x(5)	(i) (ii)		-	 	ļ	ļ	
s L-		EMBANK SLOPE	(REF. D.I-4)	<u>a</u> e	~	~	 			
00	UNIT COST		(6x6)	(8)	-		<b>}-</b>		·	
	FLOOD SECTION		0.173.00-0.85	ور رو	~	-	 <u> </u>	·	<u> </u>	
	TOTAL CO	((B)x(B))		9			 	<u> </u>	<u> </u>	89
	((3+(5+(7)	+(19)			10.290	2.790			<u> </u>	29 13.080

#### 4) PROPOSED IMPROVEMENT AND COST (STRUCTURI

41	<u> </u>	JEUSEL	IMPROVEMEN		IND COS		, I UKI
		ECTION NO.	WHERE THE STRUCTURE		1	2 .	
L	(FORD	the second s	TIMBER/BAILEY/OTHER)		OTHER	THARK	
		OSED TYPE	(REF. D.I -2) V/I-SW/I-RCBC/2-RCBC)		2-BR	2-BR	
	NO	OF LANES	3		2	5	
		NGTH (M)		(2)	6.0	26.0	
		. OF SPANS		2	1	5	
យ		SUPER	UNIT COST/M (REF. D.I-6)	0	0.0478	0.0478	
0 0		STRUCTUR	ε cosτ (@x@)	2	0.2868	1.2228	
- 	Â	ADUSTUS	UNIT COST/EACH (REF. D.I-6)	Ċ	0.3630	0.3630	
en	a 2 Agui	ABUTMENT	COST (@x 2)	6	0.726	0.726	
	cost	PIER	UNIT COST/EACH (REF. D.I-6)	T			u,
			COST (②x(②-1))	29			
		TOTAL C		ම	1.0128	1.9688	
	NO	OF LANES	3				
WAY	LE	NGTH (M)		30			
SPILLWAY	(dW)	UNIT CO		3)			
Ű	COST (MP	cost (③x⊗	)	3			
		CELL OR 2	-CELL				
		NGTH (M) SUALLY(I)+		(33			
р С	Ā		IT COST/N EF. D.I-6)	3			
с Ч	-d-W	(3	st )x(G))	65			
	COST	(REF (		6			
		TOTAL (33+50	COST	H			
		(M17~) 迎+(約)			1.0128	1.9688	`

### 5) RENEET

	AADT IN OPE	NING YEAR	9	285	285				
	PERCENT HE	AVY VEHICLES	Ľ	22.99	22.99		·····		
[   	BRIDGE LENG		9	6.0	26.0				
		CONSTANT "k" (REF. D.I-7)		0.00721	0.00681			1	
	TRAFFIC BENEFIT	UNIT BENEFIT/KM/VEH.	Ð	0.00721	0.00681			1	
1		BENEFIT	Ð	12.124	3.119				15.283
и. Ч	BRIDGE	UNIT BENEFIT/M/VEH. ( 0.066 x (4) - 0.000351 )	•	0.00012436	0.000 100 44				
2 2 2 2	BENEFIT	BENEFIT ( () x () x ()	Θ	0.213	0.744			1	0.957
	MAINTE- NANCE	UNIT BENEFIT/KM (REF. D.I.9)		-0. 205	-0. 705			1.	1
	COST SAVINGS	BENEFIT (A)x(4))	€.	- 2.389	-0.648				- 3:037
	TOTAL SE	NEFIT		9.948	3, 210	~+b++******************			13.163

### 6) ECONOMIC INDICATOR

TOTAL CONSTRUCT	ON COST (@+@)	69	16
ECONOMIC COST (	48) x 0.831 }	<del>(</del> 9)	/3
B/C RATIO (	⊕/@)		0.
IRR (	REF: D.I - II )		14

#### 7) COMMENT

r	NUMBERS TO THE OP	OF YEARS Ening year		n= ()		
223	AADT IN ( (()x 1.03	PENING YEA	R	3 285		
)						
	[			TOTAL		
			ļ. <u></u>	4		
				•		
				1		
				<u> </u>		
				2.9816		
		· · · · · · · · · · · · · · · · · · ·				
		<u> </u>				
				+		
		 		<u> </u>		
	, 			<u> </u>		
				· <u> </u>		
••				39 2.982		
	<u></u>			- < 782		
~	<i>52</i>		f 15 <mark>11 - Lan</mark> C Weijin and y January ang			
<u>}</u>	×7		<u></u>			
8	6					
8						
	<u></u>					

----

# INPUT DATA SHEET FOR PROJECT EVALUATION

## I. ROAD NAME AND CLASS

ROAD NAME	pa-1				•						
PROVINCE	PANDAN - ST.	A ANA	PROVINCE GR	OUP	A	B	с	p	E	© (	3
ADMINISTRATIVE CLASSIFICATION	I. NATIONAL	Q. PROV	INCIAL	<b>3.</b> B	ARANG	AY					
FUNCTIONAL CLASSIFICATION	1. PRIMARY MAJOR	2. SECO	NDARY MAJOR	3. C	OLLEC	TOR	. (4	) FI	EEDE	ĒR	
PROJECT CLASSIFICATION	I. TRAFFIC PROJECT	(2)DEVEL	OPMENT PROJE	CT .			•				

# 2. ROAD DATA

. ROAD DA	<b>ATA</b>		· · · ·	· · ·		TOTAL LENGTH	1.9 km
0 T 1 T 10 11	FROM	0.00	0.70				
STATION	то	0.70	1.90				
SUBSECTION LE	ENGTH (km.)	0.7	1.2				
SURFACE TYPE (1	PCC/AC/BST/G/E/NONE)	G	G				
SURFACE CONDITI	ON (G/F/B/VB/IMP.)	8	Fi				
POSSIBILITY OF	REHABILITATION	No	1/0				
	(FL/RI/Mt)	F	Ā				
	CARRIAGEWAY (m)	4.0	1.5				
WIDTH	SHOULDER (m)	0.5	0.75				
LENGTH OF	CUT SLOPE (m)						
SLOPE TO BE PROTECTED	EMBANKMENT (m)						
FLOOD	FLOOD DEPTH (m)	<b>—</b>					
SECTION TO BE RAISED	LENGTH (km)						

#### **3. STRUCTURE DATA**

STATION	1.3	19				
TYPE (St/Con/Boil/Tim/Sw/Fd)	Bail	Bail				
LENGTH (m)	16.2	15.5			]	
WIDTH (m)	3.8	3.8				
STRUCTURAL CONDITION (G/F/B/VB)	9	G				
PROPOSED BRIDGE LENGTH (m)	-	÷	· .			

#### 4. TRAFFIC DATA (OMISSIBLE FOR DEVELOPMENT PROJECT)

1.4	PRESENT TRAFFIC	POTENTIAL TRAF- FIC DIVERTED	DATE OF SURVEY	ROAD
CAR/VAN				NAME
JEEPNEY	·····			LENG
BUS.			·	SURFA
TRUCK				SURFA
TOTAL				REMA

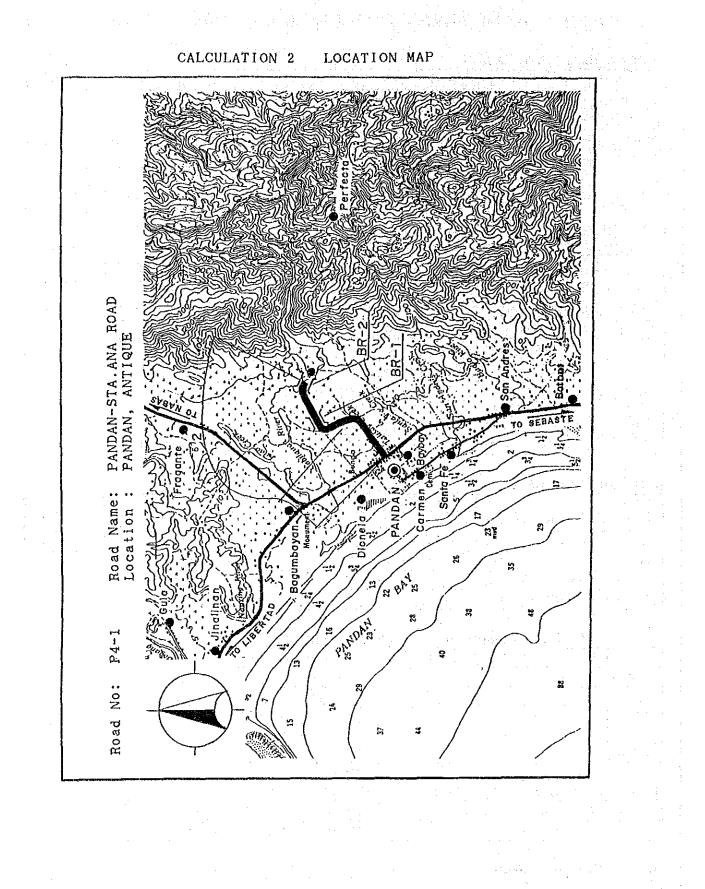
#### FROM WHICH DIVERSION IS EXPECTED ÷ тн (km) ACE TYPE (PCC/AC/BST/G/E) ACE CONDITION (G/F/B/VB) RKS :

#### 5. SOCIO-ECONOMIC DATA ( ONLY FOR DEVELOPMENT PROJECT )

POPULATION WITHIN ROAD INFLUENCE AREA (RIA	6216	POPULATION A. GRADUALLY DECREASING PATTERN DISTRIBUTION B. EVENLY DISTRIBUTING PATTERN
CULTIVATED AREA WITH RIA	580 ha.	PATTERN OT TIP CONCENTRATION PATTERN

#### **6. GENERAL REMARKS**

NOTE : ATTACH MAP INDICATING GENERAL LOCATION OF PROPOSED PROJECT, PREFERABLY IN 1:50,000 TOPOGRAPHIC MAP.



8-6

# PROJECT EVALUATION WORKSHEET (DEVELOPMENT PROJECT)

CALCULATION 2 PROJECT EVALUATION WORKSHEET

#### 1) ROAD NAME AND CLASS NAME OF ROAD PA-1. PANDAN - STA ANA ( PROVINCE GROUP - F ) PROVINCE ANTIQUE FUNCTIONAL CLASSIFICATION (REF. CHAPTER 2) I, PRIMARY MAJOR 2, SECONDARY MAJOR 3. COLLECTOR (. FEEDER)

POPULATION DISTRIBUTION	A : GRADUALLY DECKEASING	H: EVENL
PATTERN	PATTERN	PATTE

#### 3) PROPOSED IMPROVEMENT AND COST (ROAD) SUBSECTION NO. TOTAL 5 1 C 19 1.9 くく LENGTH OF SUBSECTION (KM) 0.7 EXISTING SURFACE TYPE (PAVED/GRAVEL/EARTH/NONE) G G EXISTING SURFACE CONDITION (GOOD/FAIR/BAD/VERY BAD/IMPASSABLE 8 F TERRAIN (FLAT/ROLLING/MOUNTAINOUS) F Fi CUT SLOPE LENGTH (M) SLOPE PROTECTION EMBANKMENT SLOPE LENGTH (M) 0 SPEC FLOOD DEPTH (M) FLOOD SECTION FLOOD SECTION - (H (M) TYPE (PCC/AC/BMP/GRAVEL) ( REF. F .II - 2 ) G G CARRIAGEWAY WIDTH (M) ( REF. F .IL - 2 ) 6 6.0 6.0 <u>қ</u> SHOULDER WIDTH (M) (REF. F .II - 2 ) (6 1.0 1.0 PROP TOTAL WIDTH (M) (2+2 x 3) (1 8.0 8.0 TYPE OF IMPROVEMENT (REHAB./IMPR/ WIDENING/NEW CONST.) (REF. F. 11 - 2) Robal Widen UNIT COST/KM. (REF. F.II-4) 0.714 0.718 ROAD COST (() x(7) (н 0.7998 0.2998 1.3566 UNIT COST/M. (7 ( REF. F.II - 5 ) CUT SLOPE COST (⑦x⑧) (18) SLOPE ROTECTION UNIT COST/M. (19) (REF. F.11-5) H EMBANK G cosT (()) x ()) SLOPE 00 60) UNIT COST/KM. (2.1.976.0)+0.173.(4)-0.850) 61 FLOOD cost (@ x (()) SECTION 62 TOTAL COST (6)+(8)+(2)+(2)) 01.357 0.9998 0.8568

#### NO. OF LANES (24 LENGTH (M) (5) NO. OF SPANS (29 /20 8 ROUND ) UNIT COST/M (REE F.II-7) 60 SUPER-STRUCTURE cos⊤ (@s x @s) શ Ø (MP) UNIT COST/EACH ( REF. F . II-7 ) 68 ABUTMENT COST (@x2) କ୍ଷ COST UNIT COST/EACH 60

	0	PIER	( REF F.II -7 )					
			Cost (3) *(2) -())	9				
		TOTAL	COST 9 + (3))	8				
SPILLWAY	NO	OF LAN	is is					
	LΕ	NGTH (M	)	9				
	COST (MP	UNIT C	0ST/M F .11 - 7 )	છ				
		COST	(3)	<u>55</u>				
	1-1	CELL OR	2-CELL					
	LE (USU	NGTH (M JALLY (M) I	) + 3.0 )	66				
ВC	÷		NIT COST/M EF. F.II-7)	T				
RС	-d-W S	SR C	ost j∫x⊗g)	66				
•	COST	WINGWALL & APRON (REF. F.II-7)		9				
		TOTAL	cost (9)	69				
COST (M++) (@+@+(0))								

#### 5) BENEFIT

	BRIDGE LET	(GTH (M)					
	TRAFFIC	UNIT BENEFIT/KM. 43 (REF. F.II-8)	0.43	0.73			
E F I T	BENEFIT	BENEFIT	0.301	0.516			0.817
	BRIDGE BENEFIT	UNIT BENEFIT/KM. 45 (0.066 x 43-0.000351 x 6)				· ·	
		BENEFIT (6)					 
	DEV'T. Đenefit	CONSTANT "K"	0.000	0.488			
z		UNIT BENEFIT (48) (K10.002613x(4)-000058x(5)) BENEFIT (49)	0.9864	1.1894			
ы co		(48 x(7))	0.6705	1.4273			2.118
	MAINTE- NANCE	UNIT BENEFIT/KM.	- 0.17	-0.17	 •		
	COST SAVINGS	BENEFIT (5) ( 60 x (7)	-0.119	-0.207			658.0-
	TOTAL B	ENEFIT + (49 + (5) )	0.918	1.739			<sup>33</sup> 2.612

#### 6) ECONOMIC INDICATOR

TOTAL CONSTRUC	TION COST (23+4))	53	1.357
ECONOMIC COST	( 🚭 x 0.83) )	G	.1.128
B/C RATIO	(@/@)		5 3 3
IRR	( REF. F .11-13 )		29.8

#### 7) COMMENT

POI	PULATION WITHIN RIA : Pt	0 3,153	TOTAL ROAD	LENGTH : Lt	3 1.1	9 км Р	Lt (3)		5 1659 \$1
ะบา	LTIVATED AREA THIN RIA : At	2 380 HA	At / Lt (2)/(3)		A 3995				6 20.0
POI	PULATION DISTRIBUTION		JALLY DECREAS		ENLY DIST			TIP CONC	ENTRATION
	, , , , , , , , , , , , , , , , , , ,								**************************************
	PROPOSED IMPRO		AND COST	(STRUCT	URE)				
:	SUBSECTION NO. WHERE THE	STRUCTURE							TOTAL
(	EXISTING TYPE (FORD/SPILLWAY/TIMBER/BA	ILEY/OTHER )					1		
	PROPOSED TYPE (RE (2-8R/I-BR/2-SW/I-SW/I-RC								
	NO. OF LANES						1		
	LENGTH (M)	é	9						
	NO. OF SPANS	é	- I				1		
ω	SUPER- (REE F	ST/M (11-7)	5						
œ`	STRUCTURE COST	<b>a</b> ))	Ď					-	
0 B D S D	ABUTMENT COS		8						
		1	9						
	O UNIT CO	.11 - 7 ]	0						
	COST (3) *(@	9°477	D						
	TOTAL COST (27+23+33))	(	3						
-	NO. OF LANES								
SPILLWAY	LENGTH (M)								<u>·</u>
	UNIT COST/M (REF.F.II-7)		\$						
_	8 (€9 x €3 )		9	<del></del>			<u></u>		
	I-CELL OR 2-CELL		2						
	(USUALLY (A) + 3.0)							· [	
כ כי	(REF. F. II-7)							<u>.</u>	
r	Ξ <u>~ (</u> ) × Θ)		9 9						
	WINGWALL & APRON (REF. F.II-7) TOTAL COST		1						
Ċ	(38) + (39)		9					_	41)
ιζ	OST (M+2+) ⊗ + G3 + A9 )								<u> </u>
÷	ECONOMIC INDICA	TOR							
	TOTAL CONSTRUCTION COS	r (@)+@))	53	1.357					
	ECONOMIC COST ( 5 x	0.831 )	G	.1.128	<u> </u>				
	8/C RATIO ( @/(	9 <b>9</b> )		5 4 5					
	IRR (REF. F	·.щ-13)		29.8			<u></u>		
		Oylanci <u>manang</u> yakini yang					<b></b>		
	COMMENT						·	0- <del></del>	
	· · ·								
					i.				
decald									

8-7

#### APPENDIX A

WORKSHEETS, EQUATIONS AND DATA FOR PROJECT EVALUATION IN PROVINCE GROUP - A

PROVINCES : Benguet La Union Bulacan Pampanga Zambales Cavite Laguna

WORKSHEETS, EQUATIONS AND DATA FOR PROJECT EVALUATION IN PROVINCE GROUPE - A

# CONTENTS

A.I	TRAFFIC I		
	WORKSHEE	Τ ••••••••••••••••••••••	-2
	PROPOSED A.I-1 A.I-2	IMPROVEMENT Proposed Pavement Type A Proposed Structure Type A	-3 -4
	CONSTRUC A.1-3 A.1-4 A.1-5 A.1-6	TION COSTS Road Construction Cost A Slope Protection Cost A Additional Cost for Flood Section A Structure Cost A	-7 -7
	BENEFITS A.1-7 A.1-8 A.1-9	Traffic Benefit A Bridge Benefit A Maintenance Cost Savings A	-9
	ECONOMIC A.I-10 A.I-11	INDICATORS B/C Ratio A Internal Rate of Return (IRR) A	-11 -12
A.11		ENT PROJECT	
	WORKSHEE	T ••••••••••••••••••••	-13
	AADT A.II-1	AADT ••••••• A	-14
	PROPOSED A.11-2 A.11-3	IMPROVEMENT Proposed Pavement TypeA Proposed Structure TypeA	-15 -15
	A.II-4	Slope Protection Cost A Additional Cost for Flood Section A	-15 -15
	BENEFITS A.II-8 A.II-9 A.II-10 A.II-11	Traffic Benefit A Bridge Benefit A Development Benefit A Maintenance Cost Savings A	-20 -20
	ECONOMIC A.II-12 A.II-13	INDICATORS B/C Ratio ····· A Internal Rate of Return (IRR) ····· A	-21 -21

			PROJECT	EVALUAT	ION WORK	SHEE	T (TRAFFIC PROJE	CT)			
I) ROAD N	AME AND CLASS	· · · ·			· · · · · · · · · · · · · · · · · · ·	2) A	ADT		· · · ·		
NAME OF ROAD					5	LIGHT VEHICLE ( CAR/VAN/JEEPNEY )	VEH.	*/•	NUMBERS OF YEARS	n=	
PROVINCE		( PROVINCE GROUP - A )			PRESENT	HEAVY VEHICLE (BUS/TRUCK)	VEH 2	PENING	TO THE OPENING YEAR	3	
FUNCTIONAL CLASSIFICATION (REF. CHAPTER 2)		I. PRIMARY MAJOR 2. SECONDARY MAJOR 3. COLLECTOR 4. FEEDEP			a a a	TOTAL	1) vен.	100 %	AADT IN OPENING YEAR {()x 1.03 <sup>n</sup> }	Ľ	
	ED IMPROVEMENT A	ND COST (ROA	D)			4) P	ROPOSED IMPROVEMENT ANI	D COST (STR	DICTURE)		
SUBSECTION					TOTAL	SU	JESECTION NO. WHERE THE STRUCTURE				TOTAL
LENGTH OF	LENGTH OF SUBSECTION (KM)					EX	LOCATED (ISTING TYPE ORD/SPILLWAY/TIMBER/BAILEY/OTHER)	······································			
EXISTING SU	RFACE TYPE	· · · · · · · · · · · · · · · · · · ·				PR	ROPOSED TYPE (REF. A.I - 2) -BR/1-BR/2-SW/1-SW/1-RCBC/2-RCBC)				
	RFACE CONDITION						NO. OF LANES				
YERRAIN	BAD/VERY BAD)						LENGTH (M)				
	CUT SLOPE LENGTH (M)						NO. OF SPANS (23)				
SLOPE	EMBANKMENT SLOPE (6)	······································					UNIT COST/M (3)				
SE FLOOD	LENGTH (M)		· · · · · · · · · · · · · · · · · · ·			ш • о	STRUCTURE COST (@x (2))				
SECTION	FLOOD SECTION (8)	· · · · · · · · · · · · · · · · · · ·					UNIT COST/EACH				
TYPE (PC	LENGTH (M)						E ABUIMENI COST (26)				
( REF. A. CARRIAGE	(-)) WAY WIDTH (M) (9)						UNIT COST/EACH (27)				
없는 ( <u>REF. A.</u> )	(-1) Т WIDTH (М) (Ю)						$\begin{array}{c c} PIER & I(EI, A, I^{T}, G) \\ COST & COST \\ (\mathfrak{O} \times (\mathfrak{O} - 1)) \end{array} $			· · · · · · · · · · · · · · · · · · ·	
TOTAL W	(-1)						TOTAL COST (29 ( 29+20+20)				
(9+2x(	D) MPROVEMENT (REHAB./IMPR./						NO. OF LANES				
	NEW CONST.) (REF. A.I-I)					WAY	LENGTH (M)				
ROAD	UNIT COST/KM. (12) (REF. A.I-3) COST(13)					SPILLWAY	UNIT COST/M (3) E (REF, A.I-6)				
	(@x@) UNIT COST/M (4)						$ \begin{array}{c c}     C \\     $				
-	CUT (REF. A.I-4)			·			I-CELL OR 2-CELL				
SLOPE	SLOPE COST (15) ((A)×(5))						LENGTH (M) (33 (USUALLY (1) + 3.0)				
+	UNIT COST/M (16) EMBANX (REF. A.I-4) SLOPE COST (17)	·····					$ \begin{array}{c}                                     $				
s 0.	(@x@)					U U U					
FLOOD	UNIT COST/KM. (18) (1.976·(7)+0.173·(1)-0.850)		· · · · · · · · · · · · · · · · · · ·				WINGWALL & APRON (36) (REF. A.I-6)				
SECTION	COST (19) ((®)x(8))						((39+(39))				
TOTAL CD ((3)+(5)+(7)	sr )+(9) }				29	(e	st (HP) 9+92+67)		· · · · · · · · · · · · · · · · · · ·		<b>39</b>
5) BENEFI	т. Т					6) E	CONOMIC INDICATOR				
AADT IN OP	ENING YEAR 3					1 (	TAL CONSTRUCTION COST (@+@)	<b>40</b>	, and the second se	an a	and a state of the
PERCENT HE	AVY VEHICLES				······	EC	ONOMIC COST ( ((() x 0.831 )	<u>(49</u>			
9RIDGE LEN (2) + 30 )	IGTH (M) 39					1 6	/C RATIO (		<u> </u>		
	CONSTANT "k" 40						R (REF. A.I - 11)				······
TRAFFIC	( REF. A.I - 7 ) UNIT BENEFIT/KM/VEH. 41 (@ +0.000172 x@)	· · · · · · · · · · · · · · · · · · ·								۵۰۰۰ میں دور و دور وار و دور و دو دور و دور و	<b></b>
BENEFIT	(@ +0.000172 x(2)) BENEFIT ((1) x(4) x(3))					7) C	OMMENT				······································
ш.	((1)x(3)) UNIT BENEFIT/M/VEH. (3) (0.066 x (1) - 0.000351)										
ω BRIDGE BENEFIT	(0.066 x (+) - 0.000351) BENEFIT (((%) x (%) x (3))										
W MAINTE-	UNIT BENEFIT/KM 45				·						
MANCE COST	( REF. A.1-9)	· ···									
SAVINGS TOTAL BE	(65)x(4))										
TOTAL BE	ð)				<u>ľ~</u>				and the second		the second state of the second

### A.I-1 Proposed Pavement Type

Select from Table below.

Road	AADT in	Pavement		Shoulder Width (m)				
Class I	Opening Year	Type	Width(m)	Flat	Roll'g	Mount		
Primary Major	Over 2000 1000-2000 400-1000 200- 400 100- 200 Below 100	PCC 3) AC 3) BMP 2)3) BMP 2)3)	6.7 6.7 6.0 6.0	3.02.52.02.01.51.5	$2.0 \\ 1.5 \\ 1.5 \\ 1.5 \\ 1.0 \\ 1.0 \\ 1.0$	$     \begin{array}{r}       1.5 \\       1.0 \\       1.0 \\       1.0 \\       0.5 \\       0.5 \\       0.5 \\       \end{array} $		
Secondary   Major	Over 2000 1000-2000 400-1000 200- 400 Below 200		6.0 6.0	2.52.52.01.51.0	1.5 1.5 1.5 1.0 0.5	$   \begin{array}{c}     1.0 \\     1.0 \\     1.0 \\     1.0 \\     0.5   \end{array} $		
Collector	Over 400 200- 400 50- 200 Below 50	BMP 2)3) Gravel		$     \begin{array}{r}       1.5 \\       1.5 \\       1.0 \\       1.0 \\       1.0 \\       \end{array} $	$     \begin{array}{r}       1.0 \\       1.0 \\       0.5 \\       0.5 \\     \end{array}   $	$     1.0 \\     1.0 \\     0.5 \\     0.5     $		
Feeder	Over 400 200- 400 50- 200 Below 50	Gravel		$ \begin{array}{c} 1.5\\ 1.0\\ 1.0\\ 0.5 \end{array} $	1.0 0.5 0.5 0.5	0.5 0.5 0.5 0.5		

Pavement Type and Width

Note 1) Where existing pavement type is superior to the one poposed above, use existing type.

- 2) BMP can be replaced by DBST where subgrade and drainage conditions are good. It is, however, recommended to assume BMP for budgetary and evaluation purposes.
  2) Use AC everlagy where existing condition warrants the
- 3) Use AC overlay, where existing condition warrants the use of AC overlay.

Type of Improvement

Existing Surface Type	   	Existing Surface Condition		Existing Carriageway Width	]	Type of Improvement
Standard or Superior	     	Good/Fair Good/Fair Bad/Very bad	-       	Standard Substandard any	     	Widening Rehabilitation
Substandard or Non-existing		Good/Fair Bad/Very bad Impassable		any any any	1	Improvement-2 Improvement-1 New Construction

### A.I-2 Proposed Structure Type

Select from Table below.

Eviating Type	P.	roposed Type
Existing Type	Primary Major   Secondary Major	Collector Feeder
Ford Crossing	·	Carriageway     width of   1-lane Spillway   approach   (1-SW)   road 4.0 m
	(2-BR)     	Carriageway     width of   2-lane Spillway   approach   (2-SW)   road 6.0 m
Spillway	2-lane Bridge (2-BR)	
	2-lane Bridge	AADT < 200   1-lane Bridge 
Timber Bridge     	(2-BR)	AADT > 200   2-lane Bridge   (2-BR)
Bailey Bridge		AADT < 300 I -
	2-lane Bridge   (2-BR)   	AADT > 300   2-lane Bridge 

Note : Use RCBC instead of bridge where length is short and topography is suitable.

## A.I-3 Road Construction Cost

Equation : RCC = RCCu·Ls

where, RCC = road construction cost, in Mp RCCu= unit road construction cost, in Mp/km, given in Table below Ls = subsection length, in km

Unit road construction cost "RCCu", in Mp/km

Type I	Proposed	Carriage-	! Shoulder	Т	errai	
of Improvement		way Width   (m)	Width     (m)	Flat	Rolling	Mountain's
1		4.0	0.5 1 1 1.0 1	1.827	2.050 2.264	2.651
1			1.5	1.936		-
			0.5	-	2.678	3.065 3.200
		6.0		2.651	2.952	-
•			1 2.0 1	2.775	-	-
1			1 2.5 1	2.914		
• 1	PCC		1.0	 -	- 3.142	3.693 3.768
		6.7	1 1.5 I 1 2.0 I	3,100	3.142	3.708
	·		2.5	3,466	-	-
			1 3.0 1	3.712	<b></b>	
			0.5	-		0.923
. · · · · · · · · · · · · · · · · · · ·	l		1 1 0 1	-	0.982	1.481
Rehabilita- I		Widening	1.5     2.0	0.873 1.070	1.892	-
tion/	•		2.5	1.168	· <u></u>	-
  Improvement/	*********		1 0.5 1		1.909	2.516
1		4.0	1 1.0 1	1.677	2,098	
Widening I		 	1.5	1,820		
ſ		l	1 0,5 1	•	-	2.782
1		6.0		2.374	2.364 2.785	2.858
		b.0	1 2.0 1	2,565	-	-
			2.5 1	2,779	-	
· · · ·	AC		1 1.0	-	-	3.369
!	• • • • •		1 1.5 1	~	2.867 3.172	3.483
·		6.7	1 2.0     2.5	2.869 3.108	3.176	-
<b>،</b> ا ب			3.0	3.315		-
ľ			1 0.5 1			0.907
1	··		1 1.0 1	-	0.944	1.478
1		Widening		0.819 1.023	1.416	-
l	· · · · · · · · · · · · · · · · · · ·		1 2.0 1 1 2.5 1	1.106	_	_

-- continued --

Type 1	Proposed	Carriage-	Shoulder	T	errai	n
of   Improvement		way Width (m)	(m)	Flat	Rolling	Mountain'
444 Jan ang ang ang ang ang ang ang ang ang a	**********		0.5		1.334	1,650
1		4.0	1.0	1.199	1.769	-
			1.5	1.237		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Ì			0.5	i –	1.818	2.350
1	DVD	6.0	1.0	1.690	2.084	2.418
1	BMP		1.5	1.744 1.978	2.398	· . · · ·
 Rehabilita-			0.5		0.714	0.879
tenabilita- i	1997 - E. 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 199	Widening		0.592	0.842	1.388
tion/			1.5	0.650	-	-
1			2.0	0.668	-	-
Improvement/		4.0	0.5	0.482	0.511	0.601
Widening !	- 		1.0	0.526		-
*	Gravel		0.5		0.965	1.321
· · ·		6.0	1.0	0.714	1.013	1.510
ľ		l., 1	1.5	0.823	1.045	
l	***		2.0	0.896		-
. 1		4.0	any	1.048	1.048	1.048
1	Overlay		any	1.325	1.325	1.325
		6.7	any	1.505	1.505	1.505
ł	рсс	l. I	1.0	I -	~	4.184
1		6.0	1.5		3,790	
			2.0	1 3.534 1 3.739	-	-
			1.0			
1	· · · · · · · · · · · · · · · · · · ·		1.0		4.040	4.434 5.064
		6.7	2.0	3.781	4.618	-
I			2.5	3.989		<b>-</b> .
]			3.0	4.152		
1		i ji	0.5	-		3.228
			1.0	-	2.900	3.863
i t	1	6.0	1.5 2.0	2.920 3.346	3.484	-
1	· ·	<b>1</b>	2.5	3.630	· ••	-
New I	AC		1.0			4.072
Construc- I			1.5	-	3.690	4.712
1		6.7 1	2.0	3.552	4.281	-
tion		1	2.5 3.0	3.808		-
í		4.0	0.5	- 1.334	1.534	1.815
, 			****			
	BMP		0.5		2.197	2.637
I I		6.0	1.0	2.193	2.758 2.846	3.250
			2.0	2.684	2.040 -	
1		4.0	0.5	0.536	Δ £11	0 719
. 1		<u>.</u>		0.643	0.611	0.713
	Gravel		~~~~~~			0 000
ţ I		6.0	0.5	1,430	1.637 1.772	2.003
		,,,, , , , , , , , , , , , , , , , , ,	1.5	1.553		-

#### A.I-4 Slope Protection Cost

Equation : SPC = SPCC+SPCE

 $SPCC = SPCCu \cdot Lc$  $SPCE = SPCEu \cdot Le$ 

where , SPC = slope protection cost, in Mp SPCC = cut slope protection cost, in Mp SPCE = embankment slope protection cost, in Mp SPCCu= unit cost for cut slope protection, in Mp/m, given in Table below SPCEu= unit cost for embankment slope protection, in Mp/m, given in Table below Lc = length of cut slope to be protected, in m Le = length of embankment slope to be protected, in m

Unit cost for slope protection "SPCCu", "SPCEu", in Mp/m

Item		   U	Init Cost
Cut Slope Protection	"SPCCu"		0.0253
Embankment Slope Protection	"SPCEu"		0.0275

A.I-5

Additional Cost for Flood Section

Equation : FSC = FSCu·Lf FSCu=  $1.976 \cdot Df + 0.173 \cdot Wr - 0.850$ 

where , FSC = additional cost for flood section, in Mp
FSCu= unit additional cost for flood section, in Mp/km
Lf = length of flood section, in km
Df = flood depth, in m
Wr = road width, in m

## A.I-6 Structure Cost

Equation : STC = Bl	RC+SWC+BCC				
SWC = SI	Su•Lss+ABu•Nab+Pl ∜u•Lsw Cu•Lbc+WW	Ru•Npr			
BRC = bi SWC = si	tructure cost, in ridge cost, in My pillway cost, in CBC cost, in Mp	<b>p</b>		an tha an	
ABu = uf $g$ $PRu = uf$ $g$ $Lss = 16$ $Nab = nf$ $Npr = nf$ $SWu = uf$ $g$ $Lsw = 16$ $BCu = uf$ $Lbc = 16$ $us$ $WW = co$	nit cost of super iven in Table beh nit cost of abutr iven in Table beh nit cost of pier iven in Table beh ength of superstr imber of abutmen imber of piers nit cost of spill iven in Table beh ength of spillway hit cost of RCBC, in sually road width ost for wingwall ides total), give	low hent, in My low low ucture, in ts lway, in My low y, in m , in Mp/m, h plus 3.0 and apron	p/each, ch, n m p/m, given in m , in Mp,	n Table be	low
Unit cost "SSu","AI			1. A		
Type of Structure	Item		Unit Co	$\mathbf{s} \mathbf{t}_{1}$	
2-lane Bridge	Abutment	"SSU" i "ABu" !	0.0478	Mp/m Mp/each	
1-lane Bridge	Superstructure Abutment Pier	"SSu"   "ABu"   "PRu"	$0.0357 \\ 0.2530$	Mp/m Mp/each Mp/each	
2-lane Spillway	Spillway	"SWu"	0.0182	Mp/m	
1-lane Spillway	Spillway	"SWu"	0.0132	Mp/m	
1-cell RCBC	RCBC Wingwall/Apron	"BCu"   "WW "	0.0227 0.1452		
2-cell RCBC	RCBC	"BCu"	0.0396	Mp/m	

A-8

| Wingwall/Apron "WW " | 0.1705 Mp/set

\_\_\_\_\_\_\_\_\_\_

#### A.I-7 Traffic Benefit

Equation : TRB = TRBu·Ls·VEH TRBu= k+0.000172·HV

where ,		traffic benefit, in Mp unit traffic benefit, in Mp/km/veh
	Ls =	subsection length, in km
	VEH =	AADT, in veh
	HV =	percent heavy vehicles, in %
	k =	constant, given in Table below

Constant "k"

			~	
Proposed   Pavemrnt	Existing Surface Type and Condition		Terrain	
Type	Type and condition	Flat	Rolling	Mountain's
PCC/AC	Paved - Bad Paved - Very Bad Gravel- Good/Fair Gravel- Bad Gravel- Very Bad Earth - Bad Earth - Very Bad	.00465 .00884 .00573 .00592 .00885 .01277 .01771	.00414 .00832 .00522 .00541 .00834 .01226 .01720	.00440 .00859 .00548 .00567 .00860 .01252 .01746
BMP/DBST	Paved - Bad Paved - Very Bad Gravel- Good/Fair Gravel- Bad Gravel- Very Bad Earth - Bad Earth - Very Bad	.00333 .00752 .00442 .00461 .00753 .01145 .01639	.00282 .00701 .00390 .00409 .00702 .01094 .01588	.00308 .00727 .00416 .00436 .00728 .01120 .01614
Gravel   	Gravel- Bad Gravel- Very Bad Earth - Bad Earth - Very Bad	.00422 .00715 .01107 .01601	.00371 .00663 .01055 .01550	.00397 .00690 .01082 .01576

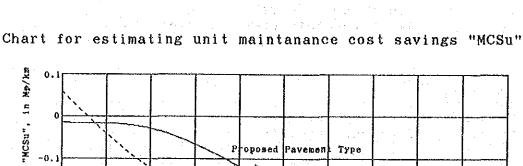
A.I-8 Bridge Benefit

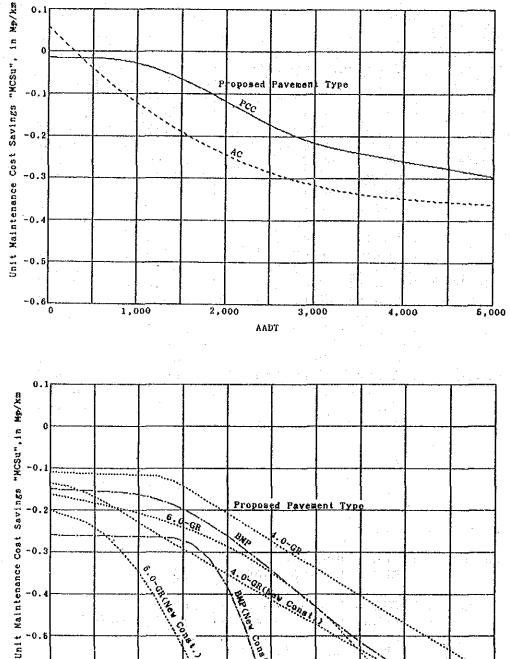
Equation : BRB = BRBu·Lb·VEH BRBu= 0.0660·TRBu-0.000351 where, BRB = bridge benefit, in Mp BRBu= unit bridge benefit, in Mp/m/veh Lb = bridge length, in m VEH = AADT, in veh TRBu= unit traffic benefit, in Mp/km/veh, obtained from A.I-7

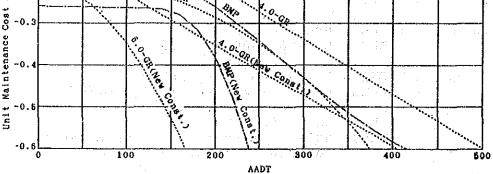
#### A.I-9 Maintenance Cost Savings

Equation :  $MCS = MCSu \cdot Ls$ 

where , MCS = maintenance cost savings, in Mp MCSu= unit maintenance cost savings, in Mp/km, given in Chart below = subsection length, in km Ls







#### A.I-10 B/C Ratio

Equation : BC = TB/EC

TB = TRB+BRB+MCSEC = 0.831.TC TC = RCC+SPC+FSC+STC

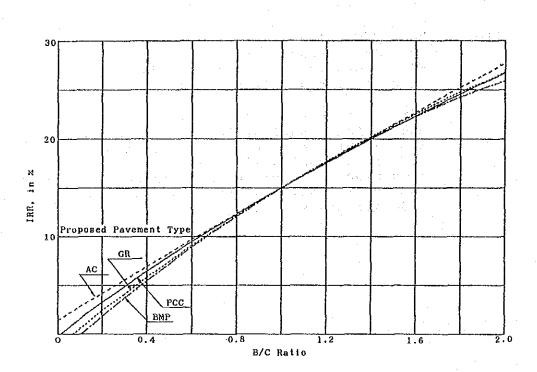
Where , BC = B/C ratio TB = total benefit, in Mp EC = economic total cost, in Mp TC = total cost, in Mp TRB= traffic benefit, in Mp BRB= bridge benefit, in Mp MCS= maintenance cost savings, in Mp RCC= road construction cost, in Mp SPC= slope protection cost, in Mp FSC= additional cost for flood section, in Mp STC= structure cost, in Mp

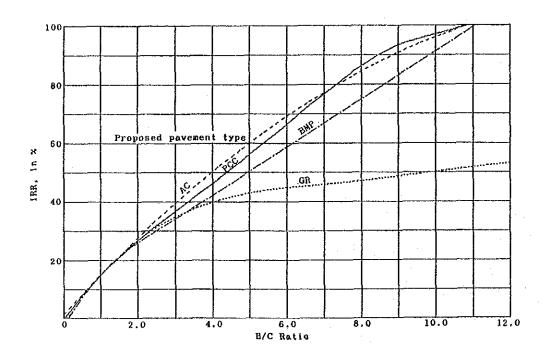
A-11

### A.I-11 Internal Rate of Return (IRR)

Obtain from Chart below.

ę.





A-12

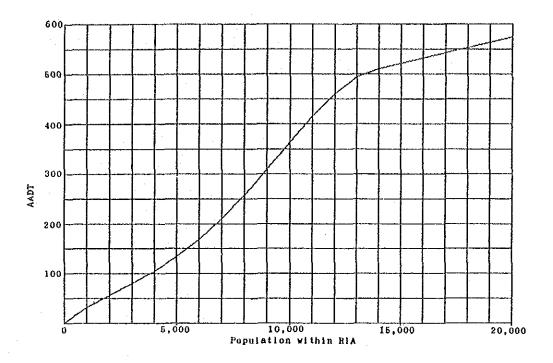
## PROJECT EVALUATION WORKSHEET (DEVELOPMENT PROJECT)

Interd         (Introduced anough - A)         (Introduced anough - A)           1. PERIORAN DALASTICATION         1. PERIADA MANDE 2. SECONDARY MANDE 3. OLICETOR 4. PEEDER         PEEDER           3.1. PEROPOSED MEROVEMENT AND COST (ROAD)         Introduced anough - A)         Introduced anough - A)         PEEDER           Juberstroad         Introduced anough - A)         Introduced anough - A)         Introduced anough - A)         PEEDER           Juberstroad         Introduced anough - A)         Introduced anough - A)         Introduced anough - A)         PEEDER           Juberstroad         Introduced anough - A)         Introduced anough - A)         Introduced anough - A)         PEEDER           Juberstroad         Introduced anough - A)         Introduced anough - A)         Introduced anough - A)         PEEDER           Juberstroad         Introduced anough - A)         Introduced anough - A)         Introduced anough - A)         Introduced anough - A)           Introduced anough - A)         Introduced anough - A)         Introduced anough - A)         Introduced anough - A)         Introduced anough - A)           Introduced anough - A)         Introduced anough - A)         Introduced anough - A)         Introduced anough - A)         Introduced anough - A)           Introduced anough - A)         Introduced anough - A)         Introduced anough - A)         Introduced anough - A		NAME AND CLASS					2) SOCIO-ECONOMIC DATA AND AADT	P
Image: Control of the second of the		ROAD		·			POPULATION WITHIN RTA : Pt	: Lt
(287 C GAPT/S 1)         (287 C GAPT/S 1)								B; EVEN
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	PROPOS	SED IMPROVEMENT A	ND COST (ROAD	)				RUCTU
Image: control terms introd	SUBSECTION							· .
Im Web 2 # 60000000000000000000000000000000000	LENGTH OF	F SUBSECTION (KM)				3	(FORD/SPILLWAY/TIMBER/BAILEY/OTHER)	
I dead pranty abover the doublewised all in the doublewised	(PAVED/GRA	AVEL/EARTH/NONE)						
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St.         TOTE (FOC/AP MARY GRAVEL)         Image: All - 2 intervent (M)         Image: All - 2 intervent (M	SECTION	FLOOD SECTION (I) LENGTH (M)					C ≥ ABUTALENT (REF. A. 11-7)	
Babe         Contraction         Contraction <th< td=""><td>TYPE (PC</td><td>CC/AC/BMP/GRAVEL )</td><td></td><td></td><td></td><td></td><td></td><td></td></th<>	TYPE (PC	CC/AC/BMP/GRAVEL )						
Bit Status         Sta		EWAY WIDTH (M) (12)	· · · · · · · · · · · · · · · · · · ·				PIFR (REF A.II-7)	
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ROAD         UNIT COST/KM.         (m)           (a, R, A, 11-4)         (b, R, C, A, 11-4)         (c, R, L)           (a, R, C, A, 11-4)         (c, R, L)         (c, R, L)         (c, R, L)           (a, R, L)         (c, R, L)         (c, R, L)         (c, R, L)         (c, R, L)           (a, R, L)         (c, R, L)           (a, R, L)         (c, R, L)         (c, R, L)         (c, R)         (c, R)         (c, R)         (c, R)           (a, R)         (c, R)         (c, R)         (c, R)         (c, R)         (c, R)         (c, R)           (a, R)         (c, R)         (c, R)         (c, R)         (c, R)         (c, R)         (c, R)           (a, R)         (c, R)         (c, R)         (c, R)         (c, R)         (c, R)         (c, R)           (a, R)         (c, R)           (b, R)         (c, R)				<u> </u>				
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SLOPE       ((0) + (0))       ((0) + (0))       ((0) + (0))       ((0) + (0))         PROTECTION       BMANK       (REF, A,11:5)       ((0) + (0))       ((0) + (0))         Image: Stope (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (0) = (	Ē	SLOPE COST (18)						
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TOTAL_COST       COST (M**)         (@ + @ + & + @ )       ()         5) BENEFIT       ()         BRIDGE LENGTH (M)       ()         (@ + @) + () + ()       ()         (@ + @) + () + ()       ()         (@ + () + ())       ()         ()       ()         ()       ()         ()       ()         ()       ()         ()       ()         ()       ()         ()       ()         ()       ()         ()       ()         ()       ()         ()       ()         ()       ()         ()       ()         ()       ()         ()       ()         ()       ()         ()       ()         ()       ()         ()       ()         ()       ()         ()       ()         ()       ()         ()       ()         ()       ()         ()       ()         ()       ()         ()       ()         ()       ()		(1.976 · (0) +0.173 · (4) -0.850 )					Q (REF. A.II~7)	
5) BENEFIT       BRIOGE LENTH (M)       G2       (2) + (3)       (2) + (4)       (3)         Image: transformed construction cost (2) + (4)       (3)       (3)       (3)       (4)         Image: transformed construction cost (2) + (4)       (3)       (3)       (4)       (4)         Image: transformed construction cost (3)       (4)       (4)       (4)       (4)       (4)         Image: transformed construction cost (4)       (4)       (4)       (4)       (4)       (4)       (4)         Image: transformed construction cost (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (4)       (							(69 + 69 )	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	((6) + (8)	+ 8 + 2 )		. <u>]</u>		P		
Image: Construction cost (2) + (3)       Image: Construction cost (2) + (4)       Image: Construction cost (2) + (4)         Image: Construction cost (2) + (4)       Image: Construction cost (2) + (4)       Image: Construction cost (2) + (4)         Image: Construction cost (2) + (4)       Image: Construction cost (2) + (4)       Image: Construction cost (2) + (4)         Image: Construction cost (2) + (4)       Image: Construction cost (2) + (4)       Image: Construction cost (2) + (4)         Image: Construction cost (2) + (4)       Image: Construction cost (2) + (4)       Image: Construction cost (2) + (4)         Image: Construction cost (2) + (4)       Image: Construction cost (2) + (4)       Image: Construction cost (2) + (4)         Image: Construction cost (2) + (4)       Image: Construction cost (2) + (4)       Image: Construction cost (2) + (4)         Image: Construction cost (2) + (4)       Image: Construction cost (2) + (4)       Image: Construction cost (2) + (4)         Image: Construction cost (2) + (4)       Image: Construction cost (2) + (4)       Image: Construction cost (2) + (4)         Image: Construction cost (2) + (4)       Image: Construction cost (2) + (4)       Image: Construction cost (2) + (4)         Image: Construction cost (2) + (4)       Image: Construction cost (2) + (4)       Image: Construction cost (2) + (4)         Image: Construction cost (2) + (4)       Image: Construction cost (2) + (4)       Image: Construle cost (2) + (4)							6) ECONOMIC INDICATOR	
TRAFF/C       (REF, A, [1]*8)         BENEFIT       BENEFIT         BENEFIT       BENEFIT/KM.         BRIDGE       (0.066 x (3)*0.000351 x (6))         BENEFIT       BENEFIT         BENEFIT       (REF, A, [1]-13.)         DEV'T.       UNIT BENEFIT         BENEFIT       (REF, A, [1]-13.)         BENEFIT       (REF, A, [1]-13.)         BENEFIT       (REF, A, [1]-13.)         MAINTE-       (REF, A, [1]-13.)	BRIDGE LE ( (2) + (3) )						TOTAL CONSTRUCTION COST ( 2 + 4) )	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		(REF. A.II-8)					ECONOMIC COST ( ( x 0.831 )	
BRIDGE BENEFIT     IO.066 x (43-0.000351 x (6))       BENEFIT     BENEFIT       U     CONSTANT "K"       U     CONSTANT       U     BENEFIT       U     GO	BENEFIT	$(63) \times (7)$					B/C RATIO (@/@)	
Image: Hear of the second system         BENEFIT         BENEFIT         BENEFIT         Generation         The second system         The second system <thte second="" system<="" th="">         The second system</thte>	BRIDGE	UNIT BENEFIT/KM. (5)					JRR (REF. A.II-13)	
L U Z DEV'T. BENEFIT W MAINTE- UNIT BENEFIT M MAINTE- UNIT BENEFIT M MAINTE- UNIT BENEFIT M MAINTE- UNIT BENEFIT (K+0.0000581x(4)-0.000013x(5)) M M M M M M M M M M M M M		BENEFIT 46						
z         DEV'T. BENEFIT         UNIT BENEFIT (K+0.000581x(-0.000013x(5)))           w         BENEFIT         (48)           a         (48) x(7)         (49)           MAINTE-         UNIT BENEFIT/KM.         60)		CONSTANT "K" 47	·····				7) COMMENT	
W         BENEFIT         49           0         (43 x(7))         (43 x(7))           MAINTE-         UNIT BENEFIT/KM.         60	DEV'T.	UNIT BENEFIT (K+0.000581x(4)-0.000013x(5))						
MAINTE- UNIT BENEFIT/KM. 60	ш							
NANCE (REF. A.II-II)	MAINTE							
COST BENEFIT (1) SAVINGS (60 x (7))	COST							
TOTAL BENEFIT ( + + + + + + + + + + + + + + + + + + +	TOTAL B					62		

Lt	3	KM	Pt/Lt (()/(3))			5
	9		AADT (REF. A.I	.1 - 1 )		6
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### A.II-1 AADT

Obtain from Chart below.



A-14

- A.II-2 Proposed Pavement Type Apply A.I-1.
- A.II-3 Proposed Structure Type Apply A.I-2.
- A.II-4 Road Construction Cost Apply A.I-3.
- A.II-5 Slope Protection Cost Apply A.I-4.
- A.II-6 Additional Cost for Flood Section Apply A.I-5.
- A.II-7 Structure Cost

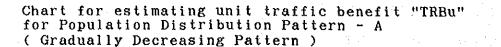
Apply A.1-6.

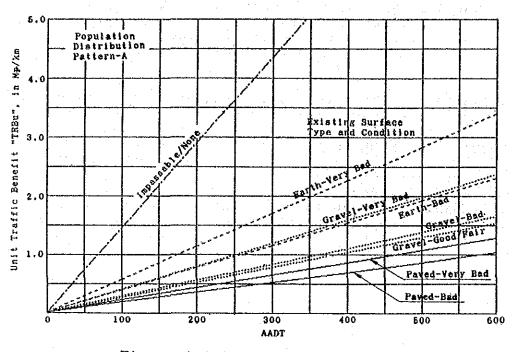
#### A.II-8 Traffic Benefit

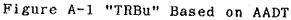
Equation : TRB = TRBu·Ls

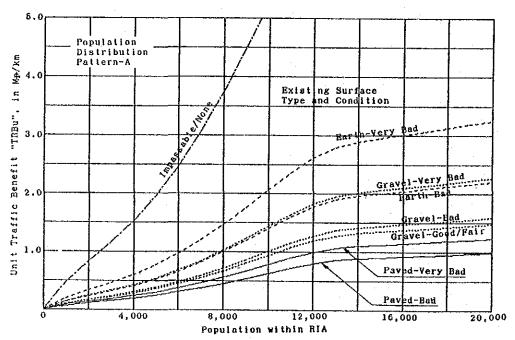
where , TRB = traffic benefit, in Mp TRBu= unit traffic benefit, in Mp/km, given in Chart below Ls = subsection length, in km

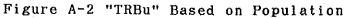
#### A-16

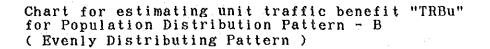


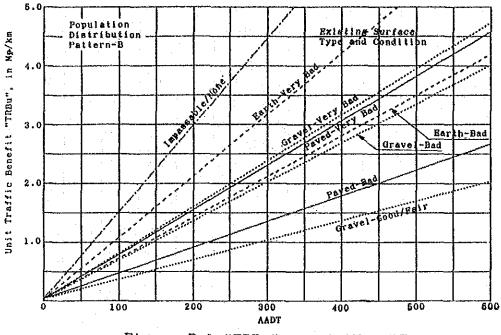


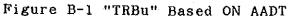


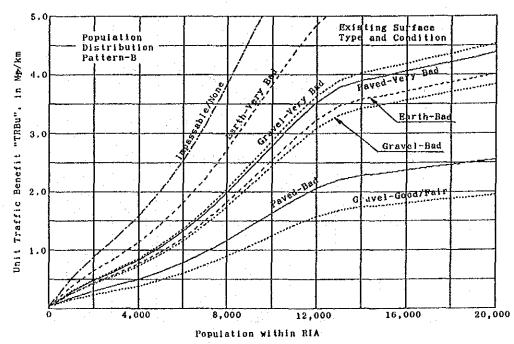


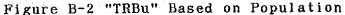






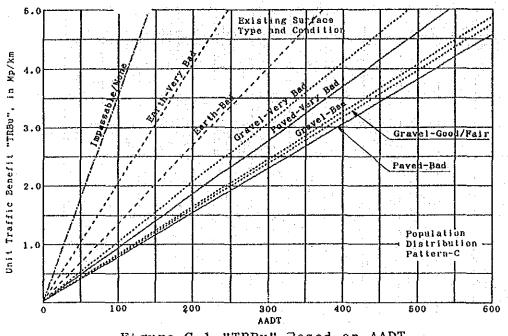


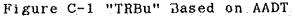


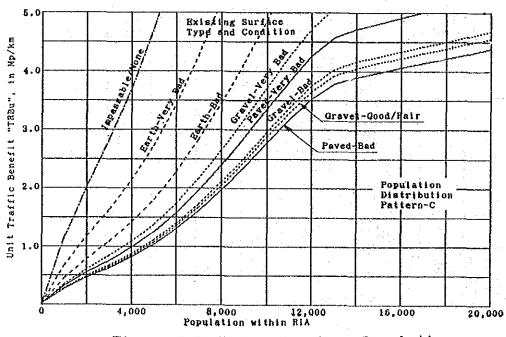


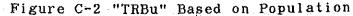
A-18

Chart for estimating unit traffic benefit "TRBu" for Population Distribution Pattern - C ( Tip Concentration Pattern )









#### A.II-9 Bridge Benefit

Equation : BRB = BRBu·Lb BRBu= 0.0660·TRBu-0.000351·VEH where , BRB = bridge benefit, in Mp BRBu= unit bridge benefit, in Mp/m Lb = bridge length, in m TRBu= unit traffic benefit, in Mp/km, obtained from A.II-8 VEH = AADT, in veh

A.II-10

Development Benefit

	= DVBu·Ls = k+0.000581·At/Lt-0.000013·Pt/Lt
 DVBu k At Pt Lt	<pre>= development benefit, in Mp = unit development benefit, in Mp/km = constant, given in Table below = total cultivated area within RIA, in ha = total population within RIA, in person = total road length, in km = subsection length, in km</pre>

Existing Surface Type and Condition			Terrain	
		Flat	Rolling	Mountain's
Paved - Bad		.1281	.1554	.1340
Paved - Very Bad	1	.1840	.2114	.1899
Gravel- Good/Fair	1	.0137	.0410	.0195
Gravel- Bad	1	0152	.0122	0093
Gravel- Very Bad	1	.0019	.0292	.0077
Earth - Bad	1	.0215	.0488	.0274
Earth - Very Bad	ł	.0583	.0856	.0642
Any - Impassable/	1			
Non-exist'g		.1048	.1321	.1107

A.II-11 Maintenance Cost Savings

Apply A.I-9.

#### A.II-12 B/C Ratio

Equation : BC = TB/EC ΤB = TRB+BRB+DVB+MCS EC  $= 0.831 \cdot TC$ TC = RCC+SPC+FSC+STC where, BC = B/C Ratio TB = total benefit, in Mp EC = economic total cost, in Mp TC = total cost, in MpTRB = traffic benefit, in Mp BRB = bridge benefit, in Mp DVB = development benefit, in Mp MCS = maintenance cost savings, in Mp RCC = road construction cost, in Mp SPC = slope protection cost, in Mp FSC = additional cost for flood section, in Mp STC = structure cost, in Mp

#### A.II-13 Internal Rate of Return (IRR)

Apply A.I-11.

#### APPENDIX B

WORKSHEETS, EQUATIONS AND DATA FOR PROJECT EVALUATION IN PROVINCE GROUP - B

PROVINCES : Bataan

Rizal

WORKSHEETS, EQUATIONS AND DATA FOR PROJECT EVALUATION IN PROVINCE GROUPE - B

## CONTENTS

B.I	TRAFFIC PROJECT					
·	WORKSHEET	<b>F</b> ••••••••••••••••••••••••••••••••••••	B-2			
	PROPOSED B.I-1 B.I-2	IMPROVEMENT Proposed Pavement Type Proposed Structure Type	B-3 B-4			
	CONSTRUCT B.I-3 B.I-4 B.I-5 B.I-6	FION COSTS Road Construction Cost Slope Protection Cost Additional Cost for Flood Section Structure Cost	B-7 B-7			
	BENEFITS B.I-7 B.I-8 B.I-9	Traffic Benefit Bridge Benefit Maintenance Cost Savings	B-9			
	ECONOMIC B.I-10 B.I-11	INDICATORS B/C Ratio Internal Rate of Return (IRR)	B-11 B-12			
B.II		ENT PROJECT				
	WORKSHEE	ſ ····	B-13			
	AADT B.II-1	AADT	B-14			
	PROPOSED B.II-2 B.II-3	IMPROVEMENT Proposed Pavement Type Proposed Structure Type	B-15 B-15			
	B.II-4	TION COSTS Road Construction Cost Slope Protection Cost Additional Cost for Flood Section Structure Cost	B-15 B-15			
	BENEFITS B.II-8 B.II-9 B.II-10 B.II-11	Traffic Benefit Bridge Benefit Development Benefit Maintenance Cost Savings	B-20 B-20			
	ECONOMIC B.II-12 B.II-13	INDICATORS B/C Ratio Internal Rate of Return (IRR)	B-21 B-21			

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	PROJEC	CT EVALUATIC	N WORK	(SHEET (TRAFFIC PROJECT)	
) ROAD NAME AND CLASS	a da mada mana mana ang mana m			2) AADT	
NAME OF ROAD	· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·		LIGHT VEHICLE (CAR/VAN/JEEPNEY) VEH. % NUMBERS OF YEARS	η°
PROVINCE		( PROVI	NCE GROUP - B )	HEAVY VEHICLE (BUS/TRUCK) VEH. 2 % UNMBERS OF YEARS HEAVY VEHICLE (BUS/TRUCK) VEH. 2 % UNMBERS OF YEARS TO THE OPENING YEAR TOTAL 1 VEH. 100 % (Dx 103 P)	3
FUNCTIONAL CLASSIFICATION (REF. CHAPTER 2)	I. PRIMARY MAJOR 2. SECONDARY MA	OR 3. COLLECTOR 4.	FEEDER	TOTAL UVEH. 100 % OF (1)x 1.03 ")	
I PRADACE MODOUCHENT A		· · · · ·	- - -	A) BRABACCD WERDOWENENT AND COST (ATDUCTURE)	
SUBSECTION NO.	ND COST (ROAD)		TOTAL	4) PROPOSED IMPROVEMENT AND COST (STRUCTURE) SUBSECTION NO. WHERE THE STRUCTURE	τοτα
LENGTH OF SUBSECTION (KM)				EXISTING TYPE	
EXISTING SURFACE TYPE				(FORD/SPILLWAY/TIMBER/BAILEY/OTHER) PROPOSED TYPE (REF. B.I-2)	
(PAVED/GRAVEL/EARTH) EXISTING SURFACE CONDITION				(2-BR/I-BR/2-SW/I-SW/I-RCBC/2-RCBC)	
(GOOD/FAIR/BAD/VERY BAD) TERRAIN				LENGTH (M)	
(FLAT/ROLLING/MOUNTAINOUS)				NO. OF SPANS (22)	
12 PROTEOTION				(2)/20 & ROUND ) UNIT COST/M (23) SUPER (REF. B.I-6)	
LENGTH (M)				- w SUPER (REF. 6.1-6) σ STRUCTURE COST (@)	
SECTION   FLOOD SECTION (8)		·			
LENGTH (M)				D E ABUTMENT COST (6)	
( REF. B. I -   ) CARRIAGEWAY WIDTH (M) (9)				UNIT COST/EACH (2)	
I(REF. B.I-I)           SHOULDER WIDTH         (M)         (0)           (REF. B.I-I)         TOTAL WIDTH         (M)         (I)           TOTAL WIDTH         (M)         (I)         (I)				$- \begin{array}{c} O \\ Pier \\ Cost \\ (O \times (Q-1)) \end{array} $	-
(REF. B.I+1) ↓ TOTAL WIDTH (M)				TOTAL COST (2)	
()+2 x () }				NO. OF LANES	1
WIDENING/NEW CONST.) (REF. B. 1-1) UNIT COST/KM. (12)				LENGTH (M) (30 LENGTH (M) (30 LENGTH (M) (31) LENGTH (M) (31) LENGTH (M) (31) LENGTH (M) (31) LENGTH (M) (30) LENGTH (M) (M) (30) LENGTH (M)	
ROAD (REF. B.I - 3)	· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·		$ \begin{array}{c c} - & & \\ \hline & & \\ \hline & & \\ \hline & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ & & \\ $	
((2)×(4)) UNIT COST/M (14)				S         COST         33           3         (③)x (④)         (③)	
CUT (REF. B.I-4) SLOPE COST (5)				I-CELL OR 2-CELL	
E SLOPE ((A)x(5)) PROTECTION UNIT COST/M (6)	······			LENGTH (M) (USUALLY (II) + 3.0 )	
SLOPE COST (17)				$ \begin{array}{c}                                     $	
C ((6x(6)) UNIT COST/KM. (18)					
FLOOD (1.976 (7)+0.173 (1)-0.850)				WINGWALL & APRON (36) (REF. B.1-6) TOTAL COST (37)	
((B)x (B))		·····	23		
TOTAL COST (③+⑥+(⑦+(⑨)				COST (MF) (@+@+窃)	<b>9</b> 9
) BENEFIT				6) ECONOMIC INDICATOR	
AADT IN OPENING YEAR (3) (3)				TOTAL CONSTRUCTION COST (@+3)	
PERCENT HEAVY VEHICLES (2)				ECONOMIC COST ( 188 x 0.831 )	
BRIDGE LENGTH (M) (9 (2) + 60 )	· · · · · · · · · · · · · · · · · · ·			B/C RATIO (1)/19)	
CONSTANT "k" (0) ( REF. B.I-7 )				IRR (REF. B.I - 11)	
TRAFFIC UNIT BENEFIT/KM/VEH. 41 BENEFIT (40 +0.000133 x 2)				-	
BENEFIT (100 + 0.000133 x (2)) BENEFIT (2) ((1)x(4)x(3))				7) COMMENT	
UNIT BENEFIT/M/VEH. (43)					
ω BRIDGE (0.066 x (4) - 0.000351) BENEFIT BENEFIT ((Φ) x (Φ) x (3))			· · · ·		
MAINTE- UNIT BENEFIT/KM (5					
MANCE     (REF. B.I-9)       COST     BENEFIT       SAVINGS     ((3)x(4))					
TOTAL BENEFIT			<del>1</del> 9		
(段+码+码)	·····	······································	~~~~~		

#### B.I-1 Proposed Pavement Type

Select from Table below.

Pavement Type and Width

Road Class	AADT in     Opening	Pavement Type	Carri- ageway			h (m)
VIASS	Year		Width(m)			Mount
Primary Major	Over 2000 1000-2000 400-1000 200- 400 100- 200 Below 100	PCC       3)         PCC       3)         AC       3)         BMP       2)3)         BMP       2)3)	6.7 6.7 6.0 6.0	$\begin{array}{r} 3.0 \\ 2.5 \\ 2.0 \\ 2.0 \\ 1.5 \\ 1.5 \\ 1.5 \end{array}$	$2.0 \\ 1.5 \\ 1.6 \\ 1.5 \\ 1.0 \\ 1.0 \\ 1.0$	$     \begin{array}{r}       1.5 \\       1.0 \\       1.0 \\       1.0 \\       0.5 \\       0.5 \\     \end{array} $
Secondary Major	Over 2000 1000-2000 400-1000 200- 400 Below 200	PCC 3) AC 3) BMP 2)3)	6.0 6.0 6.0	2.52.52.01.51.0	$   \begin{array}{r}     1.5 \\     1.5 \\     1.5 \\     1.0 \\     0.5 \\   \end{array} $	$1.0 \\ 1.0 \\ 1.0 \\ 1.0 \\ 0.5$
Collector	Over 400 200- 400 50- 200 Below 50	BMP 2)3) Gravel	6.0 6.0 4.0	1.5 1.5 1.0 1.0	$     \begin{array}{r}       1.0 \\       1.0 \\       0.5 \\       0.5 \\     \end{array} $	1.0 1.0 0.5 0.5
Feeder	Over 400 200- 400 50- 200 Below 50	AC 3) BMP 2)3) Gravel	6.0 6.0 4.0	1.51.01.00.5	1.0 0.5 0.5 0.5	0.5 0.5 0.5 0.5 0.5

Note 1) Where existing pavement type is superior to the one poposed above, use existing type.

- 2) BMP can be replaced by DBST where subgrade and drainage conditions are good. It is, however, recommended to assume BMP for budgetary and evaluation purposes.
- 3) Use AC overlay, where existing condition warrants the use of AC overlay.

Type of Impro	ve	ment				
Existing Surface Type		Existing Surface Condition	   	Existing Carriageway Width	   	Type of Improvement
Standard or Superior	     	Good/Fair Good/Fair Bad/Very bad	       	Standard Substandard any	     	Widening Rehabilitation
Substandard or Non-existing		Good/Fair Bad/Very bad Impassable		any any any		Improvement-2 Improvement-1 New Construction

#### B.I-2 Proposed Structure Type

Select from Table below.

Eviating Tuno	Proposed Type						
Existing Type	Primary Major Secondary Major						
		Carriageway     width of   1-lane Spillway   approach   (1-SW)   road 4.0 m					
Ford Crossing         		Carriageway   width of   2-lane Spillway approach   (2-SW) road 6.0 m					
Spillway	2-lane Bridge (2-BR)	_					
	2-lane Bridge	AADT < 200   1-lane Bridge   (1-BR)					
Timber Bridge     	(2-BR)	AADT > 200   2-lane Bridge   (2-BR)					
Bailey Bridge		AADT < 300					
	2-lane Bridge (2-BR)	AADT > 300   2-lane Bridge   (2-BR)					

Note : Use RCBC instead of bridge where length is short and topography is suitable.

B-4

## B.I-3 Road Construction Cost

Equation : RCC = RCCu·Ls

where, RCC = road construction cost, in Mp RCCu= unit road construction cost, in Mp/km, given in Table below Ls = subsection length, in km

Type	Proposed	Carriage-	Shoulder     Width	T	erraiı	1
of Improvement		way Width (m)		Flat	Rolling	Mountain's
an in the set of the ter set die of an 68 mi		4.0	0.5	1.827 1.936	2.050 2.264	2.651
		6.0	0.5 1.0 1.5 2.0 2.5	- 2.651 2.776 2.914	2.678 2.952 -	3.065 3.200 - - -
	PCC	6.7	$ \begin{array}{c} 1.0\\ 1.5\\ 2.0\\ 2.5\\ 3.0\\ \end{array} $	3.100 3.466 3.712	3.142 3.476 -	3.693 3.768 - - -
Rehabilita- tion/		Widening	$\begin{array}{c} 0.5 \\ 1.0 \\ 1.5 \\ 2.0 \\ 2.5 \end{array}$	0.873 1.070 1.168	0.982 1.892	0.923 1.481
Improvement/ Widening		4.0	0.5 1.0 1.5	1.677 1.820	1.909 2.098	2.516
		6.0	0.5 1.0 1.5 2.0 2.5	2.374 2.565 2.779	2.364 2.785 -	2.782 2.858 - - -
	AC	6.7	1.0 1.5 2.0 2.5 3.0	2.869 3.108 3.315	2.867 3.172 -	3.369 3.483 - - -
		Widening	0.5 1.0 1.5 2.0 2.5	- 0.819 1.023 1.106	0.944 1.416	0.907 1.478 

-- continued --

Туре	Proposed	Carriage-	Shoulder	T	errain	
of Improvement		l way Width   (m)		Flat	Rolling	Mountain
			0.5		$\begin{array}{r} \textbf{1.334} \\ \textbf{1.769} \end{array}$	1.650
1		4.0	1 1.0		1.769	-
	·	leg el 1919 - 1929 - l <b></b>	1.5	1.237		**
1		ĺ	0.5	-	1.818 2.084	2.350
	BMP	6.0	1.0	1.690	2.084	
	1941		2.0	1.978		
ehabilita- 1	· · ·	 	0.5		0.714	0.879
ng sa sa <b>t</b>		Widening.	1.0	0.592	0.842	1.388
ion/		1	1.5	0.650		-
mprovement/						
idening		4.0	1 0.5	0.482	0.511	0.601
Idening		******				
1	Gravel	1 6.0	0.5	0.714	0.965	1.321
		0.0		0.823	1.013 1.045	1.510
1			2.0	0,896		-
	**********	4.0		1.048	1.048	1.048
1	Overlay	6.0	l any i	1.325	1.325	1.325
		6.7	l any	1.505	1.505	1.505
1	PCC			- :		4.184
1		6.0	1.5	3.534	3.790	-
			2.5	3.739	· _ ·	<u> </u>
1			1.0			4.434
1			1.5	-	4.040	5.064
1		6.7	2.0 2.5	3.781	4.618	<u> </u>
i			3.0	4.152	-	
1			0.5			3.228
. 1			1.0	<b>–</b> '	2.900	3.863
· 1		6.0	1.5	2.920	3.484	-
. 1	1		2.5	$3.346 \\ 3.630$	-	-
New I	AC		1.0			4.072
Construc- I	1		1.5	· - ·	3.690	4.072
ł		6.7	2.0	3.552	4.281	-
tion   			2.5	3.808 4.007	-	-
ļ					1 204	
		4.0	0.5	1.334	1.534	1.815
	סעס		0.5		2.197	2.637
	BMP	6.0		2.193	2.758	2.037 3.250
l			1.5	2.598	2.846	
		  '	2.0	2.684	·~ . 	
		4.0	.0.5	0.536	0.611	0.713
1	Gravel		1.0	0.643		·
i i	G. 4701		0.5	_	1.637	2.003
1	1	6.0	1.0	1.430	1.772	<b>-</b> ,

#### B.I-4 Slope Protection Cost

Equatio	n :	SPC =	SPCC+SPCE
н. Н			SPCCu·Lc SPCEu·Le
wher	е,	SPCC =	slope protection cost, in Mp cut slope protection cost, in Mp embankment slope protection cost, in Mp
		SPCCu=	unit cost for cut slope protection, in Mp/m, given in Table below
	· · :	SPCEu=	unit cost for embankment slope protection, in Mp/m, given in Table below
	·		length of cut slope to be protected, in m length of embankment slope to be protected, in m
		_	

Unit cost for slope protection "SPCCu", "SPCEu", in Mp/m Item | Unit Cost Cut Slope Protection "SPCCu" | 0.0253 Embankment Slope Protection "SPCEu" | 0.0275

B.I-5 Additional Cost for Flood Section

Equation :	FSC =	FSCu·Lf
	FSCu=	1.976 · Df + 0.173 · Wr - 0.850
	· · ·	
where ,	FSC =	additional cost for flood section, in Mp
	FSCu=	unit additional cost for flood section, in Mp/km
		length of flood section, in km
	Df =	flood depth, in m road width, in m
	Wr =	road width, in m
	,	

B-7

### B.I-6 Structure Cost

Equation : STC = BI	C+SWC+BCC			
BRC = SS SWC = SV	Su•Lss+ABu•Nab+PI	łu∙Npr		
BRC = bi SWC = si	ructure cost, in ridge cost, in My billway cost, in CBC cost, in Mp	n Mp		
gi ABu = ur gi PRu = ur	hit cost of super ven in Table bel hit cost of abuth ven in Table bel hit cost of pier,	ow ment, in My ow in Mp/eac	/each,	'n,
Lss = le Nab = nu Npr = nu SWu = ur	ven in Table bel ength of superstr amber of abutment amber of piers hit cost of spill wen in Table bel	ructure, in s way, in MI	· · · · ·	•
Lsw = le BCu = ur Lbc = le us	ven in Table bel ength of spillway ait cost of RCBC, ength of RCBC, ir sually road width ost for wingwall	7, in m in Mp/m,g 1 m, 1 plus 3.0	given in m	
	des total), give	en in Table		ser(both
Type of Structure	Item	· · · · · · · · · · · · · · · · · · ·	Unit Co	ost
2-lane Bridge	Superstructure Abutment Pier	"SSu"   "ABu"   "PRu"	$0.0478 \\ 0.3630 \\ 0.3135$	Mp/m Mp/each Mp/each
1-lane Bridge	Superstructure Abutment Pier	"SSu"	0.0357 0.2530	Mp/m Mp/each Mp/each
2-lane Spillway	Spillway	"SWu"	0.0182	Mp/m
1-lane Spillway	Spillway	"SWu"	0.0132	Mp/m
1-cell RCBC	RCBC Wingwall/Apron	"BCu" "WW "	0.0227 0.1452	
2-cell RCBC				

#### B.I-7 Traffic Benefit

Equation : TRB = TRBu·Ls·VEH TRBu= k+0.000133·HV

where , TRB = traffic benefit, in Mp
TRBu= unit traffic benefit, in Mp/km/veh
Ls = subsection length, in km
VEH = AADT, in veh
HV = percent heavy vehicles, in %
k = constant, given in Table below

Constant "	'k''			
	Existing Surface Type and Condition			
Type 1		Flat	Rolling	Mountain's
1	Paved - Bad Paved - Very Bad Gravel- Good/Fair Gravel- Bad Gravel- Very Bad Earth - Bad Earth - Very Bad	.00280 .00683 .00694 .00724 .00837 .00939 .01455	$\begin{array}{r} .\ 00382\\ .\ 00784\\ .\ 00796\\ .\ 00826\\ .\ 00938\\ .\ 01041\\ .\ 01557\end{array}$	$\begin{array}{r} . 00455 \\ . 00858 \\ . 00869 \\ . 00900 \\ . 01012 \\ . 01114 \\ . 01631 \end{array}$
BMP/DBST	Paved - Bad Paved - Very Bad Gravel- Good/Fair Gravel- Bad Gravel- Very Bad Earth - Bad Earth - Very Bad	.00098 .00501 .00512 .00542 .00654 .00757 .01273	.00200 .00602 .00614 .00644 .00756 .00859 .01375	.00273 .00676 .00687 .00717 .00830 .00932 .01448
Gravel	Gravel- Bad Gravel- Very Bad Earth - Bad Earth - Very Bad	.00471 .00583 .00686 .01202	.00573 .00685 .00787 .01304	.00646 .00759 .00861 .01377

#### B.I-8 Bridge Benefit

Eq

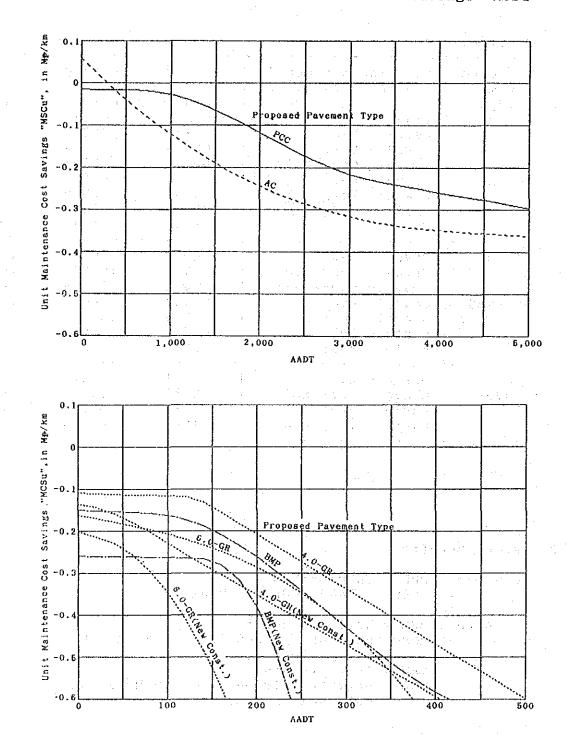
quation	:		BRBu·Lb·VEH 0.0660·TRBu-0.000351
		BRBu= Lb = VEH =	bridge benefit, in Mp unit bridge benefit, in Mp/m/veh bridge length, in m AADT, in veh unit traffic benefit, in Mp/km/veh, obtained from B.1-7

#### B.I-9 Maintenance Cost Savings

Equation :  $MCS = MCSu \cdot Ls$ 

Chart for estimating unit maintanance cost savings "MCSu"

1.12



B-10

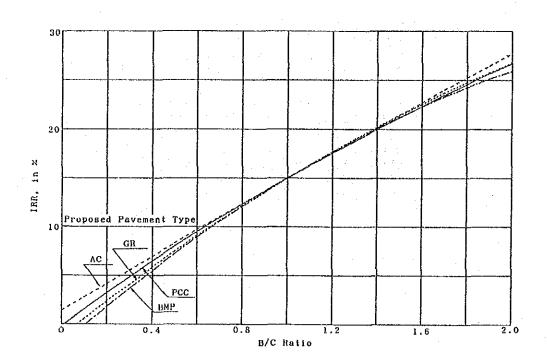
#### B.I-10 B/C Ratio

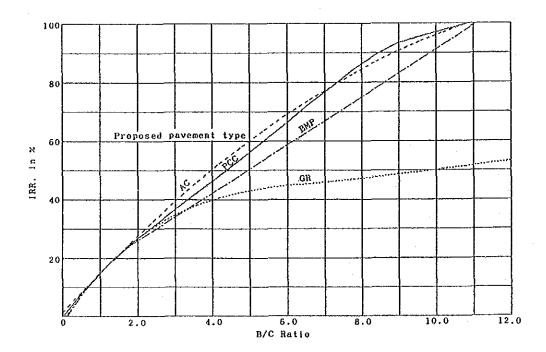
Equation : BC = TB/EC

TB = TRB+BRB+MCS EC = 0.831.TC TC = RCC+SPC+FSC+STC Where, BC = B/C ratio TB = total benefit, in Mp EC = economic total cost, in Mp TC = total cost, in Mp TRB= traffic benefit, in Mp BRB= bridge benefit, in Mp MCS= maintenance cost savings, in Mp RCC= road construction cost, in Mp

FSC= additional cost for flood section, in Mp STC= structure cost, in Mp

## B.I-11 Internal Rate of Return (IRR) Obtain from Chart below.





B-12

## PROJECT EVALUATION WORKSHEET

1) ROAD NAME AND CLASS		
NAME OF ROAD		
PROVINCE	(PR	OVINCE GROUP - B )
FUNCTIONAL CLASSIFICATION (REF. CHAPTER 2)	I. PRIMARY MAJOR 2. SECONDARY MAJOR 3. COLLECTOR 4. F	EEDER

•						ROJEC	T )						
		TON WITHIN R		DATA D		DAADT	LENGTH :	Lt	3)	KM P:/I	-t (1)	nin 1999 yang bertakan kari di di	5
CUL	TIVA	TED AREA RIA : At	·	2	HA	At /Lt			4)	AAD	Г		6
POF	UL.AT	ION DISTRIB	JTION	A :	GRADUA	(2)/3) LLY DECREAS	ING E			RIBUTING	. B.II -   ) G :	TIP CONCENT	RATION
PAT	TER				PATTER	N	a talka tir tir chaja yayı	PATT	ERN		أحوسن والمساورة المراجع والمساورة والمناط	PATTERN	an a
	UBSE	CTION NO. W		COLUMN TWO IS NOT		ND COST	<u>(STR</u>	<u>uctu</u>	RE)	₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩			TOTAL
1	XIST	CATED ING TYPE											
ł	ROP	/SPILLWAY/T DSED TYPE	( RE	F. B.II	-31	·····							
(	-	/1-BR/2-SW/	1-SW/1-RC	8C/2-R	CBC)			·					
		OF LANES	· .		60								
		NGTH (M)			8						<u> </u>		i
		OF SPANS			3		· ·				ļ		
ω		SUPER-	UNIT COS (REF B.		26					·	ļ		
Θ	-	STRUCTURE	COST	<b>)</b> )	Ð								
-	(~N)		UNIT COS	T/EACH	8					····			
62 68	H	ABUTMENT	COST (28) x 2	• •	9								
	SOO		UNIT COS	T/EACH	30		· <u> </u>				1		<b>├</b> ─── <b>│</b>
		PIER	COST (G) x12		31							-	<u>}</u>
ĺ		TOTAL COS	1 (30) x1 (2) T	5 - 1) )									
	NO		(31))				,,,,,,						
ΑY	NO. OF LANES												
SPILLWAY	LENGTH (M) (3)									- <u></u>	ļ		
as	ST (M	(REF. B.I)		···									
	<u> 8</u>	(@ x @	)		35						L		
	·	CELL OR 2-C	ELL.										
		LENGTH (M) (0500000000000000000000000000000000000											
မ	-	UNIT OP (REF.	COST/M B.II-73		- T								
0 8	¢ E	COST	60)		<b>3</b> 8								
	COST	WINGWALL ( REF. B.II	& APRON		- 59		_ <b>.</b>						
	ö	TOTAL COS	ЭT		Ð								
CÇ	ST (	( <u>39</u> + <u>69</u> M=P*) 9 + (40)	)								<del> </del>		<b>(</b> )
16	2) <del>+</del> (3	6) + (40)											Ľ
)	ECC	NOMIC I	NDICA	TOR									
	Tellinities.	L CONSTRUC			+ (4) )	53							
		DHIC COST	( 🕲 x )			Æ							
			10/6		· · · · · · · · · · · · · · · · · · ·								
		RATIO		·····									
			(REF. E	3.∏~13)							سے بی وہ بی میں مراد ختنا کہ ر		
)	CON	MENT	·····	<u> </u>									
- -					- - -								
	-	يو ميد من الشر ي								Fill de sea Atlabana,			

## 3) PROPOSED IMPROVEMENT AND COST (ROAD)

	SUBSECTION	NO.						TOTAL
	LENGTH OF	SUBSECTION	i (KM) 🕜					3
	EXISTING SU	RFACE TYPE	/NONE)					
	EXISTING SU		DITION BAD/IMPASSABLE)			 		
	TERRAIN {FLAT / ROLLING / MOUNTAINOUS }				1			
	SLOPE	CUT SLOP	E LENGTH (M) 🖲	· · · · · · · · · · · · · · · · · · ·				
SPECIAL REATMENT	PROTECTION	EMBANKME	ENT SLOPE (M)			 		
SPEC	FLOOD	FLOOD DE	ртн (м) 🔟					
۹, k	SECTION	FLOOD SEC	CTION (I)					
	TYPE (PCC/AC/BMP/GRAVEL) (REF. B.II-2) CARRIAGEWAY WIDTH (M) (REF. B.II-2)			· ·				
2 Z Z Z								
VEM5	$ \begin{array}{c} L \\ CARRIAGEWAY WIDTH (M) \\ L \\ C \\ REF. 8.II - 2 \\ SHOULDER WIDTH (M) \\ C \\ \mathsf$			-				
P P P						· .		
	TYPE OF IMPROVEMENT (REHAB, / MPR/ WIDENING/NEW CONST.) (REF. B.II-2)							
	ROAD	UNIT COST/KM. (5) (REF. B.II-4.)						
	RUAD	COST (⑤ x ⑦)	(16)					
÷		CUT	UNIT COST/M. (7) ( REF. B.II - 5 )					
(-4-M )	SLOPE	SLOPE	COST (B) (⑦x®)					
SТ	PROTECTION	EMBANK	UNIT COST/M. (19) (REF. B.LI-5)	·		 	 	
000		SLOPE	cost @ (@x9)				 	· · ·
	FLOOD		г/км. (1) 10,173 (4) - 0,850 )					
	SECTION	cos⊤ (② x (II)	, @				 	_
	TOTAL. C	os⊤ ⊗(+⊘())						3

#### 4

	HERE THE STRUCTU	RE		
RD/SPILLWAY/				
		· •		
IO. OF LANES				
ENGTH (M)		<u> </u>		
	D )	E		
SUPER-	UNIT COST/M (REF B.II-7)	66		
STRUCTURE	COST ( 20 x 24 )	1		
	UNIT COST/EACH	- 69		
	COST	1		
	UNIT COST/EACH (REF B.II-7)	80		
PIER	COST (GO x((2) -1))	3)		
TOTAL COS	эт	®		
10. OF LANES			·	
ENGTH (M)		33		
UNIT COST		8		
COST ( (G) x (G)	)	35		
	• )	<u>36</u>		
UNIT	COST/M	<u> </u>		
		- 68		
	& APRON	- 69		
TOTAL CO	ST	Ð		
(M#*)_				
	LOCATED STING TYPE RD/SPILLWAY/- POSED TYPE BR/1-BR/2-SW/ NO. OF LANES LENGTH (M) NO. OF SPANS P/20 & ROUN SUPER- STRUCTURE ABUTMENT PIER TOTAL COS (2) + 2) + NO. OF LANES LENGTH (M) UNIT COST (3) x (3) - CELL OR 2-( LENGTH (M) JSUALLY (A) + 3.0 UNIT COST (5) x (3) - CELL OR 2-( LENGTH (M) JSUALLY (A) + 3.0 UNIT COST (5) x (3) - CELL OR 2-( LENGTH (M) JSUALLY (A) + 3.0 UNIT COST (5) x (3) - CELL OR 2-( LENGTH (M) JSUALLY (A) + 3.0 UNIT COST (5) x (3) - CELL OR 2-( LENGTH (M) JSUALLY (A) + 3.0 UNIT COST (5) x (3) - CELL OR 2-( COST (5) x (3) - COST (5) x (3) - C	LOCATED STING TYPE RD/SPILLWAY/TIMBER/BAILEY/OTH POSED TYPE (REF. B.II-7) BR/1-BR/2-SW/1-SW/1-RCBC/2-RCI NO. OF LANES LENGTH (M) NO. OF SPANS $\textcircled{(2)} / 20 \ B ROUND )$ SUPER- STRUCTURE (REF. B.II-7) COST ( $\textcircled{(2)} \times \textcircled{(2)}$ ) UNIT COST/EACH (REF. B.II-7) COST ( $\textcircled{(2)} \times \textcircled{(2)}$ ) NO. OF LANES LENGTH (M) TOTAL COST ( $\textcircled{(2)} + \textcircled{(3)}$ ) NO. OF LANES LENGTH (M) UNIT COST/M (REF. B.II-7) COST ( $\textcircled{(3)} \times \textcircled{(3)}$ ) - CELL OR 2-CELL LENGTH (M) UNIT COST/M (REF. B.II-7) COST ( $\textcircled{(3)} \times \textcircled{(3)}$ ) - CELL OR 2-CELL LENGTH (M) UNIT COST/M (REF. B.II-7) COST ( $\textcircled{(3)} \times \textcircled{(3)}$ ) - CELL OR 2-CELL LENGTH (M) UNIT COST/M (REF. B.II-7) COST ( $\textcircled{(3)} \times \textcircled{(3)}$ ) - CELL OR 2-CELL LENGTH (M) UNIT COST/M (REF. B.II-7) COST ( $\textcircled{(3)} \times \textcircled{(3)}$ ) - CELL OR 2-CELL LENGTH (M) UNIT COST/M (REF. B.II-7) COST ( $\textcircled{(3)} \times \textcircled{(3)}$ ) - CELL OR 2-CELL LOR 2-CELL COST ( $\textcircled{(3)} \times \textcircled{(3)}$ ) - CELL OR 2-CELL LOR 2-CELL ( $\textcircled{(3)} \times \textcircled{(3)}$ ) ( $(\hbox{(REF. B.II-7)}$ ) COST ( $\textcircled{(3)} \times \textcircled{(3)}$ )	LOCATED STING TYPE RD/SPILLWAY/TIMBER/BAILEY/OTHER) POSED TYPE (REF. B.II-3) BR/1-BR/2-SW/I-SW/I-RCBC/2-RCBC) NO. OF LANES LENGTH (M) NO. OF SPANS $\textcircled{P} / 20 \ B \ ROUND$ ) SUPER- STRUCTURE (REF. B.II-7) STRUCTURE $(@ x \ @)$ UNIT COST/EACH $(@ x \ @)$ UNIT COST/EACH $(@ x \ @)$ UNIT COST/EACH $(@ x \ 2)$ UNIT COST/EACH $(@ x \ 2)$ $(@ x \ 2)$ $(@ x \ 2)$ UNIT COST/EACH $(@ x \ 2)$ $(@ x \ 3)$ $(@ x \ 3)$ (@ x	LOCATED STING TYPE RD/SPILLWAY/TIMBER/BAILEY/OTHER) POSED TYPE (REF. B.II-3) BR/1-BR/2-SW/I-SW/I-RCBC/2-RCBC) NO. OF LANES LENGTH (M) NO. OF SPANS $(20 \times 20 \text{ B ROUND})$ SUPER- STRUCTURE (REF. B.II-7) STRUCTURE (COST (COST (REF. B.II-7)) (COST (COST (REF.

5)	BENEFI	Τ					· · · ·	
	BRIDGE LEN	IGTH (M)	3					
	TRAFFIC BENEFIT	UNIT BENEFIT/KM.	3					-
		BENEFIT	4					
	BRIDGE BENEFIT	UNIT BENEFIT/KM. (0.066 x (3-0.000351 x 6)	6			:		
4 -		(@;x;@))	B	u	· · ·			
н Ш	DEV'T. BENEFIT	( REF. 8.11~10	Ð					
z		UNIT BENEFIT (Kt0.007661x(4)-0.000133x(5)) BENEFIT	8)					
ы в		BENEFIT (	9					
	MAINTE- NANCE Cost Savings	UNIT BENEFIT/KM.	9					
		BENEFIT (	Ð					
	TOTAL B	ENEFIT + (19) + (5) )						52)

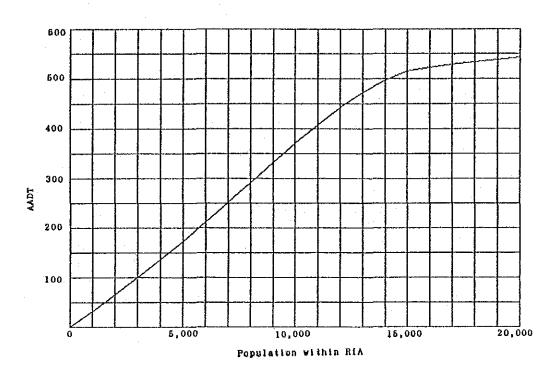
### 6)

TOTAL CONSTRUC	TION COST (23+4))	53	
ECONOMIC COST	( 🕲 x 0.831 )	Ø.	
B/C RATIO	(@/@)		
IRR	(REF. B.II~13)		

#### 7

### B.II-1 AADT

Obtain from Chart below.



## B.II-2 Proposed Pavement Type Apply B.I-1.

- B.II-3 Proposed Structure Type Apply B.I-2.
- B.II-4 Road Construction Cost Apply B.I-3.
- B.II-5 Slope Protection Cost Apply B.I-4.
- B.II-6 Additional Cost for Flood Section Apply B.I-5.
- B.II-7 Structure Cost Apply B.I-6.

#### B.II-8 Traffic Benefit

Equation : TRB = TRBu·Ls

where, TRB = traffic benefit, in Mp TRBu= unit traffic benefit, in Mp/km, given in Chart below Ls = subsection length, in km

Selection of Chart for estimating unit traffic benefit "TRBu" Population Distribution Pattern | Selection of Parameter A : Gradually Decreasing Pattern | Fig. A-1 | Fig. A-2 B : Evenly Distributing Pattern | Fig. B-1 | Fig. B-2 C : Tip Concentration Pattern | Fig. C-1 | Fig. C-2

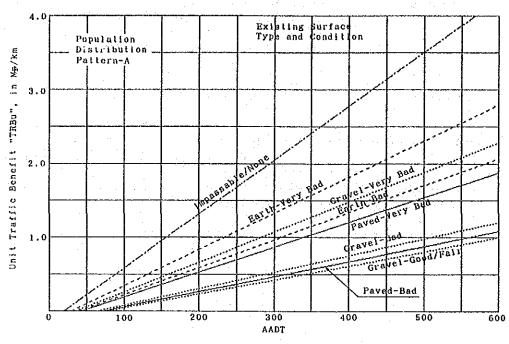


Chart for estimating unit traffic benefit "TRBu" for Population Distribution Pattern - A ( Gradually Decreasing Pattern )

Figure A-1 "TRBu" Based on AADT

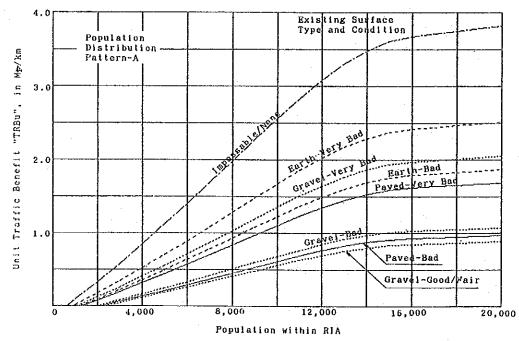
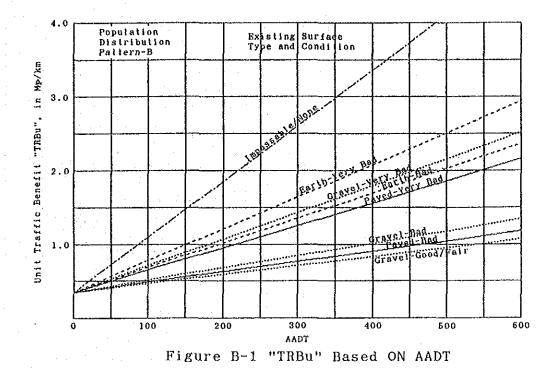


Figure A-2 "TRBu" Based on Population



#### Chart for estimating unit traffic benefit "TRBu" for Population Distribution Pattern - B ( Evenly Distributing Pattern )

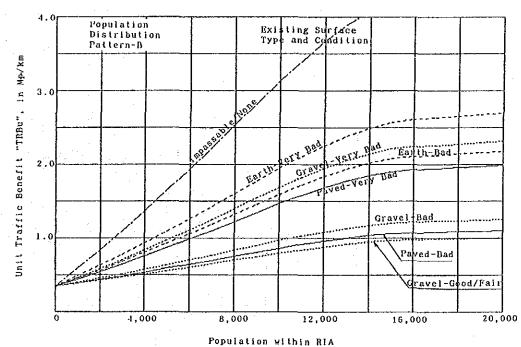
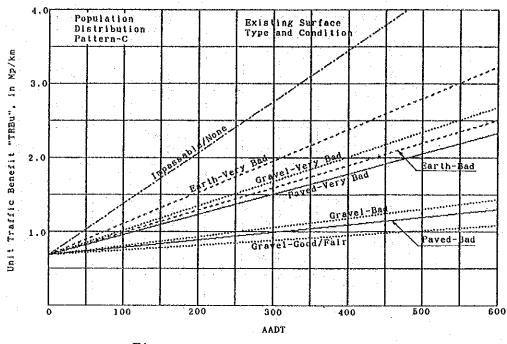


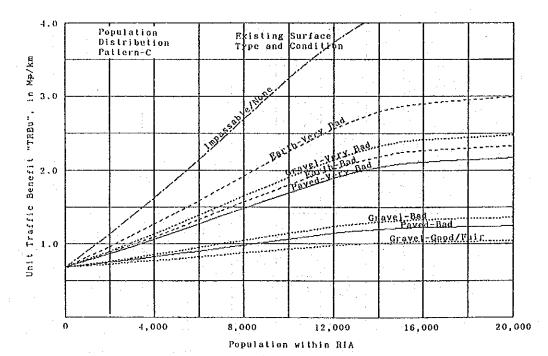
Figure B-2 "TRBu" Based on Population

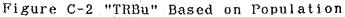
B-18



#### Chart for estimating unit traffic benefit "TRBu" for Population Distribution Pattern - C ( Tip Concentration Pattern )

Figure C-1 "TRBu" Based on AADT





B-19

B.II-9	Bridge Be	en	efit .	
	Equation	;		BRBu·Lb 0.0660·TRBu-0.000351·VEH
· · ·	where	,	BRBu= Lb = TRBu=	bridge benefit, in Mp unit bridge benefit, in Mp/m bridge length, in m unit traffic benefit, in Mp/km, obtained from B.II-8 AADT, in veh

B.II-10 Development Benefit

		DVBu·Ls k+0.007661·At/Lt-0.000133·Pt/Lt
	DVBu= k = At = Pt = Lt =	development benefit, in Mp unit development benefit, in Mp/km constant, given in Table below total cultivated area within RIA, in ha total population within RIA, in person total road length, in km subsection length, in km

Existing Surface	1		Terrain	
Type and Condition	   		Rolling	Mountain's
Paved - Bad	- 1	.756	.680	1.340
Paved - Very Bad	ł	.331	.256	.915
Gravel- Good/Fair	ł	-1.514	-1.589	930
Gravel- Bad	ł	099	174	.485
Gravel- Very Bad	1	.706	.631	1.291
Earth - Bad	ł	.356	.281	.940
Earth - Very Bad	1	.756	.681	1.341
Any - Impassable/	ł			
Non-exist'g	ł	.836	.761	1.421

#### B.II-11 Maintenance Cost Savings

Apply B.I-9.

# B.II-12 B/C Ratio

Equation : BC = TB/EC

	EC =	TRB+BRB+DVB+MCS 0.831 · TC RCC+SPC+FSC+STC
where ,	TB = EC =	B/C Ratio total benefit, in Mp economic total cost, in Mp total cost, in Mp
 	BRB = DVB = MCS = RCC = SPC = FSC =	traffic benefit, in Mp bridge benefit, in Mp development benefit, in Mp maintenance cost savings, in Mp road construction cost, in Mp slope protection cost, in Mp additional cost for flood section, in Mp structure cost, in Mp

## B.II-13 Internal Rate of Return (IRR)

Apply B.I-11.

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