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REPUBLIC OF INDONESIA
MINISTRY OF PUBLIC WORKS
DIRECTORATE GENERAL OF HIGHWAYS

THE FEASIBILITY STUDY OF THE LOCAL ROAD DEVELOPMENT IN THE REPUBLIC OF INDONESIA

KABUPATEN REPORT 36

KABUPATEN MAMUJU

MARCH 1986

JAPAN INTERNATIONAL COOPERATION AGENCY

REPUBLIC OF INDONESIA
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PREFACE

This is the Kabupaten Report of the Feasibility Study of the Local Road Development in the Republic of Indonesia for Kabupaten Mamuju in Sulawesi Selatan Province. The report has been prepared by the Study Team of the Japan International Cooperation Agency (hereinafter called JICA).

Based upon a request from the Government of Indonesia, the Government of Japan arranged for JICA to conduct the Study and JICA accordingly organized a Study Team. The study was carried out using data which were generally prepared by the Kabupaten, routed through the province, under the instructions of Bina Marga of the Ministry of Public Works and Bangda of the Ministry of Home Affairs.

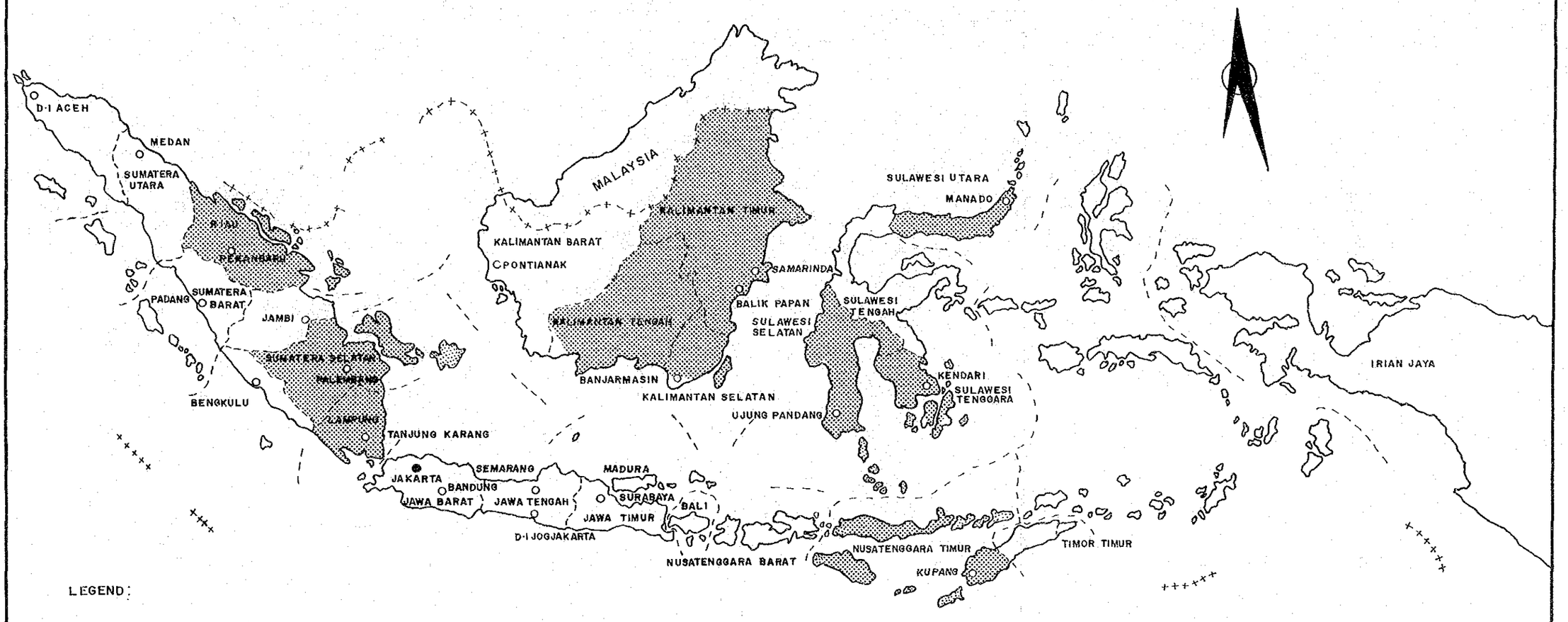
Since the study period was limited, without cooperation of Bina Marga, Bangda and local governments of both province and Kabupaten in collecting the data, the study would not have been completed within the period.

The report consists of the results of the feasibility study and proposed implementation programme of the local road development in the Kabupaten.

The simplified economic feasibility evaluation methodology utilized for the study was established by the Study Team in Phase I Study through a pilot study of seven (7) model Kabupatens, and is described in the Main Report.

The purpose of the study for the Kabupaten is mainly to estimate the total Project Cost for the local road development but only limited data is available for study base. Therefore a detailed survey and design for the improvement of the Kabupaten roads should be carried out before commencing the Project together with a review of this report.

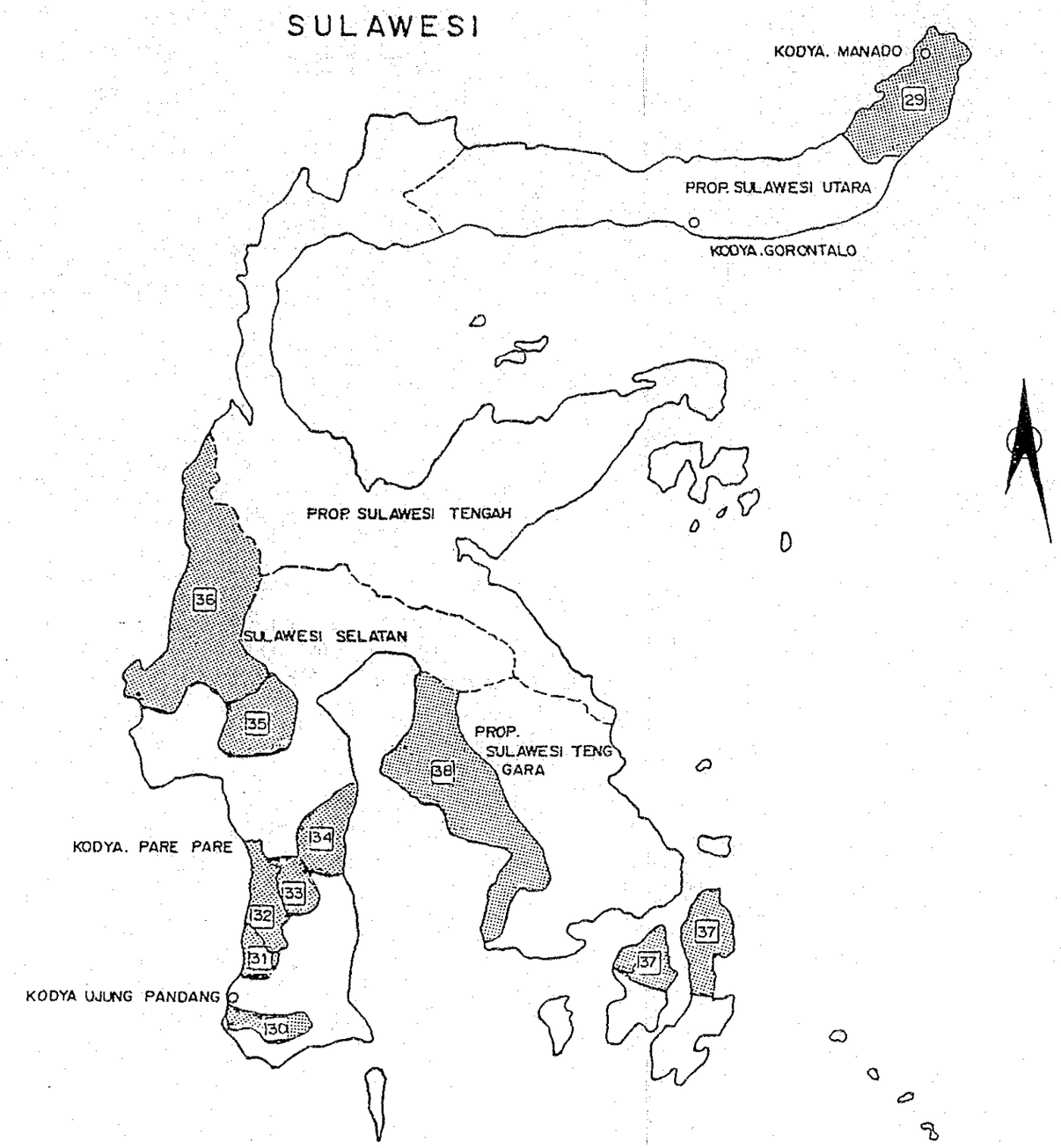
LOCATION MAP OF THE PROJECT AREAS



VIII · PROPINSI SULAWESI UTARA
29 · KAB · MINAHASA

IX · PROPINSI SULAWESI SELATAN
30 · KAB · GOWA
31 · KAB · PANGKAJENE KEPULAUAN
32 · KAB · BARRU
33 · KAB · SOPENG
34 · KAB · WAJO
35 · KAB · TANA TORAJA
36 · KAB · MAMUJU

X · PROPINSI SULAWESI TENGGARA
37 · KAB · MUNA
38 · KAB · KOLAKA



LEGEND :

---- PROVINCIAL BOUDER

LOCATION OF THE PROPOSED AREA

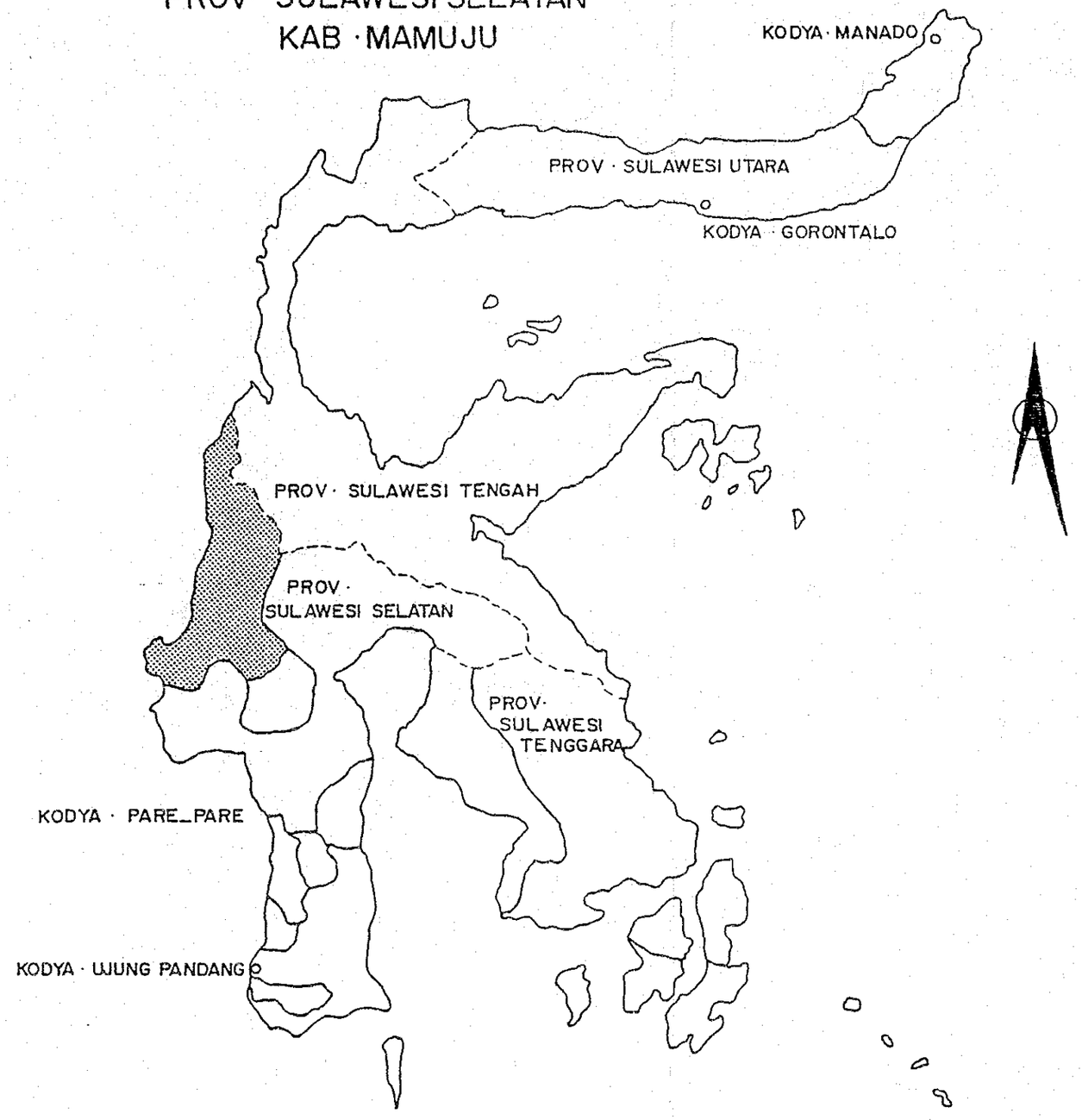
SCALE :

0 92 184 276 460 Km

SULAWESI

PROV· SULAWESI SELATAN

KAB ·MAMUJU



LEGEND :

---- PROVINCIAL BOUNDARY

LOCATION OF THE PROJECT AREA

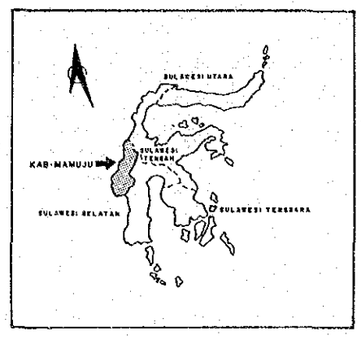
SCALE :

0 92 184 276 460 Km

L.M-36/38

KAB · MAMUJU

LOCATION MAP



BAMBA IRA
BAMBA LAMOLU
PASANG KAYU
KAROSSA
KEC·PASANGKAYU
KEC·BUDONG BUDONG
BABANA
09
08
FANGALE
07
SUMARE
02
LE BANI
03
BINANGA
MAMUJU
01
TANJUNG AONI
01A
KALUKKU
07
BELANG BELANG
BONE
03A
OKOBATU
GALUNG
KEC·MAMUJU
KEC·KALUKKU
04
KEC·TAPALANG
KM 15
04A
04B
BONEHAU
05
TAMALEA
05A
KM 30
KEC·KALUMPANG
KE MAJENE
KALUMPANG
06
DIMKANG
BUTU
06A
BAU
KARAMA
06B
06C

LEGEND :

- KABUPATEN CAPITAL
- KECAMATAN CAPITAL
- OTHER CITY
- LINK NUMBER
- PROVINCIAL BOUNDARY
- KABUPATEN BOUNDARY
- KECAMATAN BOUNDARY
- NATIONAL ROAD
- PROVINCIAL ROAD
- KABUPATEN ROAD
- VILLAGE ROAD
- RIVER

SCALE:
0 5 10 15 Km

THE FEASIBILITY STUDY OF THE LOCAL ROAD DEVELOPMENT IN THE REPUBLIC OF INDONESIA

TITLE :

SOURCE:	SCALE:	PROVINCE : SULAWESI SELATAN
DIREKTORAT JENDERAL CIPTA KARYA	AS SHOWN	KABUPATEN MAMUJU

C O N T E N T S

Chapter 1 BACKGROUND OF THE KABUPATEN

1.1 Topographic and Meteorological Conditions

1.1.1 Location and Topography

Kabupaten Mamuju is the northwesternmost Kabupaten in Sulawesi Selatan Province. It faces the Makassar Strait on the west coast. It is bordered on the north by Sulawesi Tengah Province, on the east by Kabupaten Luwu, and on the south by Kabupaten Tana Toraja, Polewali Mamasa and Majene.

The Kabupaten is isolated from other regions, because three sides the north, east and south, are walled in the steep mountain ranges, namely the Takolekayu and the Quarles mountains, while the west side is towards the sea. On the west coast flatlands widely expand north-south formed by a number of river basins from the rivers rising in the mountains. These flat areas are mostly covered with swamps.

The Kabupaten has an area of 11,058 square kilometers, approximately 15 percent of the total of the province. It consists administratively of 6 Kecamatans.

1.1.2 Meteorological Conditions

The average number of rainy days and the average amount of yearly rainfall in Kabupaten Mamuju are 84 days and 2,202 mm respectively.

One year in the Kabupaten consists of a rainy season and a dry season. The dry season is from May through October in general. However this is variable as Table 1-1-1 shows.

The number of working days which is necessary for planning the construction schedule in chapter 6, is estimated at 250 days using the following formula based upon the data shown in the table referred to above.

$$\text{Working Days} = 365 - \text{Holidays} - \text{Rainy Days} + \left(\text{Rainy Days} \times \frac{\text{Holiday}}{365}\right) + (0.10 \times \text{Rainy Days})$$

Where :

- Holidays consist of 52 Sundays and 13 national holidays; and
- 10% of rainy days are assumed to be workable days.

Table 1-1-1

METEOROLOGICAL CONDITIONS

PROVINCE : Sulawesi Selatan
KABUPATEN : Mamuju

STATION : Mamuju

MONTH	1980		1981		1982		1983		1984	
	RAINY DAYS	RAINFALL (mm)	RAINY DAYS	RAINFALL (mm)	RAINY DAYS	RAINFALL (mm)	RAINY DAYS	RAINFALL (mm)	RAINY DAYS	RAINFALL (mm)
January	11	247	10	179	17	445	16	580	-	-
February	10	374	8	187	-	-	7	210	-	-
March	10	356	10	163	8	259	6	136	-	-
April	11	334	10	278	6	224	15	419	-	-
May	8	407	13	232	8	176	6	124	4	52
June	11	584	10	184	-	-	10	255	-	-
July	-	-	14	290	-	-	9	99	14	380
August	-	-	10	435	-	-	3	30	-	-
September	-	-	14	496	-	-	6	134	12	382
October	-	-	10	191	2	37	-	-	7	107
November	12	167	15	259	-	-	-	-	13	329
December	18	305	16	252	10	268	-	-	11	442
Total	91	2,774	140	3,146	51	1,409	78	1,987	61	1,692

1.2 Socio-Economic Conditions

1.2.1 Population

The population of Kabupaten Mamuju in 1984 was 124,315 which was approximately 1.9% of the 6,475,000 total population of Sulawesi Selatan Province as shown in Table 1-2-1.

The population density was 0.11 persons per ha which was much lower than the provincial density of 0.88 because of the geographical conditions of the Kabupaten.

The recent annual average growth rate of population of the Kabupaten is 6.0% which is higher than both the provincial rate of 1.7% and the national rate of 2.2%. This may be a result of the on-going transmigration programme.

The population of each Kecamatan and its proportion to the Kabupaten population is shown in Table 1-2-2.

Table 1-2-1 POPULATION BY KABUPATEN

DESCRIPTION	POPULATION	AAGR (%)	AREA (ha)	POPULATION DENSITY (persons/ha)	SURVEY YEAR
KABUPATEN:					
GOWA	368,552	0.6	188,332	1·90	1983
PANGKAJENE KEPULAUAN	224,630	0·6	111,229	2·02	1984
BARRU	137,392	0·5	117,472	1·17	1982
SOPPENG	239,335	0·5	135,944	1·76	1984
WAJO	379,948	0·5	250,619	1·52	1984
TANA TORAJA	340,015	0·6	195,000	1· 73	1984
MAMUJU	124,315	6·0	1,105,781	0·11	1984
PROVINCE:					
SULAWESI SELATAN	6,278,200		7,278,100		1982
	6,376,100	1· 7	7,278,100	0·88	1983
	6,475,000		7,278,100		1984
JAWA IS.(Excluding DKI JAKARTA)	91,126,900	1·7	13,159,700	6·92	-
INDONESIA	161,579,500	2·2	191,944,300	0·84	-

Notes :

1. Sources:
   Kabupaten; Kabupaten concerned with the study
   Province ; Jawa and Indonesia:
   Statistical yearbook of Indonesia 1984, published by the Central statistics Bureau.
2. AAGR ; Average Annual Growth Rate.

Table 1-2-2 POPULATION BY KECAMATAN

Year : 1984

PROVINCE : SULAWESI SELATAN

KABUPATEN : MAMUJU

KECAMATAN	POPULATION	PROPORTION (%)
TAPALANG	12,162	9.8
MAMUJU	24,674	19.8
KALUKKU	36,437	29.3
KALUMPANG	11,204	9.0
BUDONG BUDONG	17,492	14.1
PASANG KAYU	22,346	18.0
TOTAL	124,315	100

1.2.2 Land Use

Although the precise condition of land use in Kabupaten Mamuju is unknown because no relevant data were collected, an outline can be given from the topographical condition.

The Kabupaten is almost 90% covered by forest or swampy areas and there is no more than 20,000 ha of culivated area accounting for about 2%.

Table 1-2-3

LAND USE

PROVINCE : SULAWESI SELATAN

(ha)

KABUPATEN	WET PADDY FIELD	UPLAND PADDY FIELD	OTHER CULTIVATED AREA	PLANTATION AREA	RESIDENTIAL AREA	USABLE OPEN SPACE	RIVER & LAKE	FORESTRY AREA	OTHERS	TOTAL AREA	SURVEY YEAR
GOWA	28,800 (15.3)	12,600 (6.7)	-	33,800 (17.9)	9,700 (5.1)	-	-	78,900 (41.9)	24,532 (13.0)	188,332 (100)	1981
PANGKAJENE KEPULAUAN	20,800 (18.7)	554 (0.5)	3,308 (3.0)	10,079 (9.1)	2,538 (2.3)	2,142 (1.9)	5,972 (5.4)	10,754 (9.7)	55,084 (49.5)	111,229 (100)	1983
BARRU	12,653 (11.1)	-	6,262 (5.5)	-	2,870 (2.5)	-	2,362 (2.1)	77,325 (67.5)	13,000 (11.3)	114,472 (100)	1982
SOPPENG	36,098 (28.7)	721 (0.6)	35,968 (28.6)	10,162 (8.1)	750 (0.6)	-	36,607 (29.1)	5,501 (4.4)	-	125,807 (100)	1983
WAJO	56,220 (22.4)	2,154 (0.9)	26,128 (10.4)	14,400 (5.7)	6,422 (2.6)	48,600 (19.4)	39,000 (15.6)	47,753 (19.1)	10,730 (4.3)	250,619 (100)	1984
TANA TORAJA	28,328 (14.5)	-	5,662 (2.9)	11,036 (5.6)	-	13,000 (6.7)	-	137,165 (70.3)	-	195,191 (100)	1983
MAMUJU	5,946 (0.5)	3,979 (0.4)	10,141 (0.9)	-	-	-	-	-	-	1,105,781 (100)	1984

Notes :

1. The value in ( ) denotes the proportion
2. Source : Kabupaten concerned with the study

1.2.3 Agriculture

The cultivated area and food crop production in Kabupaten Mamuju in 1984 were 16,490 ha and 61,812 ton respectively as shown in Table 1-2-4. Of food crops, the area and production of paddy, which consists of wet paddy and upland paddy, was 12,584 ha and 42,358 ton respectively which are 76.3% and 68.5% of the total food crops. The yield rate of paddy production is 3.37 ton per ha. Thus, paddy is the most predominant agricultural crop of the Kabupaten.

As the table shows, average annual growth rates of area and production of paddy in 1979 through 1980 were 3.5% and 10.2% respectively which indicate favorable development of the paddy production. Upland paddy accounts for 54% of all paddy production in the Kabupaten. It is desirable that productivity of paddy increases and this depends upon the future development of the vast swampland located in the coastal area by means of planned drainage.

The population of the agricultural sector which is assumed from the employment in the Kabupaten is 81.5% of the total population as shown in Table 1-2-6. Thus this is an agricultural Kabupaten.

A future requirement for agriculture in the Kabupaten is recommended to be the improvement of cultivated areas with progress of road development and the transmigration programme to obtain high productivity.

Table 1-2-4 AREA AND PRODUCTION OF FOOD CROPS

KABUPATEN : MAMUJU

CULTIVATED AREA

ITEM	1979	1980	1981	1982	1983	1984	AAGR (%)
PADDY	10,743	10,068	11,179	10,401	9,982	12,584	3.5
OTHERS	4,944	2,405	3,582	2,080	3,740	3,906	12.0
TOTAL	15,687	12,473	14,761	12,481	13,722	16,490	7.2

PRODUCTION

ITEM	1979	1981	1980	1982	1983	1984	AAGR (%)
PADDY	25,383	28,678	21,348	34,404	34,093	42,358	10.2
OTHERS	12,771	3,896	5,678	12,443	13,313	19,454	8.8
TOTAL	38,154	32,574	27,026	46,847	47,406	61,812	10.5

YIELD RATE

ITEM	1979	1980	1981	1982	1983	1984	AGGR (%)
PADDY	2.36	2.85	1.91	3.31	3.42	3.37	3.0

Notes :

1. AAGR : Average annual growth rate
2. Source : Kabupaten concerned with the study

Table 1-2-5 AREA AND PRODUCTION OF PLANTATION CROPS
Year : 1983

PROVINCE : SULAWESI SELATAN

KABUPATEN	AREA (ha)	PRODUCTION (ton)	AREA	PRODUCTION
GOWA	-	-	-	-
PANGKAJENE KEPULAUAN	11,200	4,025	2.8	5.6
BARRU	-	-	-	-
SOPPENG	-	-	-	-
WAJO	21,437	19,396	7.1	11.0
TANA TORAJA	11,306	11,400	-	-
MAMUJU	-	-	-	-

Table 1-2-6 POPULATION OF AGRICULTURAL SECTOR

PROVINCE : SULAWESI SELATAN

KABUPATEN	AGRICULTURAL SECTOR	TOTAL POPULATION	PROPORTION (%)	AAGR (%)	SURVEY YEAR
GOWA	226,000	368,552	61.3	0.05	1983
PANGKAJENE KEPULAUAN	146,000	224,630	64,8	2.0	1984
BARRU	89,000	137,392	64.8	1.0	1982
SOPPENG	166,000	293,335	69.4	0.25	1984
WAJO	243,000	379,948	63.8	4.0	1984
TANA TORAJA	260,000	340,015	76.4	3.0	1984
MAMUJU	101,000	124,315	81.5	6.0	1984

Notes :

1. AAGR : Average annual growth rate
2. Source : Kabupaten concerned with the Study

1.2.4 Other Economic Activities

Notable economic activity excluding agriculture in Kabupaten Mamuju is only the fishery sector.

Recently the volume of forestry production is tending to decline probably due to the government policy which prohibits exporting green wood. It is reported that the production in 1984 was only approximately 10,000 tons compared with approximately 51,000 tons in 1980.

The current growth of fishery production can be seen from the following figures.

	1980	1984	AAGR (%)
Catch (ton)	3,614	4,627	6.4

Notes : 1. AAGR : Average annual growth rate
2. Source : Kabupaten data

It is presumed that approximately 3,500 tons per year are exported from the Kabupaten and it is expected that the fishery sector will prosper.

1.3 Present Status of Kabupaten

1.3.1 Outline of Road Networks

In Kabupaten Mamuju there is one provincial road which leads to Mamuju, the Kabupaten capital, from the neighbouring Kabupaten. However it does not act as a regional trunk road of the Kabupaten because it ends at Mamuju.

Since the coastal areas of the Kabupaten are mostly covered by swamp and the inland region is mostly a mountainous area, Kabupaten Mamuju is less advanced from the social and economic point of view.

It seems that the main transportation system except at the south end of the Kabupaten is at present obliged to rely mostly upon the sea. Kabupaten road networks are not yet developed and there is only one Kabupaten road which runs toward the inland region, that is the road between Kalukku and Karama located on the east boundary of the Kabupaten.

1.3.2 Road Inventory

From the road inventory data prepared by the Kabupaten, the number and total length of Kabupaten roads to be studied in Kabupaten Mamuju are confirmed as 17 links and 202 Km respectively. These figures exclude Kabupaten roads with no data are not included.

According to the data the present status of the Kabupaten roads is as follows:

(1) Density of Kabupaten Roads

The density of the Kabupaten roads is 0.18 m per ha. This is lower than the national density of 0.48 m per ha and distinctly lower than 2.11 m per ha which is the density in Jawa Island, excluding DKI Jakarta, as shown in the following table. Thus, the Kabupaten lags behind in density of Kabupaten roads.

	Total Length (km)	Area (ha)	Density (m/ha)
Kabupaten : Mamuju	202	1,105,781	0.18
Province : Sulawesi Selatan	2,730	2,104,377	1.30
Jawa Is.(Excluding DKI Jakarta)	27,715	13,159,700	2.11
Indonesia	92,038	191,944,300	0.48

Notes : 1. The value for the province is the total value for the Kabupatens included in the study.

2. The sources of data are as follows:
Kabupaten and Province : Bina Marga Inventory
Jawa and Indonesia : Statistical Yearbook of Indonesia 1984, published by the Central Statistics Bureau

(2) Kabupaten Road Surface Type

The type of surface on the Kabupaten roads in the Kabupaten is shown in Table 1-3-1.

The legend used in the table is as follows:

ASP : Asphalt
KRK : Gravel/Stone/Telford/Water Bound Macadam

Table 1-3-1 EXISTING ROAD LENGTH BY SURFACE TYPE

PROV : SULAWESI SELATAN KAB : MAMUJU

(Km)

102 (7)	KRK	TNH	L.L	BTB	TOTAL
LINK 1	14	3			17
LINK 2		14			14
LINK 3		15			15
LINK 4	15				15
LINK 5			13		13
LINK 6				10	10
LINK 7					
LINK 8					
LINK 9					
LINK 10	12	5			17
LINK 11		12			12
LINK 12	15				15
LINK 13	15				15
LINK 14			24		24
LINK 15				12	12
LINK 16				12	12
LINK 17				11	11
TOTAL	71	49	37	45	202
RATIO	35	24	18	22	(%)

TNH : Earth

LL : Others

Comparison of the proportions of surface type in the Kabupaten with other regions is as follows:

	ASP	KRK	TNH/LL
Kabupaten : Mamuju	-	59.4	48.6
Province : Sulawesi Selatan	13.0	46.0	41.0
Jawa Is.(Excluding DKI Jakarta)	56.2	25.0	18.8
Indonesia	26.0	26.6	47.4

Thus, in the Kabupaten the there are no roads with asphalt surfacing. The proportion of low grade roads such as earth roads and others is fairly high. This means that the road classification in the Kabupaten is low.

(3) Surface Condition of Kabupaten Roads

The surface condition of the Kabupaten roads classified as good, fair, poor and bad which are shown as BA, SD, RU and RB respectively, are summarized in Table 1-3-2.

Comparison of the proportions of the various surface conditions of the Kabupaten roads in the Kabupaten with other regions is as follows:

	Good	Fair	Poor	Bad
Kabupaten : Mamuju	19.3	28.2	48.5	4.0
Province : Sulawesi Selatan	41.1	27.3	25.8	5.8
Jawa Is.(Excluding DKI Jakarta)	45.6	29.8	19.6	5.0
Indonesia	43.5	21.8	21.1	13.6

The surface condition level of the Kabupaten roads in the Kabupaten is lower than both that of Indonesia and Jawa Island. The proportion in good condition is relatively low. Therefore improvement of Kabupaten roads in poor or bad condition is desirable.

Table 1-3-2 EXISTING ROAD CONDITION BY SURFACE TYPE

PROVINCE : SULAWESI SELATAN

KABUPATEN : MAMUJU (1)

NO		KRK				TANAH				KERIKIL				BITU			
NO		BA	SD	RU	RB	BA	SD	RU	RB	BA	SD	RU	RB	BA	SD	RU	RB
LINK	1	95	5					60	40								
LINK	2					20	50	30									
LINK	3							99	1								
LINK	4	34	33	33													
LINK	5										30	70					
LINK	6													20	40	40	
LINK	7																
LINK	8																
LINK	9																
LINK	10	82	80	27	2			60	40								
LINK	11							99	1								
LINK	12	29	34	37													
LINK	13	26	28	46													
LINK	14										30	70					
LINK	15													20	40	40	
LINK	16													20	40	40	
LINK	17													20	40	40	
AVERAGE		39	32	29	0	4	10	70	18	0	30	70	0	20	40	40	0
LENGTH			78 Ke				47 Ke				37 Ke				45 Ke		
(Ke)		28	23	21	0	2	5	34	8	0	11	26	0	9	18	18	0

(4) Terrain Conditions of Kabupaten Roads

The difficulty of road improvement is mainly dependent upon the terrain conditions.

The terrain conditions of the Kabupaten roads, classified as flat, hilly, mountainous and swampy which are shown as DT, BK, GN and RW, respectively are summarized in Table 1-3-3.

The proportions of terrain conditions in the Kabupaten are 31.0% flat, 46.0% hilly, 18.0% mountainous and 5.0% swampy. There is not so much mountainous or swampy areas in the Kabupaten, so road construction is anticipated to be not difficult.

1.3.3 Bridge Inventory

A bridge inventory showing the existing condition of bridges on the Kabupaten roads in Kabupaten Mamuju was prepared by the Kabupaten.

The bridge types are classfied as timber, concrete, steel and others which are shown in the inventory as KY, BT, BJ and LL respectively.

The inventory shown in Table 1-3-4 and Table 1-3-5 indicates a total of 53 bridges with a total length of 538 m of which 19 or 35.8% are timber, 5 or 9.4% are concrete and 4 or 7.5% are others. Steel bridges account for 25 or 47.2% of the total. On the other hand, 125 bridges with a total length of 1763 m are required to be newly constructed.

The number of existing bridges by span length is as follows:

Bridge Type	〈3	〈5	〈8	〈10	〈12	〈14	〈16	〈18	〈20	〈99	Total
Timber	-	17	1	-	-	-	-	-	1	-	19
Concrete	-	1	-	1	1	1	-	-	-	1	5
Steel	-	19	-	-	-	-	-	2	1	3	25
Others	1	2	-	-	1	-	-	-	-	-	4
Total	1	39	1	1	2	1	-	2	2	4	53

Thus, most of the existing bridges on the Kabupaten roads are timber and steel, and the majority of spanlengths is within the range of 3 m to 5 m.

Table 1-3-3 EXISTING ROAD LENGTH BY TERRAIN CONDITION

PROV : SULAWESI SELATAN KAB : MAMUJU

(Km)

NO (3)	DT	BK	RW	GN	TOTAL
LINK 1	11	6			17
LINK 2	4	2	8		14
LINK 3	9	6			15
LINK 4	1	11		3	15
LINK 5		13			13
LINK 6	4	6			10
LINK 7					
LINK 8					
LINK 9					
LINK 10	17				17
LINK 11	9	1	2		12
LINK 12	4	8		3	15
LINK 13	2	9		4	15
LINK 14	1	9		14	24
LINK 15		11		1	12
LINK 16	1	8		4	12
LINK 17		3		8	11
TOTAL	62	93	10	37	202
RATIO	31	46	5	18	(%)

Table 1-3-4 NUMBER AND LENGTH OF BRIDGES

PROV : SULAWESI SELATAN KAB : MAMUJU

<<<< BRIDGE >>>> (UNIT: m)

	EXISTING		NOT EXIST		TOTAL	
LINK NO	NO.	LENGTH	NO.	LENGTH	NO.	LENGTH
1	20	202.00			20	202.00
2	3	55.00			3	55.00
3			16	281.00	16	281.00
4	12	75.00	6	96.00	18	171.00
5			24	173.00	24	173.00
6			10	149.00	10	149.00
10	10	165.00			10	165.00
11			9	195.00	9	195.00
12	6	31.00	18	238.00	24	269.00
15			11	146.00	11	146.00
16			12	184.00	12	184.00
17	2	10.00	19	301.00	21	311.00
TOTAL	53	538.00	125	1763.00	178	2301.00

Table 1-3-5 NUMBER OF EXISTING BRIDGES BY BRIDGE TYPE

PROV : SULAWESI SELATAN KAB : MAMUJU

(No)

103 (18)	BT	BJ	KY	LL	TOTAL
LINK 1	2	18			20
LINK 2	3				3
LINK 3					
LINK 4			12		12
LINK 5					
LINK 6					
LINK 10		7		3	10
LINK 11					
LINK 12			5	1	6
LINK 15					
LINK 16					
LINK 17			2		2
TOTAL	5	25	19	4	53
RATIO	9	47	36	8	(%)

1.3.4 Traffic

Inventories of the average daily traffic (ADT) on the Kabupaten roads in Kabupaten Mamuju were prepared by the Kabupaten and are shown in Chapter 2.

From the inventories, total value of average daily trips by vehicle type and their proportions in the Kabupaten in 1985 are summarized as follows:

	SEDAN	BUS	TRUCK	MOTOR-CYCLE	TOTAL
Total Trips	46	2	32	109	135
Proportion (%)	24.34	1.06	16.93	57.67	100.00

Source : Bina Marga Inventory

The proportions of registered vehicles by vehicle type are as follows:

	SEDAN	BUS	TRUCK	MOTOR-CYCLE	TOTAL
Proportion (%)	0.00	6.09	5.74	88.17	100.00

Source : Kabupaten.

Thus, the proportion of motorcyles in the Kabupaten is by far the highest.

From the above tables the following can be observed:

- Number of total trips might be underestimated
- Proportions are probably reasonable.

Essentially, for estimation of future traffic volumes past and present traffic data together with the trend in the number of registered vehicles are important basic data. However the data obtained for the study was traffic count data for each road link in 1985 and of low reliability.

Therefore the future traffic volumes are estimated by the calculation process recommended in chapter 3 of the Main Report.

Chapter 2 ESTIMATIONS OF FUTURE TRAFFIC VOLUME AND BENEFIT

2.1 Future Traffic Volume

2.1.1 Traffic Growth Rate

The traffic growth rate used for estimation of the future traffic volume on the Kabupaten roads was estimated by the following calculation process.

Growth of Production Basis "A":

$$\sqrt{\text{Annual Population Growth of the Kabupaten} \times \text{Growth of the Total Cultivated Area}}$$

Growth of Productivity "B" :

$$\sqrt{\text{Growth of the Total Paddy Field Area} \times \text{Growth of the Paddy Production per ha}}$$

Traffic Growth Rate: Initial estimated figure:

$$\overline{GR'} = \sqrt{A \times B}$$

Traffic Growth Rate GR =Final adjusted figure:

$$\sqrt{GR' \times \text{Trend of GDP/Capita of the Province Concerned}}$$

Results of the estimation are shown in Table 2-1-1.

Table 2-1-1 TRAFFIC GROWTH RATE ESTIMATION

PROV : SULAWESI SELATAN KAB : MAMUJU

A)	Growth Rate of Population	:	6.00 (%)
B)	Growth Rate of Cultivated Area	:	5.50 (%)
C)	Growth Rate of Rice field	:	3.50 (%)
D)	Growth Rate of Rice yield rate	:	3.00 (%)
E)	Growth Rate of GDP / capita	:	6.60 (%)
a)	Geometrical Mean (A x B)	:	5.75 (%)
b)	Geometrical Mean (C x D)	:	3.25 (%)
c)	Geometrical Mean (a x b)	:	4.49 (%)
d)	Geometrical Mean (c x E)	:	5.54 (%)
	TRAFFIC GROWTH RATE	:	5.54 (%)

2.1.2 Present and Future Traffic Volume

The future traffic volumes on the Kabupaten roads in 1998 for the Project life time of ten years were estimated by the following formula :

$$Tn = Te\ (1 + r)^n$$

Where :

Tn : Future traffic volume n years later
Te : Traffic volume in 1985
r : Traffic growth rate

The results are shown in Table 2-1-2 together with the traffic volume in 1985.

Table 2-1-2 EXISTING AND FUTURE TRAFFIC VOLUME

PROV : SULAWESI SELATAN KAB : MAMUJU

< SPD : 1/2 >

	INVENTORY (1985)					RATE	AFTER 13 YEARS (1998)					CLASS
LINK NO	MBL	BUS	TRUK	SPD	TOTAL		MBL	BUS	TRUK	SPD	TOTAL	
1	19	1	10	40	50	5.5%	38	2	20	81	101	IIIB-2
2	0	0	0	5	3	5.5%	0	0	0	10	6	IIIC
3	0	0	0	0	0	5.5%	0	0	0	0	0	IIIC
4	0	0	0	0	0	5.5%	0	0	0	0	0	IIIC
5	0	0	0	0	0	5.5%	0	0	0	0	0	IIIC
6	2	0	3	6	8	5.5%	4	0	6	12	16	IIIC
7	0	0	0	0	0	5.5%	0	0	0	0	0	IIIC
8	0	0	0	0	0	5.5%	0	0	0	0	0	IIIC
9	0	0	0	0	0	5.5%	0	0	0	0	0	IIIC
10	19	1	10	40	50	5.5%	38	2	20	81	101	IIIB-2
11	0	0	0	0	0	5.5%	0	0	0	0	0	IIIC
12	0	0	0	0	0	5.5%	0	0	0	0	0	IIIC
13	0	0	0	0	0	5.5%	0	0	0	0	0	IIIC
14	0	0	0	0	0	5.5%	0	0	0	0	0	IIIC
15	2	0	3	6	8	5.5%	4	0	6	12	16	IIIC
16	2	0	3	6	8	5.5%	4	0	6	12	16	IIIC
17	2	0	3	6	8	5.5%	4	0	6	12	16	IIIC
PERCENT	24.34	1.06	16.93	57.67			24.34	1.06	16.93	57.67		

2.2 Benefit

2.2.1 Benefit Estimation Method

Generally, estimation of the benefit on each Kabupaten road due to the Project was made by analyzing the direct benefit i.e. the VOC reduction benefit, which was estimated by comparing "with project" and "without project" based upon the future traffic volume on the road. However for the following road links it was decided to estimate the indirect benefit through the producer's surplus benefit.

a) Road links with present traffic volume (ADT) less than 60 equivalent 4-wheel vehicles.

b) Road links with no 4-wheel vehicle operation at present.

The indirect benefit was changed into the future traffic volume and the VOC reduction benefit was estimated.

The VOC adopted for the estimation is shown in Table 2-2-1.

Table 2-2-1 VEHICLE OPERATION COST ON KABUPATEN ROADS

(KM)

SURFACE	CONDITION	SEDAN	BUS	TRUCK	MOTORCYCLE
ASPHALT	GOOD	104.7	86.2	85.4	15.9
	Fair	125.5	101.0	98.0	18.2
	Poor	164.1	135.2	138.5	22.8
	Bad	222.1	202.0	205.0	29.1
GRAVEL	Good	125.7	101.4	102.5	18.5
	Fair	145.0	124.6	127.1	21.1
	Poor	198.6	172.6	178.4	27.1
	Bad	242.7	228.9	231.2	31.8
EARTH	Fair	201.8	180.0	185.1	28.0
	Poor	240.7	218.2	225.8	31.8
	Bad	264.9	278.0	281.7	35.5

Source : Bina Marga

Table 2-2-2 FUTURE TRAFFIC VOLUME ESTIMATED BY THE PRODUCER'S SURPLUS

PROV : SULAWESI SELATAN KAB : MAMUJU

(1998)

LINK NO	CLASS	SURFACE	MOBIL	BUS	TRUCK	SEPEDA	TOTAL
1	IIIC	KRK	8	0	6	19	24
2	IIIC	KRK	7	0	5	15	20
3	IIIB-2	KRK	30	1	21	70	87
4	IIIB-2	KRK	35	2	25	83	104
5	IIIC	KRK	7	0	5	18	21
6	IIIC	KRK	6	0	4	14	17
10	IIIB-2	KRK	23	1	16	54	67
11	IIIB-2	KRK	24	1	16	56	69
12	IIIB-2	KRK	19	1	13	46	56
13	IIIC	KRK	9	0	6	20	25
14	IIIC	KRK	14	1	10	33	42
15	IIIC	KRK	7	0	5	16	20
16	IIIC	KRK	7	0	5	16	20
17	IIIC	KRK	7	0	5	17	21

2.2.2 Benefit

The benefit estimation was carried out for each Kabupaten road. Table 2-2-3 shows a sample of the result of benefit estimation. In the table "surplus" and "VOC" show the estimation method utilized and III A, III B-1, III B-2 and III C show the road classification.

Table 2-2-3

RESULTS OF BENEFIT ESTIMATION

KABUPATEN : MAMUJU

(1000Rupiah)

	LINK 1	LINK 2	LINK 3	LINK 4	LINK 5	LINK 6	LINK 10	LINK 11	LINK 12	LINK 13
	17 Km	14 Km	15 Km	15 Km	13 Km	10 Km	17 Km	12 Km	15 Km	15 Km
	IIIC	IIIC	IIIB-2	IIIB-2	IIIC	IIIC	IIIB-2	IIIB-2	IIIB-2	IIIC
YEAR	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus	Surplus
1988	0	0	0	0	0	0	0	0	0	0
1989	2090	5336	28420	8476	2597	1126	13182	18000	5096	2528
1990	2107	5390	28420	8866	2884	1142	13700	18000	5304	2554
1991	2107	5390	29244	9095	2884	1142	14589	18563	5549	2554
1992	2107	5390	30021	9486	3186	1159	14634	19727	5757	2579
1993	2107	5390	32253	10064	3218	1293	15050	20950	5980	3047
1994	2107	5390	33708	10476	3218	1309	15939	21008	6210	3073
1995	2107	5390	33781	10866	3250	1456	15984	22173	6641	3098
1996	2448	6377	35236	11298	3839	1473	17290	22736	6870	3337
1997	2448	6377	36013	11694	3871	1624	17379	23395	7116	3566
1998	2448	6377	38923	12459	3904	1624	18224	24580	7346	3805
SUM	22076	56807	326019	102780	32851	13348	155971	209132	61869	30141
COST	-47846	-16080	140896	7106	-27302	-28099	32057	81701	-17212	-36169
/Km	-2814	-1149	9393	474	-2100	-2810	1886	6808	-1147	-2411

Chapter 3 ENGINEERING

3.1 Design Criteria and Specification

3.1.1 Geometric Design Criteria

Currently a technical standard for improvement of Kabupaten roads i.e. PETUNJUK TEKNIS INPRES PENUNJANGAN JALAN KABUPATEN, TAHUN 1984-1985 is established by Bina Marga.

The geometric design criteria in the above standard are recommended to be adopted in general for the Project. Following discussions with Bina Marga, exceptions to this are allowed for Pavement width and pavement type to minimize the construction cost of the Kabupaten road improvement, if necessary. The geometric design criteria adopted for the Project are shown in Table 3-1-1. The typical cross sections of Kabupaten roads are shown in Fig. 3-1-1.

3.1.2 Loading Specification

The LOADING SPECIFICATIONS FOR HIGHWAY BRIDGES BY DIRECTORATE GENERAL BINA MARGA is used in principle as the basic specification of loading and the TECHNICAL STANDARD FOR KABUPATEN ROADS compiled by Bina Marga shows that the design live load for bridges on Kabupaten roads is 70% of the Bina Marga live road. However, after discussions with Bina Marga the following loads were decided as the design live loads for the standard bridges of Kabupaten roads:

a. 50% of Bina Marga live load (hereinafter BM 50) is applied for concrete and timber bridges on roads of III A classification.

b. 10-ton truck load is applied for timber bridges on roads of III B-1, III B-2 and III C classification.

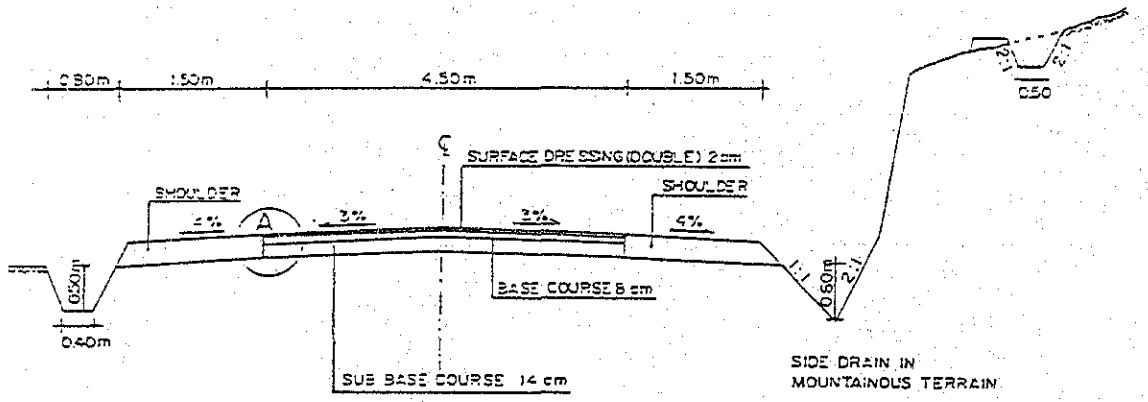
Table 3-1-1

DESIGN CRITERIA FOR KABUPATEN ROADS

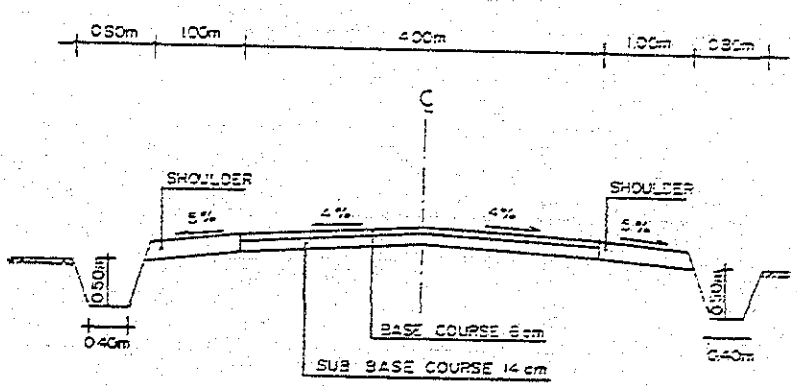
ROAD CLASSIFICATION		CLASS III A			CLASS III B-1			CLASS III B-2			CLASS III C		
SURFACE TYPE		ASPHALT SEAL (DOUBLE)			ASPHALT SEAL (SINGLE)			GRAVEL			GRAVEL		
TRAFFIC VOLUME : ADT (Forecast 10 th year average per day)		3000 - 500			500 - 200			200 - 50			50		
T E R R A I N		FLAT TO ROLLING	HILLY	MOUNT-AINOUS	FLAT TO ROLLING	HILLY	MOUNT-AINOUS	FLAT TO ROLLING	HILLY	MOUNT-AINOUS	FLAT TO ROLLING	HILLY	MOUNT-AINOUS
TRAFFIC LANES		1+	1+	1+	1+	1+	1+	1+	1+	1+	1	1	1
DESIGN SPEED (Km/hr)	DESIRABLE	70	60	40	70	40	30	60	40	30	50	30	AS PRACTI-CABLE
	MINIMUM	30	30	30	30	30	AS PRACTI-CABLE	30	30	AS PRACTI-CABLE	30	AS PRACTICABLE	
GRADIENT (LIMITING) (%)	DESIRABLE	4	5	8	4	6	8	4	7	8	5	8	12
	MAXIMUM	7	7	10	7	8	10	7	9	12	7	12	16
PAVEMENT WIDTH (M)	DESIRABLE	6.0	6.0	6.0	4.5	4.5	4.5	4.5	4.5	4.5	3.5	3.5	3.5
	MINIMUM	4.5	4.5	4.5	3.5	3.5	3.5	3.5	3.5	3.5	3.0	3.0	3.0
SHOULDER WIDTH (M)	DESIRABLE	2.0	1.5	1.5	1.5	1.5	1.0	1.5	1.0	1.0	1.0	1.0	0.75
	MINIMUM	1.5	1.0	0.75	1.0	1.0	0.75	1.0	0.75	0.5	0.75	0.5	0.5
ROAD BED WIDTH (M)	DESIRABLE	10.0	9.0	9.0	8.0	7.5	6.5	7.5	6.5	6.5	5.5	5.5	5.0
	MINIMUM	6.0	6.0	6.0	5.5	5.5	5.0	5.5	5.0	4.5	4.5	4.0	4.0
RIGHT OF WAY (M)	DESIRABLE	16			12			12			12		
	MINIMUM	12			10			10			8		
ROAD CAMBER (%)	PAVEMENT	3			3			4			4		
	SHOULDER	4			4			5			5		

Fig. 3-1-1 STANDARD ROAD CROSS SECTIONS

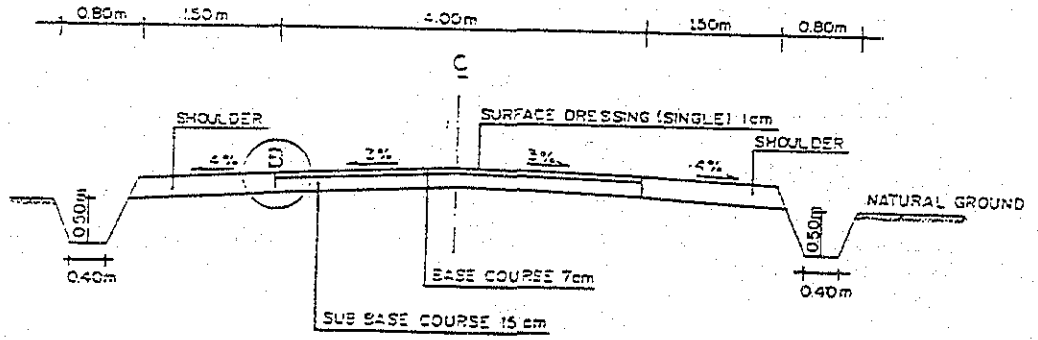
CLASS III A



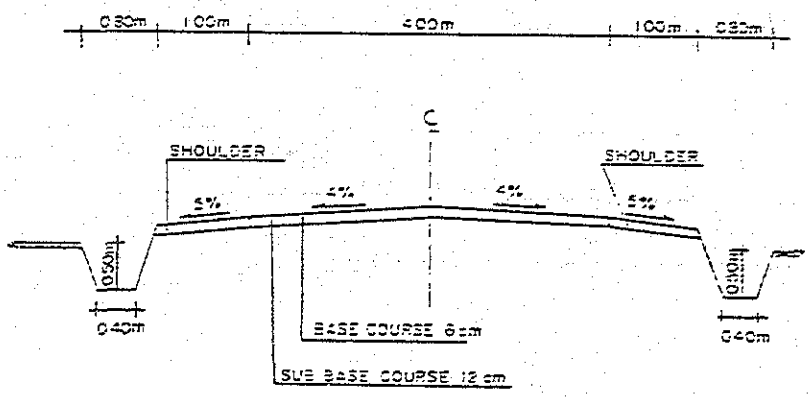
CLASS III B-2



CLASS III B-1



CLASS III C



3.2 Pavement Design

3.2.1 Design Conditions

From the engineering data prepared by the Kabupaten it is noted that the pavement structure of the Kabupaten roads seems to have been determined without adequate designs, therefore the Kabupaten roads generally have insufficient capacity. The standards generally used for highway pavement design such as Road Note 29, Road Note 31 and AASHTO are not suitable for Kabupaten roads with small traffic volumes and loads.

Therefore formulae suitable for the pavement design of Kabupaten roads are recommended as described in Chapter 5 of the Main Report.

The following are important factors for the design of pavement thickness.

1) Design Traffic Volume

As the pavement thickness is designed for each road classification the design traffic volume of which the target year is 1998, is adopted for each classification as follows:

Road Classification	Design Traffic Volume (vpd)
III A	1,000
III B-1	500
III B-2	200
III C	50

2) Strength of Roadbed

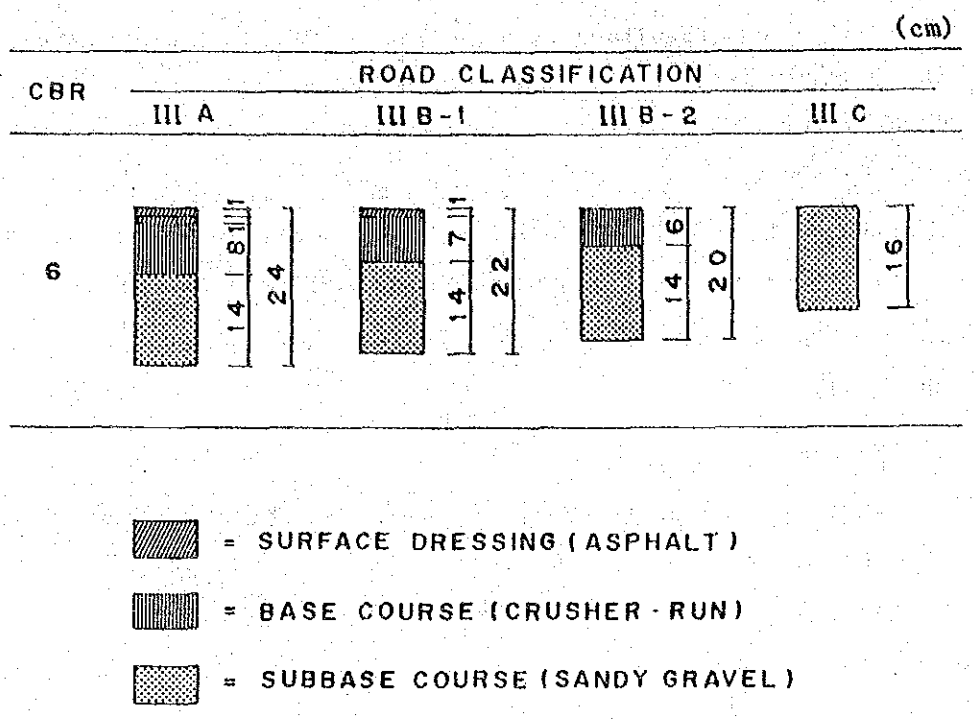
The CBR value of the existing roadbed is a very important factor for the pavement design but no results are available from CBR tests on the Kabupaten roads.

CBR of the laterite is generally in the range of CBR 4 to 10. However site CBR tests should be conducted before construction to finally decide the pavement thickness.

3.2.2 Pavement Structure

Fig. 3-2-1 shows the standard pavement structure adopted for the Kabupaten roads.

Fig. 3-2-1 PAVEMENT STRUCTURE



3.3 Design of Bridges and Other Structures

3.3.1 Standard Bridge

There are so many bridges to be improved or to be constructed on the Kabupaten roads in the Project Area that it is very difficult to prepare an individual design for each bridge. Therefore, standardization is recommended as being necessary for the bridge design with conclusions as described below.

(1) Bridge Type

1) Superstructure

The following two types have been finally selected with the agreement of Bina Marga after studying the actual rural conditions of bridge construction. Fig. 3-3-1 shows the cross sections of standard types.

a. Timber beam bridge (hereinafter timber bridge) for roads class III B-1, III B-2 and III C.

b. Reinforced concrete T-girder bridge (hereinafter RC-bridge) for roads class III A.

2) Substructure

Taking account of the actual combinations of super and substructure types noted from the field survey, the following two types are recommended as standard because of ease of construction and economy.

a) Timber pile bents for timber bridge
b) Rubble in Mortar masonry for RC bridge

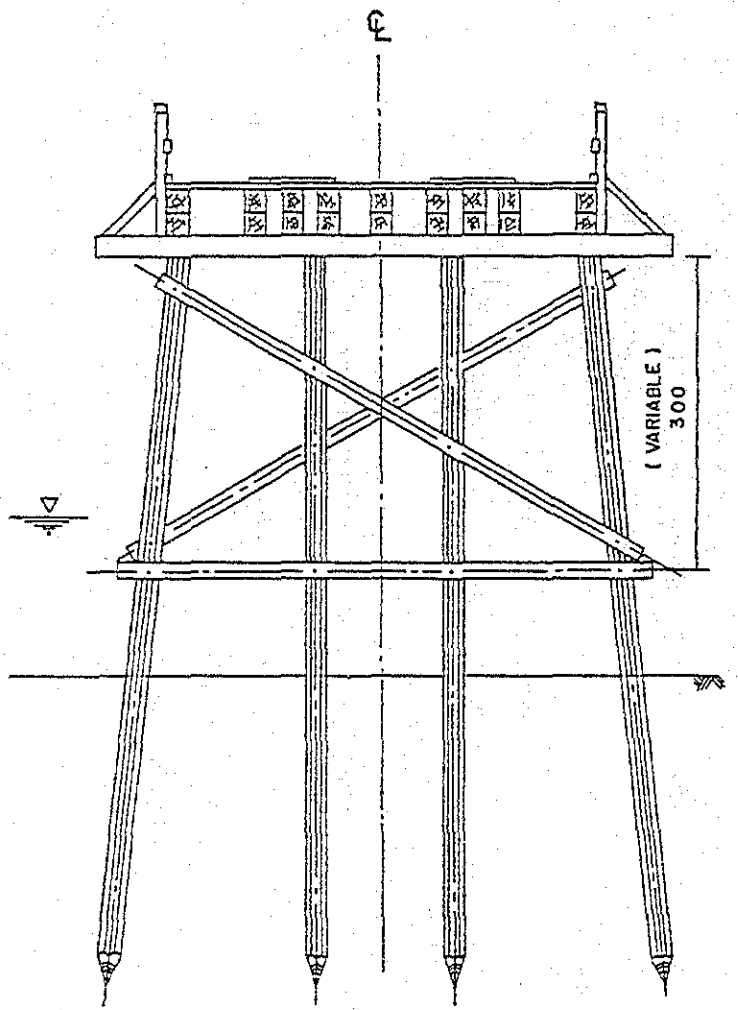
3) Foundation

There is no information of subsoil conditions in the inventory data. However, timber piles of 20 cm diameter are generally recommended as piles of this type are in common use.

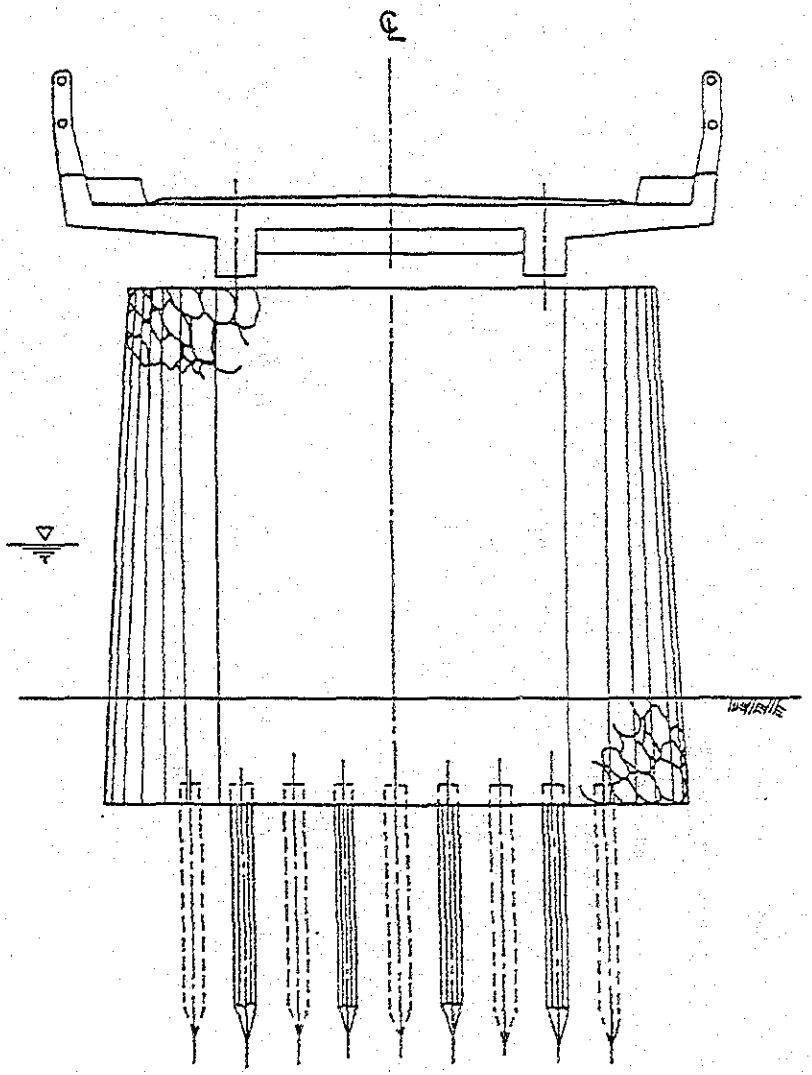
The pile length is suggested to be a minimum of 3 meters under the bottom of the foundation. The length and number of piles should be decided in order to be adequate for the condition of the foundation materials.

Fig. 3-3-1 CROSS SECTIONS OF STANDARD BRIDGES

TIMBER BRIDGE



REINFORCED CONCRETE BRIDGE



(2) Bridge Width

The effective bridge widths for the standard bridges have been decided as follows through discussions with Bina Marga considering the actual width of Kabupaten roads:

a) Timber bridge: 4.0 m in general
b) RC bridge : 4.5 m in general

(3) Span Length

The range of span lengths are determined as:

a) Timber bridge: 3.0, 5.0 and 8.0 m
b) RC bridge : 3.0, 5.0, 10.0 and 15.0 m

3.3.2 Other Structure

Culverts and retaining walls shown in Fig. 3-3-2 and Fig. 3-3-3 are recommended as standard structures.

(1) Culvert

The following two culvert types have been adopted for the transverse drainage.

a) Reinforced concrete pipe culvert ϕ 80 cm
b) Rubble in mortar box culvert with RC slab 80 cm X 80 cm

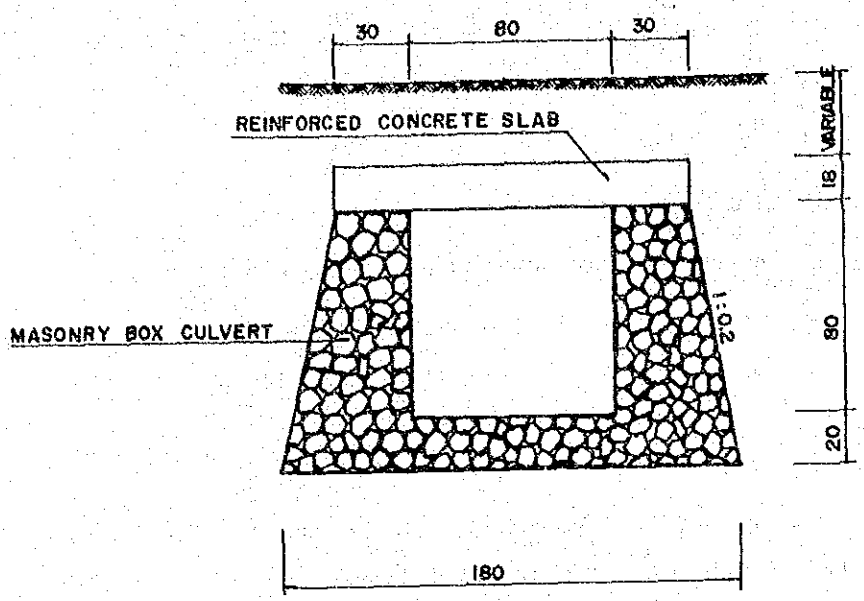
(2) Retaining Wall

The following two types of retaining walls have been adopted because of ease of construction, economy and familiarity in Indonesia.

a) Rubble in mortar retaining wall
b) Timber retaining wall

Fig. 3-3-2 STANDARD CULVERTS

80 x 80 RUBBLE IN MORTAR BOX CULVERTS



Ø 80 RENFORCED CONCRETE PIPE CULVERT

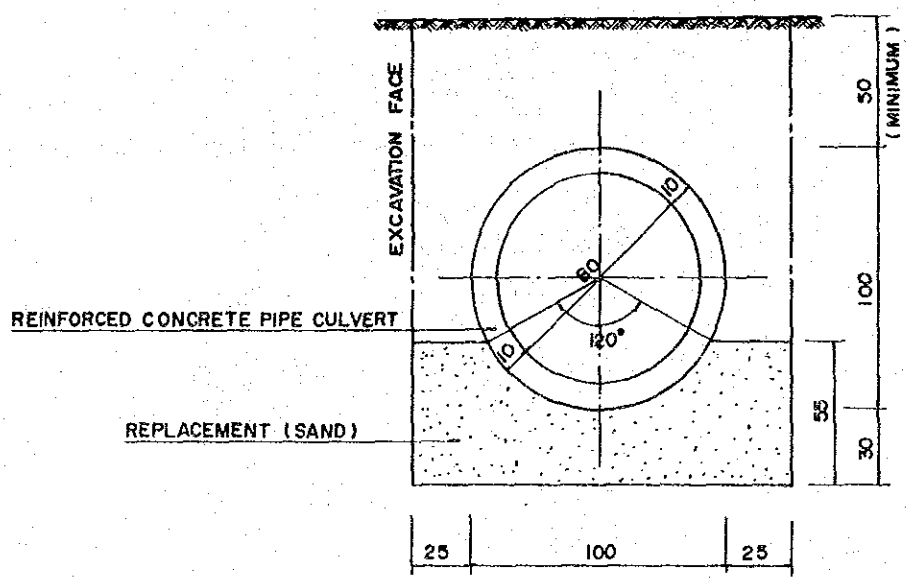
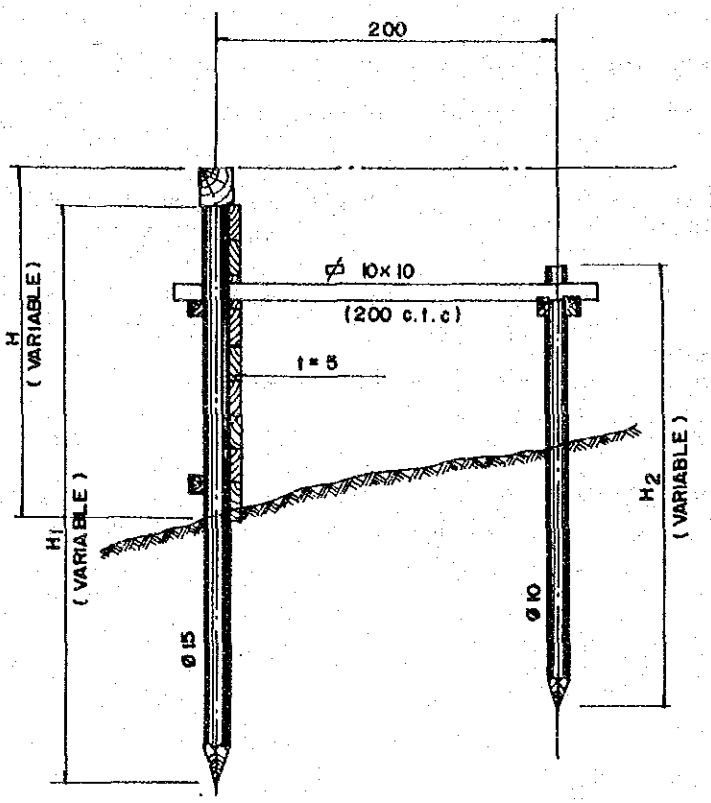
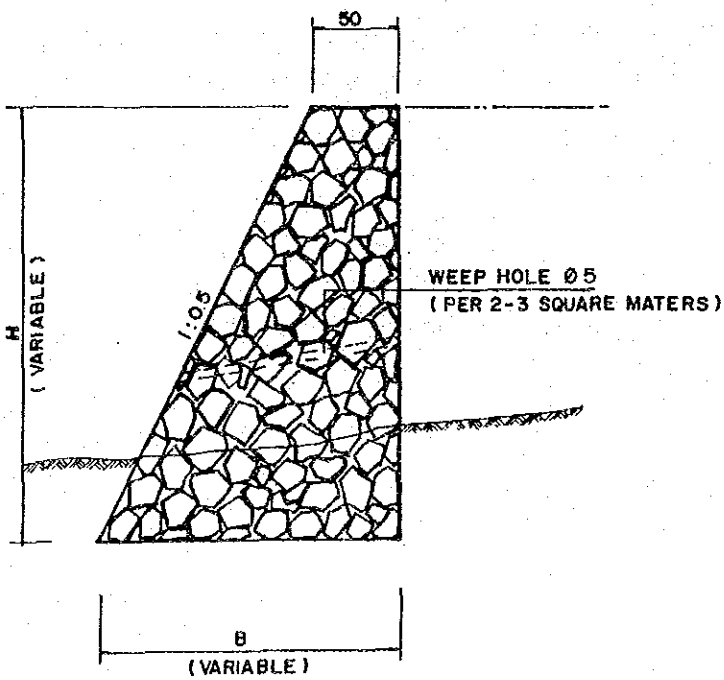


Fig. 3-3-3 STANDARD RETAINING WALLS

TIMBER RETAINING WALL



RUBBLE IN MORTAR WALL



3.4 Selection of Equipment Types

From the results of comparison of two types of Kabupaten road construction methods, i.e. equipment intensive method and labour intensive method construction methods for major works were basically decided as shown in Table 3-4-1.

Table 3-4-1 CONSTRUCTION METHODS FOR MAJOR WORKS

METHOD	WORK TYPE
Equipment Intensive	Earthwork, Base Course and Subbase Course
Labour Intensive	Surface Dressing, Drainage, Bridge and Other Structures.

3.4.1 Points to be Considered for the Selection

Full consideration was given to the following points in studying the selection of equipment type.

a. Most of the construction in the Project is pavement works for road improvement.

b. The pavement width adopted is equal to or less than 4.5 m and therefore large sized equipment is omitted from the selection process.

c. Equipment should be capable of with standing the heavy rainfall and poor soil quality. Equipment for construction in swampy areas is considered if necessary.

d. Uniformity of equipment types with existing equipment is considered to facilitate repair of the equipment in the provincial work shop.

e. Since the scale of the construction is small and transportation of equipment will frequently be necessary, wheel type equipment has been selected as much as possible as this can move by itself or by being towed.

f. The road like to be improved are scattered all over the Kabupatens and therefore a low bed truck or equivalent is necessary for transportation of crawler type equipment. It is desirable to protect the existing pavement from damage caused by the movement of crawler type equipment on the existing roads.

g. The capacity of the equipment has been decided taking into consideration the construction volume and the combination of equipment in the main work.

3.4.2 Combinations of Equipment for Major Works and Maintenance

The combinations of equipment for major works and maintenance are listed in Table 3-4-2 and 3-4-3 respectively.

Table 3-4-2 EQUIPMENT OF ONE WORK GANG FOR MAJOR TYPES OF WORK

TYPE OF WORK	EQUIPMENT REQUIRED	
1. Site Clearing in Light Bush	1- Bulldozer 90 HP 2- Dump Truck 3.0 Ton	1- Wheel Loader 1.2 m^3
2. Excavation & Embankment		
i) Normal Fill	1- Bulldozer 90 HP 1- Vibratory Roller 4.0 Ton (D&T)	1- Water Tank Truck 4,000 Ltr
ii) Fill by Borrow Material	1- Bulldozer 90 HP 3- Dump Truck 3.0 Ton	1- Wheel Loader 1.2 m^3
iii) Fill in Swamp	1- Swamp Bulldozer 90 HP 1- Water Tank Truck 4,000 Ltr	1- Vibratory Roller 4.0 Ton (D&T)
iv) Excavation to Spoil	1- Bulldozer 90 HP 1- Wheel Loader 1.2 m^3	4- Dump Truck 3.0 Ton
3. Subgrade Preparation	1- Motor Grader 75 HP 1- Vibratory Roller 4.0 Ton (D&T)	1- Water Tank Truck 4,000 Ltr
4. Subbase Course	1- Motor Grader 75 HP 1- Vibratory Roller 4.0 Ton (D&T)	1- Water Tank Truck 4,000 Ltr
5. Base Course	1- Motor Grader 75 HP 1- Vibratory Roller 4.0 Ton 1- Portable Crusher/Screens 30-40 Ton/H	1- Water Tank Truck 4,000 Ltr
6. Cement Stabilizing	1- Motor Grader 70 HP 1- Bulldozer 90 HP 1- Wheel Loader 1.2 m^3 1- Flat Bed Truck 3.0 Ton	1- Vibratory Roller 4.0 Ton (D&T) 1- Road Stabilizer 1- Water Tank Truck 4,000 Ltr
7. Surface Course	1- Asphalt Sprayer 850 Ltr 1- Tyre Roller 8-15 Ton 1- Portable Crusher/Screens 30-40 Ton/H	1- Flat Bed Truck 3.0 Ton
8. Concrete	1- Concrete Mixer 0.5 m^3 1- Water Pump 200 Ltr/Min 1- Concrete Vibrator 3.3 HP	1- Flat Bed Truck 3.0 Ton 1- Hand-Guided Vibratory Roller 1000 Kg

Table 3-4-3 EQUIPMENT OF ONE WORK GANG FOR MAINTENANCE

TYPE OF WORK	EQUIPMENT REQUIRED
Road	1- Motor Grader
	1- Tyre Roller 8-15 Ton
	1- Hand-Guided Vibratory Roller 1000 Kg
	1- Flat Bed Truck 3.0 Ton
	1- Dump Truck 3.0 Ton
Bridge and Other Structure	1- Flat Bed Truck With Crane 3.0 Ton

3.5 Workshop and Laboratory

3.5.1 Policy of the Kabupaten Workshop

A workshop will be provided for each Kabupaten. The function of the workshop is to cope with requests from the construction site. The main service will be routine maintenance while the secondary service will be light repairs which can be carried out by changing parts. Dismantling and assembling of units which need setting or adjustment using special equipment or facilities will not be carried out in the Kabupaten workshop. Such repairs are planned to be carried out by the provincial workshop or the regional Workshop of Bina Marga.

Accordingly the main tasks of the Kabupaten workshop are as follows:

1) Administration for and storage of equipment
2) Routine maintenance and light repair of equipment
3) Storage and supply of spare parts
4) Operation of equipment including crushing plant.

3.5.2 Workshop Equipment and Tools

Equipment and tools for the workshop are recommended as shown in Table 3-5-1.

Table 3-5-1 WORKSHOP EQUIPMENT AND TOOLS

DESCRIPTION	QUANTITY
Upright Drilling Machine	1 Set
Electric Hand Drill	1
Electric Portable Grinder	1
Disc Grinder	1
Bench Electric Grinder	1
Engineer's Vice	1
DC Electric Welder with Engine	1 Set
Portable Hydraulic Jack, Screw Head	1
Hydraulic Jack	1
Grease Gun	2
Suction Pump for Oil Recovery	2
High Pressure Grease Pump	1

continued

DESCRIPTION	QUANTITY
Drum Opening Spanner	1
Silicon Normal Charger	1
Tyre Changer Air Operated	1
Tyre Service Tool Set	1
Tyre Pressure Gauge	1
Automatic Tyre Inflator	1
Plug Cleaner and Tester	1
Mechanics Tool Set, Heavy Equipment	1
Mechanics Tool Set, Large Vehicle	1
Portable Air Compressor	1
Electric Cord Reel, 15 A, 50 m	1
Oil Measure, Polyethylene	1
Funnel 200 mm, Steel	3
Hand Truck (Cart), 4-Wheel	1
Nylon Sling, 10 ton	2
Chain Block, 1 ton	2
Wire Rope (for sling), 1.8 ton	2
Wire Rope (for sling) 3.2 ton	2
Generator	1

3.5.3 Laboratory

For quality control of construction in the Project it is recommended that a laboratory is provided for each Kabupaten. For each laboratory, provision of laboratory test equipment for the following tests is recommended:

- Physical characteristic, compaction and strength tests for the road bed and pavement materials.
- Slump and strength tests for the bridge concrete.

In the laboratory a fixed water tank should be provided for CBR tests and curing of concrete specimens.

The proposed laboratory equipment is listed in Table 3-5-2.

Table 3-5-2 LABORATORY TEST EQUIPMENT

DESCRIPTION	QUANTITY
Soil Moisture Test Set (JIS A1203)	1
Liquid Limit Set (JIS A1205)	1
Plastic Limit Set (JIS A1206)	1
Compaction Set (JIS A1210)	1
CBR Laboratory Set, Mechanical (JIS A1211)	1
Sand Density Apparatus (JIS A1214)	1
Aggregate Test Sieve Set	1
Portable Cone Penetrometer	1
Compression & Bending Test Machine	1
Cylinder Mould (JIS A1132, 1108)	9
Slump Test Apparatus (JIS A1101)	2

To conduct the surveys necessary for road and structure construction such as centering, profile leveling, cross section leveling etc., the surveying equipment listed in Table 3-5-3 recommended.

Table 3-5-3 SURVEYING EQUIPMENT

DESCRIPTION	QUANTITY
Transit	1
Level	1
Staff	3

Chapter 4 CONSTRUCTION AND MAINTENANCE COST ESTIMATIONS

4.1 Unit Price

With regard to the unit prices of materials and labor, the data were collected from each Kabupaten through Bina Marga. The collected data were compared with those of Jakarta using BAHAN BANGUNAN DKI-JAKARTA MAY & JUNE 1985 compiled by PUSAT INFORMASI TEHNIK PEMBANGUNAN, and then finalized.

4.1.1 Unit Labour Price

The unit labour prices of Kabupaten Mamuju and other Kabupatens in Sulawesi Selatan Province are shown in Table 4-1-1.

Table 4-1-1 UNIT LABOUR PRICE

(Rp)

KABUPATEN	MAN	SKL LAB	CAP	MAS	LAB	DRIV	OPE
Gowa	2,000	2,000	2,500	2,500	1,500	3,000	3,750
Pangkajene Kepulauan	2,000	2,000	3,000	3,000	1,500	3,500	3,500
Barru	3,000	2,500	3,000	3,000	2,000	3,000	3,500
Soppeng	2,250	2,200	3,000	3,000	1,700	2,750	3,000
Wajo	2,500	2,000	3,000	3,000	1,500	3,000	4,500
Tana Toraja	3,000	2,500	3,000	3,000	2,000	3,500	7,500
Mamuju	2,500	2,000	3,500	3,500	1,500	3,500	5,000
Average	2,464	2,171	3,000	3,000	1,671	3,179	4,393

Notes :

MAN : Mandur
SKL LAB : Skilled Labour
CAP : Carpenter
MAS : Mason
LAB : Labourer
DRIV : Driver
OPE : Operater

4.1.2 Unit Price of Materials

Table 4-1-2 shows the unit price of materials for Kabupaten Mamuju together with for other Kabupatens in Sulawesi Selatan Province.

Table 4-1-2 UNIT PRICE OF MATERIALS

(Rp)

MATERIAL	UNIT	GOWA	PANGKAJENE KEPULAUAN	BARRU	SOPPENG
Bitumen	L	275	250	325	250
Asphalt Oil	L	700	700	750	700
Gasoline	L	250	250	250	250
Sand	M^3	4,000	5,000	6,000	5,250
Cement	bag	3,750	3,750	3,750	4,250
River Stone	M^3	4,000	4,500	6,000	5,250
Steel Moulds	Set	7,500	7,000	7,000	7,000
Timber	M^3	200,000	150,000	180,000	225,000
Pain	L	3,500	2,500	2,500	2,500
Reinforcing Steel	Kg	750	750	750	1,000
Tying Wire	Kg	1,200	1,200	1,500	1,500
Equivalent Royalty	M^3	250	250	250	250

MATERIAL	UNIT	WAJO	TANA TORAJA	MAMUJU	AVERAGE
Bitumen	L	275	400	270	295
Asphalt Oil	L	700	800	700	1,000
Gasoline	L	250	250	250	250
Sand	L	5,000	8,000	3,500	5,250
Cement	bag	4,000	4,500	4,500	4,070
River Stone	M^3	7,500	7,000	3,500	5,393
Steel Moulds	Set	7,500	7,000	7,000	7,143
Timber	M^3	200,000	175,000	160,000	184,285
Paint	L	3,500	2,500	2,750	2,820
Reinforcing Steel	Kg	750	1,000	800	825
Tying Wire	Kg	1,500	1,500	1,100	1,357
Equivalent Royalty	M^3	250	250	250	250

4.1.3 Hourly Equipment Cost

The hourly equipment cost for Kabupaten is shown in Table 4-1-3.

Table 4-1-3

HOURLY EQUIPMENT COST

PROVINCE : SULAWESI SELATAN
KABUPATEN : MAMUJU

(UNIT : Rp) (6'85)

CODE NO	EQUIPMENT NAME	CLASS	LOCAL COST OWNERSHIP	LOCAL COST OPERATION	LOCAL COST SUB-TOTAL	FOREIGN COST OWNERSHIP	FOREIGN COST OPERATION	FOREIGN COST SUB-TOTAL	TOTAL COST
	Bulldozer	120 HP	311	15,025	15,336	7,769	1,034	8,803	24,139
	Bulldozer/Ripper	120 HP	340	16,045	16,385	8,500	1,591	10,091	26,476
	Swamp Bulldozer	120 HP	356	16,290	16,646	8,879	1,662	10,541	27,187
	Bulldozer	90 HP	197	10,273	10,470	4,914	654	5,568	16,038
	Bulldozer/Ripper	90 HP	212	10,869	11,081	5,300	992	6,292	17,373
	Bulldozer	65 HP	140	7,475	7,615	3,500	465	3,965	11,580
	Bulldozer/Ripper	65 HP	153	7,928	8,081	3,819	714	4,533	12,614
	Swamp Bulldozer	90 HP	212	10,859	11,071	5,284	989	6,273	17,344
	Swamp Bulldozer	65 HP	162	7,723	7,885	4,050	758	4,808	12,693
	Motor Grader	110 HP	277	12,909	13,186	6,919	1,295	8,214	21,400
	Motor Grader	75 HP	192	8,842	9,034	4,779	894	5,673	14,707
	Motor Grader	65 HP	172	7,765	7,937	4,300	804	5,104	13,041
	Road Stabilizer	W=1850 mm	344	3,414	3,758	8,594	428	9,022	12,780
	Vibratory Roller	4 ton	116	3,899	4,015	2,900	385	3,285	7,300
	Hand-guide Vib. Roller	1000 Kg	102	696	798	850	30	880	1,678
	Tire Roller	8-15 ton	125	8,998	9,123	3,106	103	3,209	12,332
	Vibratory Roller (D&T)	4 ton	116	3,899	4,015	2,900	385	3,285	7,300
	Hand-guide Vib. Roller	600 Kg	72	475	547	600	21	621	1,168
	Rough Terrain Crane	10 ton	402	15,079	15,481	10,039	751	10,790	26,271
	Hydraulic Excavator; Wheel	0.3 m3	165	9,271	9,436	4,109	546	4,655	14,091
	Wheel Loader	1.2 m3	281	9,636	9,917	7,019	934	7,953	17,870
	Wheel Loader	0.3 m3	91	3,390	3,481	2,269	302	2,571	6,052
	Water Tank Truck	4000 ltr.	105	3,498	3,603	868	124	992	4,595
	Fuel Tank Truck	4000 ltr.	106	3,504	3,610	882	126	1,008	4,618
	Dump Truck	3.0 ton	177	4,288	4,465	1,469	210	1,679	6,144
	Flat Bed Truck with Crane	3.0 ton	69	3,736	3,805	1,717	128	1,845	5,650
	Dump Loader Truck	12 ton	154	23,678	23,832	3,838	127	3,965	27,797
	Dump Truck	5.0 ton	263	7,113	7,376	2,189	313	2,502	9,878
	Flat Bed Truck	3.0 ton	23	3,306	3,329	563	42	605	3,934
	Portable Crusher/Screening	30-40 t/h	752	25,237	25,989	18,800	2,502	21,302	47,291
	Concrete Mixer	0.5 m3	648	2,555	3,203	5,400	435	5,835	9,038
	Water Pump	200 l/min	23	317	340	188	6	194	534
	Concrete Vibrator	3.3 HP	9	280	289	73	2	75	364
	Asphalt Sprayer	850 ltr.	123	861	984	1,019	145	1,164	2,148

4.2 Unit Construction Cost by Work Type

4.2.1 All Works Except Bridges

The unit construction costs by work type, excluding bridge construction costs, have been estimated using the combination of equipment described in Clause 3.4 and the unit prices already listed. The results are summarized in Table 4-2-1.

Table 4-2-1 UNIT COST BY WORK TYPE EXCEPT BRIDGE WORK

PROV : SULAWESI SELATAN KAB : MAMUJU

(Rp)

ITEM	UNIT	LOCAL	FOREIGN	TOTAL
Superstructure (Timber;Span 3m;10T)	m2	52,520	3,812	56,332
Superstructure (Timber;Span 5m;10T)	m2	58,174	4,210	62,384
Superstructure (Timber;Span 8m;10T)	m2	77,055	5,529	82,584
Superstructure (Timber;Span 3m;BM50)	m2	65,123	4,714	69,837
Superstructure (Timber;Span 5m;BM50)	m2	71,097	5,108	76,205
Superstructure (Timber;Span 8m;BM50)	m2	90,171	6,466	96,637
Superstructure (Concrete;Span 3m;BM50)	m2	54,854	89,335	144,189
Superstructure (Concrete;Span 5m;BM50)	m2	56,035	99,771	155,806
Superstructure (Concrete;Span 8m;BM50)	m2	57,494	108,638	166,132
Superstructure (Concrete;Span10m;BM50)	m2	62,696	123,327	186,023
Superstructure (Concrete;Span15m;BM50)	m2	67,112	145,197	212,309
Substructure (Pier;for Timber;10T)	NO	457,406	35,428	492,834
Substructure (Abut;for Timber;10T)	NO	1,244,461	163,285	1,407,746
Substructure (Pier;for Timber;BM50)	NO	672,697	52,434	725,131
Substructure (Abut;for Timber;BM50)	NO	1,406,642	181,918	1,588,560
Substructure (Pier;for Concrete;BM50)	NO	1,573,479	467,969	2,041,448
Substructure (Abut;for Concrete;BM50)	NO	3,417,174	984,591	4,401,765
Demolition of Bridge (Timber->Timber)	m2	14,529	1,463	15,992
Demolition of Bridge (Timber->Concrete)	m2	14,529	1,463	15,992
Demolition of Bridge (Concrete)	m2	81,826	69,705	151,531
Maintenance of Timber Bridge (New)	m2	9,584	1,177	10,761
Maintenance of Concrete Bridge (New)	m2	2,045	2,726	4,771
Maintenance of Timber Bridge (Exist)	m2	9,297	2,433	11,730
Maintenance of Concrete Bridge (Exist)	m2	4,914	2,390	7,304

4.2.2 Bridges

The unit construction costs by bridge type including the cost of demolition of existing bridges are shown in Table 4-2-2.

Table 4-2-2 BRIDGE COST

PROV : SULAWESI SELATAN KAB : MAMUJU

(Rp)

ITEM	UNIT	LOCAL	FOREIGN	TOTAL
Site Clearance in Light Bush	m2	187	91	278
Subgrade Preparation	m2	24	11	35
Normal Fill	m3	1,939	865	2,804
Fill in Swamp	m3	2,828	1,055	3,883
Normal Excavation to Spoil	m3	1,131	524	1,655
Sub Base Course	m3	3,631	1,351	4,982
Base Course	m3	4,978	2,303	7,281
Shoulder	m2	338	146	484
Asphalt Patching	m2	3,699	1,339	5,038
Surface Dressing (Single)	m2	617	544	1,161
Surface Dressing (Double)	m2	778	855	1,633
Earth Drain	m	833	119	952
Earth Drain in Swamp (by machine)	m3	1,330	475	1,805
Pipe Culvert D80cm	m	41,405	43,777	85,182
Masonry Culvert (80x80cm)	m	58,736	37,380	96,116
Retaining Wall and Wing Wall (Timber)	m2	14,893	246	15,139
Retaining Wall and Wing Wall (Masonry)	m3	41,223	11,706	52,929
Gabion Protection	m3	8,525	121	8,646
Manual routine maintenance of road	Km	131,948	7,260	139,208
Routine maintenance of earth road	Km	106,610	37,948	144,558
Routine maintenance of gravel road	Km	216,507	88,186	304,693
Routine maintenance of asphalt road	Km	369,900	133,900	503,800

Chapter 5 RESULTS OF ECONOMIC FEASIBILITY EVALUATION

5.1 Preliminary Screening

The road links to be improved should be effective for development of the Project Area. The road links where improvements were assumed to be inefficient for development of the Project Area were generally screened out using the following cut-off criteria.

(1) Very short roads, less than 2 Km long, which have no connection with the trunk road network.

(2) Roads not connected to the network at any point

(3) Unpreferred roads, due to poor suitability for transportation compared to other existing alternative roads serving the same purpose.

(4) Road in good condition according to the Bina Marga road inventory which lists improvement projects carried out in the last two or three years

(5) Roads with asphalt surface in good condition

(6) Urban roads, except those forming part of a longer route

(7) Roads serving single large organizations rather than the general public

(8) Roads with no inventory data

(9) Kabupaten roads also assigned as provincial roads

The road links to be screened out in Kabupaten Mamuju are shown in Table 5-1-1.

Table 5-1-1 ROAD LINKS TO BE SCREENED OUT

KABUPATEN : MAMUJU

CRITERIA NO	ROAD LINK NO
(8)	07,08,09

5.2 Evaluation

5.2.1 Primary Analysis

The Kabupaten roads were classified by using the future traffic volume on the road links in 1998. The primary analysis of the IRR was carried out using the construction and maintenance costs. Road links where IRRs were more than 10% were defined as feasible links.

Results of primary analysis are shown in Table 5-2-1.

5.2.2 Secondary Analysis

From the infeasible road links evaluated by the primary analysis, road links where the IRRs were between 1% and 10%, i.e. road links which could become feasible if down graded by one rank, in classification were down graded and the costs re-estimated. Using these costs, a secondary analysis of IRR was carried out. Road links where these IRRs were then more than 10% were also defined as feasible links. This reflected that even though the road classification was rather low the road link should be improved.

Results of secondary analysis are shown in Table 5-2-2.

5.2.3 Ranking of Feasible Road Links

From the results of the primary and secondary analysis, road links where the IRRs were more than 10% were selected and their NPVs and B/Cs were estimated. The ranking of feasible road links from the economic evaluation are decided in the order of the NPVs, i.e. the larger the NPV the higher the road link priority as shown in Table 5-2-3.

Table 5-2-1 RESULTS OF PRIMARY ANALYSIS

PROVINCE : SULAWESI SELATAN KABUPATEN : MAMUJU

LINK NO	LENGTH	CLASS	IRR(%)	REMARK
1	17 Km	IIIC	0.07B	Surplus
2	14 Km	IIIC	0.07B	Surplus
3	15 Km	IIIB-2	0.07B	Surplus
4	15 Km	IIIB-2	0.07B	Surplus
5	13 Km	IIIC	0.07B	Surplus
6	10 Km	IIIC	0.07B	Surplus
10	17 Km	IIIB-2	0.07B	Surplus
11	12 Km	IIIB-2	0.07B	Surplus
12	15 Km	IIIB-2	0.07B	Surplus
13	15 Km	IIIC	0.07B	Surplus
14	24 Km	IIIC	0.07B	Surplus
15	12 Km	IIIC	0.07B	Surplus
16	12 Km	IIIC	0.07B	Surplus
17	11 Km	IIIC	0.07B	Surplus

Table 5-2-2 RESULTS OF SECONDARY ANALYSIS

Nil

Table 5-2-3 RANKING OF FEASIBILITY ROAD LINKS

Nil

Chapter 6 IMPLEMENTATION PROGRAMME

6.1 Implementation Schedule

6.1.1 Project Cost

The total Project Cost for the Kabupaten is composed of the cost of construction and maintenance, supplementation as described later, and workshop, laboratory and survey equipment. The total Project Cost for the Kabupaten is summarized in Table 6-1-1.

Table 6-1-1 TOTAL PROJECT COST (1)

KABUPATEN: Mamuju

(Rpx10^6)

COST	FOREIGN CURRENCY	LOCAL CURRENCY	TOTAL
CONSTRUCTION	377	1,452	1,829
MAINTENANCE	61	217	278
SUPPLEMENTATION	264	-	264
WORKSHOP EQUIPMENT & TOOLS	28	-	28
LABORATORY EQUIPMENT	12	-	12
SURVEY EQUIPMENT	5	-	5
TOTAL	747	1,669	2,416

The total Project Cost can be divided into costs as shown in Table 6-1-2.

Table 6-1-2 TOTAL PROJECT COST (2)

(Rpx10^6)

COST	FOREIGN CURRENCY	LOCAL CURRENCY	TOTAL
CIVIL WORK	112	1,659	1,771
CONSTRUCTION & MAINTENANCE EQUIPMENT	549	-	549
SPARE PARTS	41	10	51
WORKSHOP/LABORATORY/SURVEY EQUIPMENT	45	-	45
TOTAL	747	1,669	2,416

The cost for civil work is composed of the cost of labour and materials, operation cost excluding spare parts, indirect cost and transportation cost of equipment, and ownership cost for existing equipment.

6.1.2 Proposed Road Links

(1) Road Link to be Improved

The road links to be improved were generally selected taking into consideration the following criteria:

(1) Feasible road links
- Feasible road links from the primary evaluation
- Feasible road links from the secondary evaluation

(2) Road links selected from the engineering points of view

(3) Road links selected because of basic human needs.

The road links finally proposed to be improved in the Kabupaten are the 9 links with the total length of 133 km which is 66% of the 202 km total length of Kabupaten roads studied. The proposed road links are shown in Table 6-1-3.

Table 6-1-3 ROAD LINKS TO BE IMPROVED

KABUPATEN : MAMUJU

REASON FOR SELECTION	ROAD LINK NO
Feasible	
- Primary	-
- Secondary	-
Engineering Point of View	-
Basic Human Needs	1,2,3,4,5,10,11,12,13,

As the table shows there are no feasible road links from the economic evaluation. Therefore the following minimum required road links are selected regardless of any result of economic evaluation from the view point of basic human needs:

- Road links which connect the Kabupaten capital with the Kecamatan capital provided the population density of the Kecamtan is greater than the mean for the Kabupaten; and
- Road links which are effective in providing more effective development from the road improvement.

The order of proceeding with the improvement of the proposed road links are decided as shown in Table 6-1-4.

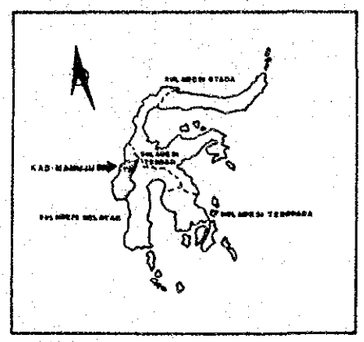
Table 6-1-4 ROAD LINKS TO BE IMPROVED BY YEAR

PROV : SULAWESI SELATAN KAB : MAMUJU

YEAR	LINK NO ( ) : rate
1988 :	1, 10
1989 :	2 (50%), 11 (60%)
1990 :	2 (50%), 4, 11 (40%)
1991 :	3 (65%), 12
1992 :	3 (35%), 5, 13

KAB · MAMUJU

LOCATION MAP



CONSTRUCTION PROGRAMME

ROAD LINK NUMBER	FISCAL YEAR				
	1980/81	1981/82	1982/83	1983/84	1984/85
01,10	158				
12,11		331			
02,04,11			459		
03,12				479	
03,09,13					401
TOTAL COST (10^6 Rp)	158	331	459	479	401

THE FEASIBILITY STUDY OF THE LOCAL ROAD DEVELOPMENT IN THE REPUBLIC OF INDONESIA

TITLE : CONSTRUCTION PROGRAMME

SOURCE:	SCALE:	PROVINCE SULAWESI SELATAN
DIREKTORAT JENDERAL CIPTA KARYA	AS SHOWN	KABUPATEN MAMUJU

(2) Road Links to Be Maintained

It is desirable that all Kabupaten roads are maintained. However, because of the limited budget it is inevitable that some road links in the Kabupatens will be left without maintenance for the time being. The budget should be used for those which are effective in producing more useful development of the Kabupaten through the road development project. The road links to be maintained are finally proposed as shown in Table 6-1-5.

Table 6-1-5 ROAD LINKS TO BE MAINTAINED

PROV : SULAWESI SELATAN KAB : MAMUJU

(1000Rp)

LINK NO	LENGTH (Km)	RA (%)	RD (%)	RU (%)	RB (%)	ASPHAL (Km)	GRAVEL (Km)	EARTH (Km)	IR NO	AREA (m2)	RC NO	AREA (m2)	BRIDGE COST	LOCAL COST	FOREIGN COST	TOTAL COST
1	17	70.2	4.2	10.6	7.1	0	14	3	5	472.00	15	336.00	7,991	11,633	3,423	15,056
2	14	20.0	50.0	30.0	0.0	0	0	14	0	0.00	3	238.50	1,742	4,512	1,203	5,715
4	15	34.0	32.7	33.3	0.0	0	15	0	5	220.00	7	140.00	3,603	7,960	2,302	10,262
10	17	8.5	42.1	36.5	12.9	0	12	5	5	568.00	5	116.00	7,510	11,225	3,031	14,256
12	15	28.7	34.0	37.3	0.0	0	15	0	0	0.00	6	124.00	906	5,836	1,728	7,564
13	15	26.0	28.0	46.0	0.0	0	15	0	0	0.00	0	0.00	0	5,227	1,432	6,659
SUM	93					0	71	22	15	1260.00	36	954.50	21,751	46,393	13,119	59,512

6.1.3 Annual Construction and Maintenance Cost

The annual allocation of the total construction and maintenance cost in the five years programme for Kabupaten Mamuju is finally recommended as shown in Tables 6-1-6 (1), (2) and (3) for the construction, maintenance and total respectively.

The proposed construction cost is Rp 1,829 x 10^6 and maintenance cost is Rp 278 x 10^6 which is approximately 13% of the total expenditure.

Table 6-1-6 (1) CONSTRUCTION AND MAINTENANCE COST
(CONSTRUCION)

PROV : SULAWESI SELATAN KAB : MAMUJU

(UNIT : 1000Rp)

ITEM	(1988)	(1989)	(1990)	(1991)	(1992)	(TOTAL)	
LOCAL CURRENCY :	110,683	269,490	333,927	394,555	324,363	1,433,018	(78.4%)
Ownership Cost	2,189	4,285	4,903	3,501	3,327	18,205	(1.3%)
Operation Cost	63,606	133,697	145,483	107,434	98,963	549,183	(38.3%)
Material Cost	11,509	39,945	63,115	127,195	93,412	335,176	(23.4%)
Labour Cost	18,942	56,412	76,870	104,961	86,353	343,538	(24.0%)
Contingency	14,437	35,151	43,556	51,464	42,308	186,916	(13.0%)
FOREIGN CURRENCY :	47,316	81,486	105,901	84,140	76,876	395,719	(21.6%)
Ownership Cost	31,046	59,093	67,115	49,518	46,604	253,376	(64.0%)
Operation Cost	4,496	8,434	9,319	6,809	6,448	35,506	(9.0%)
Material Cost	5,602	3,330	15,654	16,838	13,797	55,221	(14.0%)
Labour Cost	0	0	0	0	0	0	(0.0%)
Contingency	6,172	10,629	13,813	10,975	10,027	51,616	(13.0%)
TOTAL COST :	157,999	350,975	439,828	478,694	401,240	1,828,736	
Ownership Cost	33,235	63,378	72,018	53,019	49,931	271,581	(14.9%)
Operation Cost	68,102	142,131	154,802	114,243	105,411	584,689	(32.0%)
Material Cost	17,111	43,275	78,769	144,033	107,209	390,397	(21.3%)
Labour Cost	18,942	56,412	76,870	104,961	86,353	343,538	(18.8%)
Contingency	20,609	45,779	57,369	62,438	52,336	238,531	(13.0%)

(Contingency : 15%)

Table 6-1-6 (2) CONSTRUCTION AND MAINTENANCE COST

(MAINTENANCE)

PROV : SULAWESI SELATAN KAB : MAMUJU

(UNIT : 1000Rp)

ITEM	(1988)	(1989)	(1990)	(1991)	(1992)	(TOTAL)	
LOCAL CURRENCY :	17,453	46,107	42,137	49,847	61,289	216,833	(78.2%)
Ownership Cost	202	541	494	606	634	2,477	(1.1%)
Operation Cost	10,236	26,856	24,528	29,292	30,866	121,778	(56.2%)
Material Cost	1,111	3,674	3,359	3,777	9,586	21,507	(9.9%)
Labour Cost	5,904	15,036	13,756	16,172	20,203	71,071	(32.8%)
FOREIGN CURRENCY :	4,940	13,216	12,063	14,406	15,928	60,553	(21.8%)
Ownership Cost	4,206	11,224	10,243	12,291	13,016	50,980	(84.2%)
Operation Cost	454	1,194	1,089	1,338	1,393	5,468	(9.0%)
Material Cost	280	798	731	777	1,519	4,105	(6.8%)
Labour Cost	0	0	0	0	0	0	(0.0%)
TOTAL COST :	22,393	59,323	54,200	64,253	77,217	277,386	
Ownership Cost	4,408	11,765	10,737	12,897	13,650	53,457	(19.3%)
Operation Cost	10,690	28,050	25,617	30,630	32,259	127,246	(45.9%)
Material Cost	1,391	4,472	4,090	4,554	11,105	25,612	(9.2%)
Labour Cost	5,904	15,036	13,756	16,172	20,203	71,071	(25.6%)

Table 6-1-6 (3) CONSTRUCTION AND MAINTENANCE COST

(TOTAL)

PROV : SULAWESI SELATAN KAB : MAMUJU

(UNIT : 1000Rp)

ITEM	(1988)	(1989)	(1990)	(1991)	(1992)	(TOTAL)	
LOCAL CURRENCY :	120,136	315,597	376,064	444,402	385,652	1,649,851	(78.3%)
Ownership Cost	2,391	4,826	5,397	4,107	3,961	20,682	(1.3%)
Operation Cost	73,842	160,553	170,011	136,726	129,829	670,961	(40.7%)
Material Cost	12,620	43,619	66,474	130,972	102,998	356,683	(21.6%)
Labour Cost	24,846	71,448	90,626	121,133	106,556	414,609	(25.1%)
Contingency	14,437	35,151	43,556	51,464	42,308	186,916	(11.3%)
FOREIGN CURRENCY :	52,256	94,702	117,964	98,546	92,804	456,272	(21.7%)
Ownership Cost	35,252	70,317	77,358	61,809	59,620	304,356	(66.7%)
Operation Cost	4,950	9,628	10,408	8,147	7,841	40,974	(9.0%)
Material Cost	5,882	4,128	16,385	17,615	15,316	59,326	(13.0%)
Labour Cost	0	0	0	0	0	0	(0.0%)
Contingency	6,172	10,629	13,813	10,975	10,027	51,616	(11.3%)
TOTAL COST :	180,392	410,298	494,028	542,947	478,457	2,106,122	
Ownership Cost	37,643	75,143	82,755	65,916	63,581	325,038	(15.4%)
Operation Cost	78,792	170,181	180,419	144,873	137,670	711,935	(33.8%)
Material Cost	18,502	47,747	82,859	148,587	118,314	416,009	(19.8%)
Labour Cost	24,846	71,448	90,626	121,133	106,556	414,609	(19.7%)
Contingency	20,609	45,779	57,369	62,438	52,336	238,531	(11.3%)

(Contingency : 15%)

6.1.4 Construction and Maintenance Equipment Cost

(1) Required Number of Equipment

The required numbers of construction equipment for Kabupaten Mamuju are estimated from the annual proposed construction quantities as shown in Table 6-1-7.

The proposed numbers of equipment to be purchased are finally decided considering the following number of existing equipment in the Kabupaten which are available for the Project .

- 1-Portable Crusher

The proposed numbers of maintenance equipment have been decided as shown below from the proposed annual maintenance volume taking into account the capacity of the proposed maintenance gangs.

a. Equipment for Road Maintenance

- 1-Flat Bed Truck 3 Ton

b. Equipment for Bridge Maintenance

- 1-Flat Bed Truck with Grane 3 Ton

(2) Equipment Cost

The proposed construction and maintenance equipment and their purchase costs are shown in Table 6-1-8. In the Project the supplementation cost or equipment cost supplemented is the difference between the purchase cost for newly supplied equipment and the depreciated value.

This comes about because full depreciation of the supplied equipment would not be completed within the Project Period of 5 years.

Table 6-1-7 REQUIRED NUMBER OF EQUIPMENT

PROV : SULAWESI SELATAN KAB : MAMUJU

EQUIPMENT NAME	WORKABLE	EXISTING	(1988)	(1989)	(1990)	(1991)	(1992)
Bulldozer/Ripper	250	0	0.23	0.14	0.20	0.20	0.22
Swamp Bulldozer	250	0	0.00	0.57	0.49	0.26	0.14
Motor Grader	250	0	0.56	0.42	0.55	0.51	0.57
Hand-guide Vib. Roller	250	0	0.15	0.17	0.57	0.94	0.97
Tire Roller	250	0	0.00	0.00	0.00	0.00	0.00
Vibratory Roller (D&T)	250	0	0.40	0.83	0.82	0.60	0.50
Hydraulic Excavator; Wheel	250	0	0.00	1.95	1.67	0.98	0.53
Wheel Loader	250	0	0.68	1.08	1.21	0.91	0.90
Water Tank Truck	250	0	0.24	0.57	0.55	0.39	0.32
Dump Truck	250	0	4.98	10.39	11.01	7.76	7.46
Flat Bed Truck with Crane	250	0	0.13	0.30	0.82	1.20	0.89
Flat Bed Truck	250	0	0.10	0.06	0.20	0.32	0.33
Portable Crusher/Screening	250	1	0.15	0.00	0.09	0.09	0.16
Concrete Mixer	250	0	0.04	0.00	0.21	0.02	0.02
Water Pump	250	0	0.04	0.00	0.68	0.02	0.02
Concrete Vibrator	250	0	0.02	0.00	0.03	0.02	0.02
Asphalt Sprayer	250	1	0.00	0.00	0.00	0.00	0.00

NOTE WORKABLE : workable days in a year
EXISTING : number of existing equipment

Table 6-1-8 EQUIPMENT PURCHASE COST

PROV : SULAWESI SELATAN KAB : MAMUJU

(1000 Rp)

EQUIPMENT NAME	CLASS	CIF (JAKARTA)	PURCHASE NO.	PURCHASE COST
Bulldozer	90 HP	49,150	-	-
Bulldozer/Ripper	90 HP	53,000	-	-
Swamp Bulldozer	90 HP	52,850	1	52,850
Swamp Bulldozer	65 HP	40,500	-	-
Motor Grader	75 HP	47,800	1	47,800
Road Stabilizer	W=1850 mm	85,950	-	-
Hand-guide Vib. Roller	1000 Kg	8,500	1	8,500
Tire Roller	8-15 ton	31,070	1	31,070
Vibratory Roller (D&T)	4 ton	29,000	1	29,000
Vibratory Roller	4 ton	29,000	-	-
Rough Terrain Crane	10 ton	100,400	-	-
Hydraulic Excavator; Wheel	0.3 m3	41,100	1	41,100
Wheel Loader	1.2 m3	70,200	1	70,200
Water Tank Truck	4000 ltr.	12,750	1	12,750
Dump Truck	3.0 ton	14,700	11	161,700
Dump Loader Truck	12 ton	56,300	-	-
Flat Bed Truck with Crane	3.0 ton	25,190	2	50,380
Flat Bed Truck	3.0 ton	11,275	1	11,275
Portable Crusher/Screening	30-40 t/h	188,000	-	-
Concrete Mixer	0.5 m3	18,000	-	-
Water Pump	200 l/min	630	-	-
Concrete Vibrator	3.3 HP	740	-	-
Asphalt Sprayer	850 ltr.	10,200	-	-
Service Car	3 ton	11,600	1	11,600
4 Wheel Drive Vehicle	70 HP	17,500	1	17,500
Motorcycle	100 cc	1,100	3	3,300

PURCHASE COST TOTAL	549,025
OWNERSHIP COST (FOREIGN)	285,222
EQUIPMENT COST SUPPLEMENTED	263,803

NOTE : OWNERSHIP COST (FOREIGN) for Existing Equipment

Portable Crusher/Screening	19,134

6.1.5 Other Costs

Cost other items includes the costs of workshop equipment and tools, laboratory test equipment and survey equipment which are recommended in Sub-Clause 3.5. These total costs are summarized in Table 6-1-1.

6.1.6 Quantities by Work Type

The annual construction and maintenance quantities for all proposed road links are shown in Table 6-1-9.

Table 6-1-9 CONSTRUCTION QUANTITIES FOR ALL PROPOSED LINKS

PROV : SULAWESI SELATAN KAB : MAMUJU

ITEM	UNIT	(1988)	(1989)	(1990)	(1991)	(1992)	(TOTAL)
Site Clearance in Light Bush	m2	0.00	3000.00	3000.00	0.00	0.00	6000.00
Subgrade Preparation	m2	48000.00	92400.00	75600.00	68250.00	36750.00	321000.00
Normal Fill	m3	400.00	0.00	0.00	0.00	0.00	400.00
Fill in Swamp	m3	0.00	25410.00	21840.00	11602.50	6247.50	65100.00
Normal Excavation to Spoil	m3	1608.00	1768.00	1384.00	1560.00	840.00	7160.00
Sub Base Course	m3	5714.60	9088.00	8148.00	6892.00	5406.00	35248.60
Base Course	m3	6240.00	0.00	3600.00	3600.00	6720.00	20160.00
Shoulder	m2	68000.00	35600.00	58400.00	59250.00	71750.00	293000.00
Asphalt Patching	m2	0.00	0.00	0.00	0.00	0.00	0.00
Surface Dressing (Single)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Surface Dressing (Double)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Earth Drain	m	0.00	8440.00	7960.00	1950.00	11450.00	29800.00
Earth Drain in Swamp (by machine)	m3	0.00	39000.00	33000.00	19500.00	10500.00	102000.00
Pipe Culvert D80cm	m	150.00	0.00	90.00	90.00	90.00	420.00
Masonry Culvert (80x80cm)	m	0.00	0.00	0.00	0.00	0.00	0.00
Retaining Wall and Wing Wall (Timber)	m2	400.00	0.00	0.00	0.00	0.00	400.00
Retaining Wall and Wing Wall (Masonry)	m3	51.20	0.00	0.00	0.00	0.00	51.20
Gabion Protection	m3	400.00	0.00	0.00	0.00	0.00	400.00
Superstructure (Timber;Span 3m;10T)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Superstructure (Timber;Span 5m;10T)	m2	0.00	36.00	64.00	164.00	288.00	552.00
Superstructure (Timber;Span 8m;10T)	m2	0.00	432.00	632.00	1518.60	797.40	3380.00
Superstructure (Timber;Span 3m;BM50)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Superstructure (Timber;Span 5m;BM50)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Superstructure (Timber;Span 8m;BM50)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Superstructure (Concrete;Span 3m;BM50)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Superstructure (Concrete;Span 5m;BM50)	m2	0.00	0.00	45.00	0.00	0.00	45.00
Superstructure (Concrete;Span 8m;BM50)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Superstructure (Concrete;Span10m;BM50)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Superstructure (Concrete;Span15m;BM50)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Substructure (Pier;for Timber;10T)	NO	0.00	10.80	16.20	33.60	13.40	74.00
Substructure (Abut;for Timber;10T)	NO	0.00	10.80	19.20	56.80	59.20	146.00
Substructure (Pier;for Timber;BM50)	NO	0.00	0.00	0.00	0.00	0.00	0.00
Substructure (Abut;for Timber;BM50)	NO	0.00	0.00	0.00	0.00	0.00	0.00
Substructure (Pier;for Concrete;BM50)	NO	0.00	0.00	0.00	0.00	0.00	0.00
Substructure (Abut;for Concrete;BM50)	NO	0.00	0.00	4.00	0.00	0.00	4.00
Demolition of Bridge (Timber->Timber)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Demolition of Bridge (Timber->Concrete)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Demolition of Bridge (Concrete)	m2	0.00	0.00	40.00	0.00	0.00	40.00
Manual routine maintenance of road	Km	38.00	89.50	82.00	97.50	97.50	404.50
Routine maintenance of earth road	Km	9.00	10.50	10.50	0.00	0.00	30.00
Routine maintenance of gravel road	Km	29.00	79.00	71.50	97.50	97.50	374.50
Routine maintenance of asphalt road	Km	0.00	0.00	0.00	0.00	0.00	0.00
Maintenance of Timber Bridge (New)	m2	0.00	0.00	0.00	0.00	1164.00	1164.00
Maintenance of Concrete Bridge (New)	m2	0.00	0.00	0.00	0.00	0.00	0.00
Maintenance of Timber Bridge (Exist)	m2	370.00	1260.00	1150.00	1260.00	1260.00	5300.00
Maintenance of Concrete Bridge (Exist)	m2	364.25	894.88	824.88	852.50	914.50	3851.00

6.2 Organization and Construction System

6.2.1 Organization

The *Bupati as head of the Kabupaten has been authorized* by Law No. 13, 1980 as an official responsible for the Local Road Development Project implementation. This means that the DPUK is considered as a responsible agency for the actual execution of the Project.

According to instruction letter dated June 24, 1982 Ref. No. 620/975-/BANGDA, the Project Manager appointed by the Bupati will be responsible for the operation and maintenance of the equipment. Accordingly the Equipment Coordinator appointed from the staff of the Regional Public Works (Kantor Wilayah) by Bina Marga as a coordinator between the Governor and the Bupati will be responsible for delivery, effectual utilization and maintenance of the equipment.

The standard organization of DPUK consists of a minimum of four sections, i.e. Road Section, Housing and City Planning Section, Irrigation Section and Administration Section. For execution of the Project it is strongly recommended that the structural organization of DPUK is established. It will be necessary not only to organize new sections but also to reorganize the current structure through a review of the roles and responsibilities of each inter-related section.

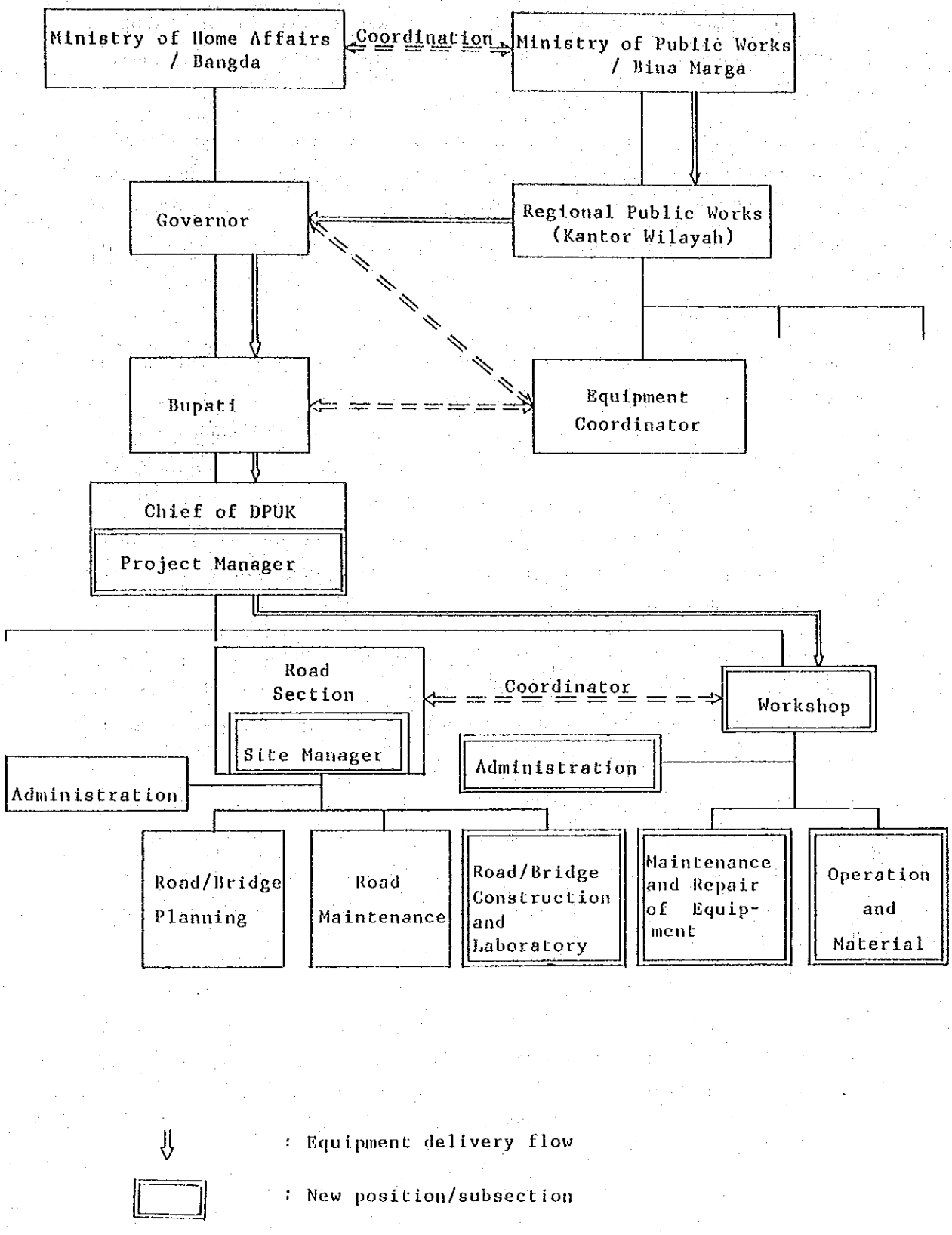
It is recommended that the workshop is newly organized to consist of three sub-sections, i.e. maintenance and repair of equipment, operation and materials, and administration to execute the main tasks described in Clause 3.5.

The sub-section of laboratory would be under the relevant Road Section. The proposed organization is shown in Fig. 6-2-1.

6.2.2 Construction System

For the construction of Kabupaten roads with a ten year effective design life, it has been recommended in Clause 3.4 that the equipment intensive method should be adopted for earth work and pavement work with the exception of surface dressing.

Fig. 6-2-1 PROPOSED ORGANIZATION



Current road construction in the Kabupatens is obliged to rely upon the traditional labour intensive method. It is therefore assumed that both the DPUK and the local contractors in the Kabupatens do not have sufficient experience and technique for the equipment intensive method of road construction.

For realization of the Local Road Development Project the GOI has ensured availability of the required human resources of DPUK and intends to conduct training programmes for those human resources as described in Clause 8.3 of the Main Report. This means that the GOI intends the Kabupatens to have the ability to execute the Project by force account (Swakelola).

It should be recognized from the experiences in the first local road project, which was assisted by OECF, ADB and IBRD, that because of their poor construction management and traditional labour intensive methods most of the road construction by local contractors could not be completed within the contract periods. Therefore execution of the road improvement by force account is desirable as recommended from their experience by the consultants for the first local road project.

It is strongly recommended that except for labourers the staff of the force account team should not be hired by the day as it would then not be able to consolidate the foundations for development of self reliability.

However, it will be very difficult to execute all the Projects by force account because of the need for many Kabupaten staff. The GOI has emphasized the need to promote the employment of local weak contractors in order to up-grade their capability in the road project schemes within the Fourth Five-Year Plan (REPELITA)

Taking into consideration the conditions mentioned above it is strongly recommended that the DPUK is obliged to lend some equipment with skilled operators to the local contractors in the Kabupatens for the execution of a part of the road improvement works.

The types of work executed only by force account are recommended as follows:

- Routine maintenance work for the Kabupaten roads
- Laboratory tests
- Production of crushed stone
- Technical service for the equipment