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 2

## KABUPATEN INDRAGIRI HILIR

MARCH 1986

JAPAN INTERNATIONAL COOPERATION AGENCY

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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 Indragiri Hilir in Riau 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

# SUMATERA

I · PROPINSI RIAU
- 01 · KAB · INDRAGIRI HULU
- 02 · KAB · INDRAGIRI HILIR
- 03 · KAB · BENGKALIS

II · PROPINSI SUMATERA SELATAN
- 04 · KAB · MUSI RAWAS
- 05 · KAB · MUSI BANYUASIN
- 06 · KAB · BANGKA
- 07 · KAB · BELITUG

III PROPINSI LAMPUNG
- 08 · KAB · LAMPUNG TENGAH

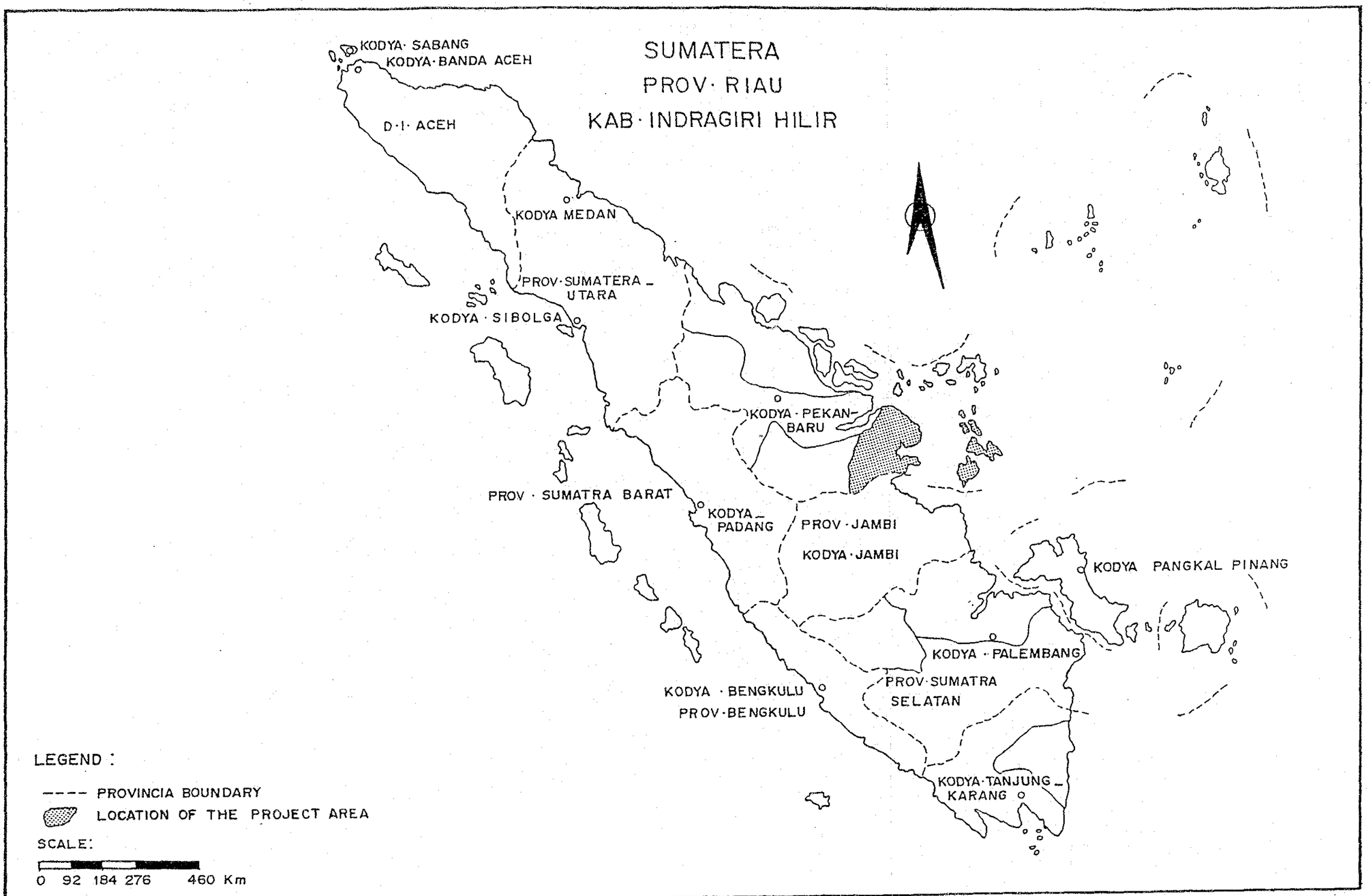

LEGEND :

---- PROVINCIAL BOUNDARY

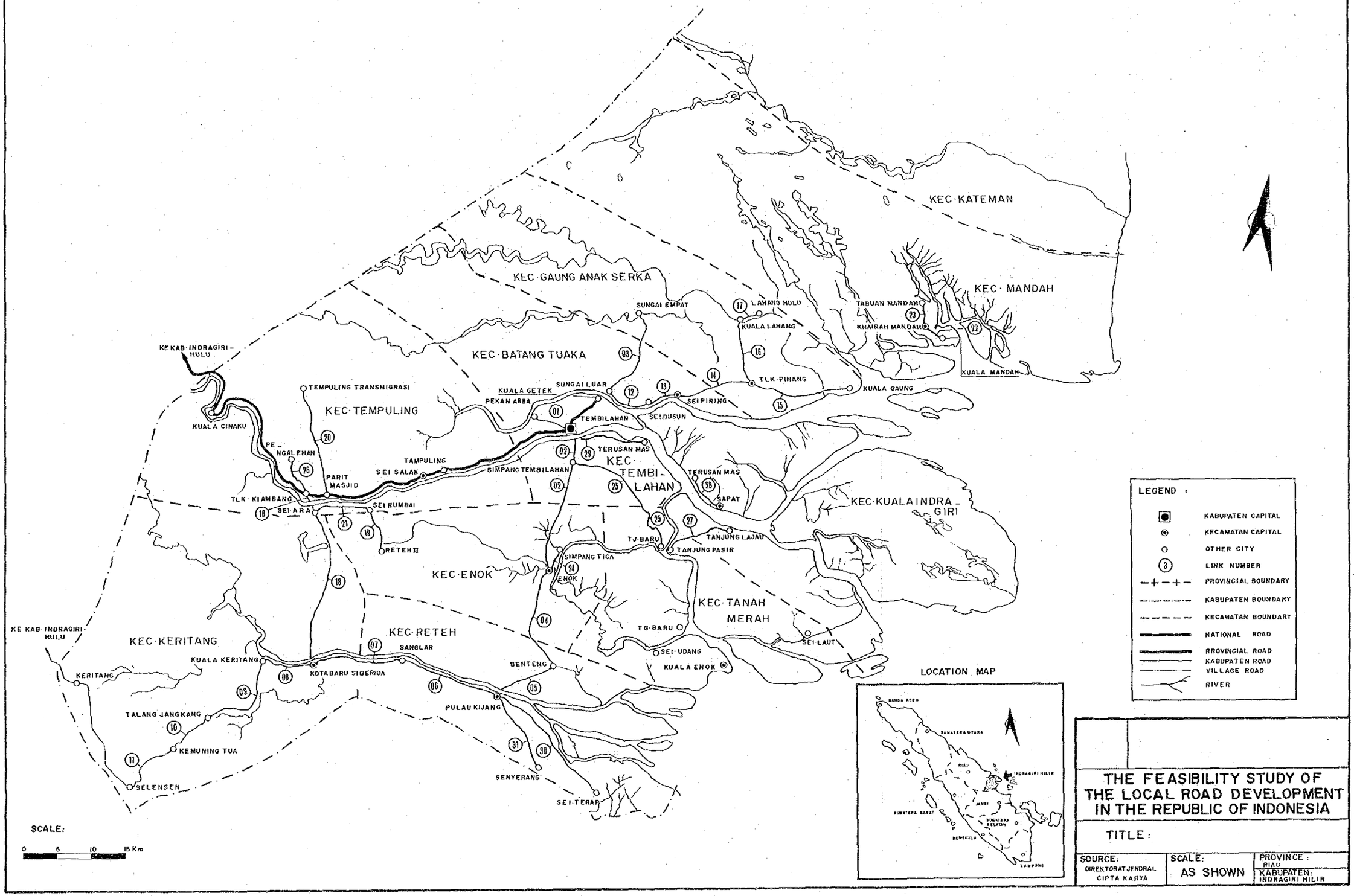
LOCATION OF THE PROPOSED AREA

SCALE :

0 92 184 276 460 Km


SUMATERA
PROV· RIAU
KAB· INDRAGIRI HILIR
KODYA· SABANG
KODYA·BANDA ACEH
D·I· ACEH
KODYA MEDAN
PROV·SUMATERA – UTARA
KODYA · SIBOLGA
KODYA · PEKAN– BARU
PROV · SUMATRA BARAT
KODYA – PADANG
PROV·JAMBI
KODYA·JAMBI
KODYA PANGKAL PINANG
KODYA · PALEMBANG
PROV·SUMATRA SELATAN
KODYA · BENGKULU
PROV·BENGKULU
KODYA·TANJUNG – KARANG
LEGEND :
---- PROVINCIA BOUNDARY
LOCATION OF THE PROJECT AREA
SCALE:
0 92 184 276 460 Km

# KAB · INDRAGIRI HILIR




LEGEND :

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

LOCATION MAP




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

TITLE :

| SOURCE: | SCALE: | PROVINCE : RIAU |
|---|---|---|
| DIREKTORAT JENDRAL CIPTA KARYA | AS SHOWN | KABUPATEN : INDRAGIRI HILIR |

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 Indragiri Hilir is bordered by Kabupaten Indragiri Hulu on the west and faces the sea on the east.

Tembilahan, the capital of the Kabupaten is located on the estuary of the Indragiri River. The equator croses the Kabupaten slightly north of the centre.

Excetp for a hilly area lying on the southwest boundary of the Kabupaten, which is also the provincial boundary, the Kabupaten is almost flat. However, the coastal area is widely covered by swamps which make use of the land difficult.

The area of the Kabupaten is about 11,606 sqaure kilometers, approximately 12 percent of the total of Riau Province. It administers 11 Kecamatan.

### 1.1.2 Meteorological Conditions

The average number of rainy days and the average amount of yearly rainfall in Kabupaten Indragiri Hulu are 153 days and 2,139 mm respectively.

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

The number of working days per year, which is necessary for planning the construction schedule in chapter 6, is estimated at 220 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 : Riau
KABUPATEN : Indragiri Hulu STATION : Air Molek

| 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 | 7 | 97 | 10 | 125 | | | | | | |
| February | 12 | 314 | 18 | 204 | | | | | | |
| March | 16 | 318 | 17 | 214 | | | | | | |
| April | 21 | 300 | 20 | 245 | | | | | | |
| May | 14 | 197 | 18 | 192 | | | | | | |
| June | 7 | 111 | 8 | 79 | | | | | | |
| July | 13 | 178 | 14 | 181 | | | | | | |
| August | 10 | 142 | 5 | 78 | | | | | | |
| September | 15 | 77 | 21 | 276 | | | | | | |
| October | 10 | 220 | 12 | 189 | | | | | | |
| November | 16 | 242 | 7 | 19 | | | | | | |
| December | 17 | 223 | 18 | 178 | | | | | | |
| Total | 158 | 2,419 | 168 | 1,980 | 132 | 2,017 | - | - | - | - |

## 1.2 Socio-Economic Conditions

### 1.2.1 Population

The population of Kabupaten Indragiri Hilir in 1984 was 424,583 which was approximately 17.4% of the 2,442,800 total population of Riau Province as shown in Table 1-2-1.

The population density wa 0.34 persons per ha which was higher than the provincial density of 0.25 and lower than the national density of 0.84.

The recent annual average growth rate of population of the Kabupaten is 2.0% which is lower than both the provincial rate of 3.1% and the national rate of 2.2%. This may be due to the fact that the transmigration programme in the Kabupaten has not yet commenced.

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: | | | | | |
| INDRAGIRI HULU | 259,032 | 5.5 | 1,585,400 | 0.16 | 1982 |
| INDRAGIRI HILIR | 424,583 | 2.0 | 1,232,582 | 0.34 | 1984 |
| BENGKALIS | 639,607 | 5.5 | 3,089,783 | 0.21 | 1983 |
| PROVINCE: | | | | | |
| R I A U | 2,306,300 | | 9,456,200 | | 1982 |
| | 2,373,600 | 3.1 | 9,456,200 | 0.25 | 1983 |
| | 2,442,800 | | 9,456,200 | | 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 : RIAU

KABUPATEN : INDRAGIRI HILIR

| KECAMATAN | POPULATION | PROPORTION (%) |
|---|---|---|
| RETEH | 62,751 | 14.8 |
| ENOK | 31,845 | 7.5 |
| KUALA INDRAGIRI | 31,925 | 7.5 |
| TEMBILAHAN | 54,562 | 12.9 |
| TEMPULING | 37,710 | 8.9 |
| GAUNG ANAK SERKA | 49,082 | 11.6 |
| MANDAH | 29,954 | 7.2 |
| KATEMAN | 21,410 | 5.1 |
| KERITANG | 53,917 | 12.8 |
| TANAH MERAH | 28,155 | 6.7 |
| BATANG TUAKA | 20,632 | 4.9 |
| TOTAL | 424,583 | 100 |

### 1.2.2 Land Use

In Kabupaten Indragiri Hilir, 393,560 ha of the current available land use area, which is approximately 30.4% of the 1,232,582 ha total area of the Kabupaten, is used for living purposes and for industrial activity of the inhabitants of the Kabupaten. It is the total value of columns (1) through (6) in Table 1-2-3.

The current available land use area consists of 362,827 ha of agricultural harvest area and 11,733 ha of residential area which are 96.9% and 3.1% of the current available land use area respectively.

The agricultural harvest area consists of 43,961 ha of paddy field, 92,864 ha of plantation and 225,002 ha of other cultivated area which are 12.1%, 25.7% and 62.2% of the agricultural harvest area respectively.

It can be realized from the land use that the main industry in the Kabupaten is plantation.

Table 1-2-3

LAND USE

PROVINCE : RIAU

(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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| INDRAGIRI HULU | 19,242 (1.2) | | 24,363 (1.5) | 81,054 (5.1) | 25,000 (1.6) | - | - | 1,237,490 (78.1) | 198,279 (12.5) | 1,585,429 (100) | 1982 |
| INDRAGIRI HILIR | 41,985 (3.4) | 1,976 (0.2) | 225,002 (18.3) | 92,864 (7.5) | 11,733 (1.0) | - | 15,897 (1.3) | 839,230 (68.0) | 3,895 (0.3) | 1,232,582 (100) | 1983 |
| BENGKALIS | 23,707 (0.8) | 11,730 (0.4) | 193,841 (6.3) | 111,578 (3.6) | - | 226,095 (8.6) | - | 2,056,307 (66.5) | 426,517 (13.8) | 3,089,783 (100) | 1983 |

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 Indragiri Hilir in 1984 was 54,297 ha and 191,599 tons 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 47,315 ha and 174,143 tons respectively which are 87.1% and 90.9% of the total food crops. The yield rate of paddy production is 3.68 tons 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 1980 through 1984 were 5.1% and 9.5% respectively which show a favorable development of paddy production.

A characteristic of the Kabupaten paddy production is that the wet paddy field forms approximately 93% of the total cultivated area.

The commodity crops, of which palm oil and rubber are major, are produced by the plantations. The area and production of plantation crops in 1984 were 163,429 ha and 78,175 tons respectively with current growth rates being 7.1% and 3.1% respectively. Thus the plantation crop, which is an export product, is important agriculturally. Some changes are expected considering the international balance of supply and demand.

The population of the agricultural sector is 74.0% of the total population as shown in Table 1-2-6. Thus the Kabupaten is an agricultural Kabupaten.

Future agricultural development in the Kabupaten depends upon an improvement programme through irrigation projects in order to promote more intensive productivity together with the enforcement of transmigration programmes.

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

KABUPATEN : INDRAGIRI HILIR

CULTIVATED AREA

(ha)

| ITEM | YEAR | | | | | | AAGR |
|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | (%) |
| PADDY | 39,314 | 38,743 | 45,459 | 44,295 | 42,320 | 47,315 | 5.1 |
| OTHERS | 5,025 | 4,541 | 10,692 | 15,179 | 22,131 | 6,982 | 11.1 |
| TOTAL | 44,339 | 43,284 | 56,151 | 59,474 | 64,451 | 54,297 | 5.8 |

PRODUCTION

(ton)

| ITEM | YEAR | | | | | | AAGR |
|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | (%) |
| PADDY | 105,633 | 92,317 | 132,790 | 150,731 | 148,764 | 174,143 | 9·5 |
| OTHERS | 6,420 | 4,509 | 8,153 | 28,966 | 46,845 | 17,456 | 40·3 |
| TOTAL | 112,053 | 96,826 | 140,943 | 179,697 | 195,609 | 191,599 | 18.6 |

YIELD RATE

(ton/ha)

| ITEM | YEAR | | | | | | AAGR |
|---|---|---|---|---|---|---|---|
| | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | (%) |
| PADDY | 2.69 | 2.38 | 2.92 | 3.40 | 3.52 | 3.68 | 6.0 |

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 : RIAU

| KABUPATEN | AREA (ha) | PRODUCTION (ton) | AAGR (%) AREA | AAGR (%) PRODUCTION |
|---|---|---|---|---|
| INDRAGIRI HULU | 81,054 | 21,696 | 7.8 | 2.7 |
| INDRAGIRI HILIR | 163,429 | 78,175 | 7.1 | 3.6 |
| BENGKALIS | 111,578 | 32,980 | 8.4 | 7.1 |

Table 1-2-6 POPULATION OF AGRICULTURAL SECTOR

PROVINCE : RIAU

| KABUPATEN | AGRICULTURAL SECTOR | TOTAL POPULATION | PROPORTION (%) | AAGR (%) | SURVEY YEAR |
|---|---|---|---|---|---|
| INDRAGIRI HULU | 223,000 | 259,032 | 86.0 | 5.0 | 1982 |
| INDRAGIRI HILIR | 314,000 | 424,583 | 74.0 | 1.5 | 1984 |
| BENGKALIS | 553,000 | 639,607 | 86.4 | 5.5 | 1983 |

Notes :

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

### 1.2.4 Other Economic Activities

Notable economic activities excluding agriculture in Kabupaten Indragiri Hilir are the livestock and forestry sectors.

The following shows the low growth rate of forestry production in recent years.

| | 1980 | 1984 | AAGR (%) |
|---|---|---|---|
| Production ($m^3$) | 228,242 | 235,576 | 0.8 |

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

There is no exact data from which to judge whether the production is used only for the Kabupaten consumption as green wood or exported as sawn wood from Dumai Harbour.

The following shows the growth of livestock production.

| | 1980 | 1984 | AAGR (%) |
|---|---|---|---|
| Production (ton) | 4,575 | 6,485 | 9.1 |

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

Judging from present conditions approximately. 5,000 tons are exported from the Kabupaten, therefore this Kabupaten sector is expected to continue to prosper.

The fishery and manufacturing industries are both in less advanced sectors and have just enough production volume to supply the consumption of the Kabupaten itself.

## 1.3 Present Status of Kabupaten Roads

### 1.3.1 Outline of Road Networks

The existing transportation system in Kabupaten Indragiri Hilir still relies mainly upon river transportation which leads in all directions, therefore the Kabupaten roads only take a complementary role.

There is one provincial road which reaches Kuala Getek from Tembilahan, the Kabupaten capital leading from Rengat, a neighbouring Kabupaten capital. However, it does not appear to be a regional trunk line due to its unsatisfactory surface conditions at present and its geographically unfavorable route as an access road for the whole region.

To unify the regional transportation systems effectively it seems that in Kabupaten Indragiri Hilir it is necessary to improve and extend the existing provincial roads in collaboration with consolidation of the infra-structures needed for development of other sectors.

### 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 Indragiri Hilir are confirmed as 31 links and 330 Km respectively. These figures exclude Kabupaten roads with no data.

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 0.26 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: Indragiri Hilir | 330 | 1,232,582 | 0.26 |
| Province : Riau | 1,882 | 5,907,756 | 0.32 |
| 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

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

PROV : RIAU KAB : INDRAGIRI HILIR

(Km)

| NO | | HRD | BTB | L.L | KRK | TOTAL |
|---|---|---|---|---|---|---|
| LINK | 1 | 4 | 1 | | | 5 |
| LINK | 2 | | | 23 | | 23 |
| LINK | 3 | | | | 12 | 12 |
| LINK | 4 | | | 17 | | 17 |
| LINK | 5 | | | 9 | | 9 |
| LINK | 6 | | | 16 | | 16 |
| LINK | 7 | | | 17 | | 17 |
| LINK | 8 | | | 9 | | 9 |
| LINK | 9 | | | 16 | | 16 |
| LINK | 10 | 1 | | | 7 | 8 |
| LINK | 11 | 12 | | | | 12 |
| LINK | 12 | 9 | | | | 9 |
| LINK | 13 | 6 | | | | 6 |
| LINK | 14 | 13 | | | | 13 |
| LINK | 15 | 16 | | | | 16 |
| LINK | 16 | 10 | | | | 10 |

(Km)

| NO | | HRD | BTB | L.L | KRK | TOTAL |
|---|---|---|---|---|---|---|
| LINK | 17 | 3 | | | | 3 |
| LINK | 18 | 22 | | | | 22 |
| LINK | 19 | 6 | | | | 6 |
| LINK | 20 | 16 | | | | 16 |
| LINK | 21 | 8 | | | | 8 |
| LINK | 22 | 2 | | | | 2 |
| LINK | 23 | 4 | | | | 4 |
| LINK | 24 | 3 | | | | 3 |
| LINK | 25 | 7 | | | | 7 |
| LINK | 26 | 5 | | | | 5 |
| LINK | 27 | 8 | | | | 8 |
| LINK | 28 | 5 | | | | 5 |
| LINK | 29 | 10 | | | | 10 |
| LINK | 30 | 20 | | | | 20 |
| LINK | 31 | 13 | | | | 13 |
| TOTAL | | 203 | | 107 | 19 | 330 |
| RATIO | | 62 | 0 | 32 | 6 | (%) |

KRK : Gravel/Stone/Telford/Water Bound Macadam

TNH : Earth

LL : Others

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

| | ASP | KRK | TNH/LL |
|---|---|---|---|
| Kabupaten: Indragiri Hilir | - | 6.0 | 94.0 |
| Province : Riau | 3.0 | 23.3 | 73.7 |
| Jawa Is. (Excluding DKI Jakarta) | 56.2 | 25.0 | 18.8 |
| Indonesia | 26.0 | 26.6 | 47.4 |

Thus, there are no asphalt paved roads. The proportion of low grade roads such as earth roads and others is extremely high. This means that the classification of the Kabupaten roads is very 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: Indragiri Hilir | 8.5 | 31.8 | 43.6 | 16.1 |
| Province :Riau | 40.2 | 30.2 | 25.9 | 3.7 |
| Jawa Is. (Excluding DKI Jakarta) | 45.6 | 29.8 | 19.6 | 5.0 |
| Indonesia | 43.5 | 21.8 | 21.1 | 13.6 |

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

PROVINCE : RIAU

KABUPATEN : INDRAGIRI HILIR

(1)

| NO | ? | TAH | | | | BTB | | | | L.L | | | | KRK | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NO | | BA | SD | RU | RB | BA | SD | RU | RB | BA | SD | RU | RB | BA | SD | RU | RB |
| LINK | 1 | | 23 | 26 | 51 | | 10 | 30 | 60 | | | | | | | | |
| LINK | 2 | | | | | | | | | 45 | 27 | 28 | | | | | |
| LINK | 3 | | | | | | | | | | | | | | 48 | 42 | 10 |
| LINK | 4 | | | | | | | | | | 55 | 40 | 5 | | | | |
| LINK | 5 | | | | | | | | | | 56 | 42 | 2 | | | | |
| LINK | 6 | | | | | | | | | | 74 | 26 | | | | | |
| LINK | 7 | | | | | | | | | | 59 | 41 | | | | | |
| LINK | 8 | | | | | | | | | 44 | 53 | 3 | | | | | |
| LINK | 9 | | | | | | | | | 3 | 44 | 53 | | | | | |
| LINK | 10 | | 69 | 40 | | | | | | | | | | | 55 | 40 | 5 |
| LINK | 11 | | 79 | 21 | | | | | | | | | | | | | |
| LINK | 12 | | 81 | 19 | | | | | | | | | | | | | |
| LINK | 13 | | 26 | 74 | | | | | | | | | | | | | |
| LINK | 14 | | 33 | 67 | | | | | | | | | | | | | |
| LINK | 15 | | 3 | 61 | 36 | | | | | | | | | | | | |
| LINK | 16 | | 3 | 56 | 44 | | | | | | | | | | | | |
| LINK | 17 | | | 68 | 32 | | | | | | | | | | | | |
| LINK | 18 | | | 58 | 43 | | | | | | | | | | | | |
| LINK | 19 | | | 73 | 27 | | | | | | | | | | | | |
| LINK | 20 | | | 66 | 34 | | | | | | | | | | | | |
| LINK | 21 | | | 61 | 39 | | | | | | | | | | | | |
| LINK | 22 | | | 40 | 60 | | | | | | | | | | | | |
| LINK | 23 | | | 38 | 63 | | | | | | | | | | | | |
| LINK | 24 | | | 70 | 30 | | | | | | | | | | | | |
| LINK | 25 | 3 | 26 | 67 | 4 | | | | | | | | | | | | |
| LINK | 26 | 92 | 10 | | | | | | | | | | | | | | |
| LINK | 27 | | | 74 | 26 | | | | | | | | | | | | |
| LINK | 28 | | | 56 | 44 | | | | | | | | | | | | |
| LINK | 29 | | | 72 | 28 | | | | | | | | | | | | |
| LINK | 30 | 35 | 31 | 35 | | | | | | | | | | | | | |
| LINK | 31 | 32 | 40 | 28 | | | | | | | | | | | | | |
| AVERAGE | | 7 | 18 | 51 | 24 | 0 | 10 | 30 | 60 | 13 | 55 | 30 | | 0 | 52 | 41 | 8 |
| LENGTH | | 203 Km | | | | 3 Km | | | | 107 Km | | | | 19 Km | | | |
| (Km) | | 14 | 37 | 101 | 49 | 0 | 0 | 0 | 1 | 14 | 59 | 32 | 2 | 0 | 10 | 8 | 2 |

The surface condition levels of the Kabupaten roads in the Kabupaten is lower than either that of Indonesia or of Jawa Island. The proportion in good condition is relatively low. Therefore improvement of Kabupaten roads in poor or bad condition is necessary.

(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, are summarized in Table 1-3-3.

The proportions of terrain conditions in the Kabupaten are 2.0% flat, and 98.0% swampy. There are no mountainous areas in the Kabupaten. However, road construction is anticipated to be difficult because of the large proportion of swampy ground.

1.3.3 Bridge Inventory

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

The bridges 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 1-3-5 indicates a total of 157 bridges with a total length of 3,059 m of which 100% are timber. On the other hand, 61 bridges with a total length of 1086 m are required to be newly constructed.

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

PROV : RIAU KAB : INDRAGIRI HILIR

(Km)

| 102 ( 3) | RW | DT | TOTAL |
|---|---|---|---|
| LINK 1 | 5 | | 5 |
| LINK 2 | 23 | | 23 |
| LINK 3 | 12 | | 12 |
| LINK 4 | 17 | | 17 |
| LINK 5 | 9 | | 9 |
| LINK 6 | 16 | | 16 |
| LINK 7 | 17 | | 17 |
| LINK 8 | 9 | | 9 |
| LINK 9 | 16 | | 16 |
| LINK 10 | | 8 | 8 |
| LINK 11 | 12 | | 12 |
| LINK 12 | 9 | | 9 |
| LINK 13 | 6 | | 6 |
| LINK 14 | 13 | | 13 |
| LINK 15 | 16 | | 16 |
| LINK 16 | 10 | | 10 |
| LINK 17 | 3 | | 3 |
| LINK 18 | 22 | | 22 |
| LINK 19 | 6 | | 6 |
| LINK 20 | 16 | | 16 |
| LINK 21 | 8 | | 8 |
| LINK 22 | 2 | | 2 |
| LINK 23 | 4 | | 4 |
| LINK 24 | 3 | | 3 |
| LINK 25 | 7 | | 7 |
| LINK 26 | 5 | | 5 |
| LINK 27 | 8 | | 8 |
| LINK 28 | 5 | | 5 |
| LINK 29 | 10 | | 10 |
| LINK 30 | 20 | | 20 |
| LINK 31 | 13 | | 13 |
| TOTAL | 322 | 8 | 330 |
| RATIO | 98 | 2 | (%) |

Table 1-3-4 NUMBER AND LENGTH OF BRIDGES

PROV : RIAU KAB : INDRAGIRI HILIR

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

| | EXISTING | | NOT EXIST | | TOTAL | |
|---|---|---|---|---|---|---|
| LINK NO | NO. | LENGTH | NO. | LENGTH | NO. | LENGTH |
| 1 | 1 | 12.00 | | | 1 | 12.00 |
| 2 | 21 | 187.00 | | | 21 | 187.00 |
| 3 | 5 | 45.00 | | | 5 | 45.00 |
| 4 | | | 8 | 54.00 | 8 | 54.00 |
| 5 | 7 | 78.00 | | | 7 | 78.00 |
| 6 | 32 | 834.00 | | | 32 | 834.00 |
| 7 | 22 | 714.00 | 1 | 30.00 | 23 | 744.00 |
| 8 | 13 | 171.00 | | | 13 | 171.00 |
| 9 | | | 8 | 86.00 | 8 | 86.00 |
| 10 | 7 | 93.00 | | | 7 | 93.00 |
| 11 | 6 | 75.00 | | | 6 | 75.00 |
| 12 | 8 | 150.00 | | | 8 | 150.00 |
| 13 | 4 | 110.00 | | | 4 | 110.00 |
| 14 | 12 | 172.00 | | | 12 | 172.00 |
| 15 | | | 6 | 130.00 | 6 | 130.00 |
| 16 | 1 | 30.00 | 4 | 80.00 | 5 | 110.00 |
| 17 | | | 3 | 70.00 | 3 | 70.00 |
| 18 | | | 3 | 75.00 | 3 | 75.00 |
| 19 | | | 3 | 55.00 | 3 | 55.00 |
| 20 | | | 3 | 75.00 | 3 | 75.00 |
| 21 | | | 6 | 90.00 | 6 | 90.00 |
| 22 | 3 | 60.00 | | | 3 | 60.00 |
| 23 | 4 | 58.00 | | | 4 | 58.00 |
| 24 | 3 | 50.00 | | | 3 | 50.00 |
| 25 | | | 4 | 86.00 | 4 | 86.00 |
| 26 | 3 | 45.00 | | | 3 | 45.00 |
| 27 | | | 7 | 120.00 | 7 | 120.00 |
| 28 | | | 5 | 135.00 | 5 | 135.00 |
| 29 | 5 | 175.00 | | | 5 | 175.00 |
| TOTAL | 157 | 3059.00 | 61 | 1086.00 | 218 | 4145.00 |

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

PROV : RIAU KAB : INDRAGIRI HILIR

(No)

| 103 (18) | KY |
|---|---|
| LINK 1 | 1 |
| LINK 2 | 21 |
| LINK 3 | 5 |
| LINK 4 | |
| LINK 5 | 7 |
| LINK 6 | 32 |
| LINK 7 | 22 |
| LINK 8 | 13 |
| LINK 9 | |
| LINK 10 | 7 |
| LINK 11 | 6 |
| LINK 12 | 8 |
| LINK 13 | 4 |
| LINK 14 | 12 |
| LINK 15 | |
| LINK 16 | 1 |
| LINK 17 | |
| LINK 18 | |
| LINK 19 | |
| LINK 20 | |
| LINK 21 | |
| LINK 22 | 3 |
| LINK 23 | 4 |
| LINK 24 | 3 |
| LINK 25 | |
| LINK 26 | 3 |
| LINK 27 | |
| LINK 28 | |
| LINK 29 | 5 |
| TOTAL | 157 |
| RATIO | |

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

| Bridges Type | Span Length (m) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | <3 | <5 | <8 | <10 | <12 | <14 | <16 | <18 | <20 | <99 | Total |
| Timber | 96 | 49 | 6 | 1 | - | - | 1 | 1 | 1 | 2 | 157 |
| Concrete | - | - | - | - | - | - | - | - | - | - | - |
| Steel | - | - | - | - | - | - | - | - | - | - | - |
| Others | - | - | - | - | - | - | - | - | - | - | - |
| Total | 96 | 49 | 6 | 1 | - | - | 1 | 1 | 1 | 2 | 157 |

Thus, all of the existing bridges on the Kabupaten roads are timber and the majority of spanlengths is less than 3 m.

### 1.3.4 Traffic

Inventories of the average daily traffic (ADT) on the Kabupaten roads in Kabupaten Indragiri Hilir 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 | 3 | 0 | 0 | 1,473 | 743 |
| Proportion (%) | 0.27 | 0.00 | 0.00 | 99,73 | 100.00 |

Source : Bina Marga Inventory

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

| | SEDAN | BUS | TRUCK | MOTOR-CYCLE | TOTAL |
|---|---|---|---|---|---|
| Proportion (%) | 0.07 | 0.29 | 48.00 | 51.64 | 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 : RIAU KAB : INDRAGIRI HILIR

| | | | |
|---|---|---|---|
| A) | Growth Rate of Population | : | 2.00 (%) |
| B) | Growth Rate of Cultivated Area | : | 6.00 (%) |
| C) | Growth Rate of Rice field | : | 5.00 (%) |
| D) | Growth Rate of Rice yield rate | : | 6.00 (%) |
| E) | Growth Rate of GDP / capita | : | 6.80 (%) |
| a) | Geometrical Mean ( A x B ) | : | 3.98 (%) |
| b) | Geometrical Mean ( C x D ) | : | 5.50 (%) |
| c) | Geometrical Mean ( a x b ) | : | 4.74 (%) |
| d) | Geometrical Mean ( c x E ) | : | 5.76 (%) |
| | TRAFFIC GROWTH RATE | : | 5.76 (%) |

### 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 : RIAU KAB : INDRAGIRI HILIR

( SPD : 1/2 )

| | INVENTORY (1985) | | | | | RATE | AFTER 13 YEARS (1990) | | | | | CLASS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LINK NO | MBL | BUS | TRUK | SPD | TOTAL | | MBL | BUS | TRUK | SPD | TOTAL | |
| 1 | 3 | 0 | 0 | 100 | 53 | 5.8% | 6 | 0 | 0 | 207 | 110 | IIIB-2 |
| 2 | 0 | 0 | 0 | 35 | 18 | 5.8% | 0 | 0 | 0 | 72 | 37 | IIIC |
| 3 | 0 | 0 | 0 | 100 | 50 | 5.8% | 0 | 0 | 0 | 207 | 104 | IIIB-2 |
| 4 | 0 | 0 | 0 | 40 | 20 | 5.8% | 0 | 0 | 0 | 83 | 41 | IIIC |
| 5 | 0 | 0 | 0 | 50 | 25 | 5.8% | 0 | 0 | 0 | 104 | 52 | IIIB-2 |
| 6 | 0 | 0 | 0 | 50 | 25 | 5.8% | 0 | 0 | 0 | 104 | 52 | IIIB-2 |
| 7 | 0 | 0 | 0 | 30 | 15 | 5.8% | 0 | 0 | 0 | 62 | 31 | IIIC |
| 8 | 0 | 0 | 0 | 40 | 20 | 5.8% | 0 | 0 | 0 | 83 | 41 | IIIC |
| 9 | 0 | 0 | 0 | 50 | 25 | 5.8% | 0 | 0 | 0 | 104 | 52 | IIIB-2 |
| 10 | 0 | 0 | 0 | 70 | 35 | 5.8% | 0 | 0 | 0 | 145 | 72 | IIIB-2 |
| 11 | 0 | 0 | 0 | 30 | 15 | 5.8% | 0 | 0 | 0 | 62 | 31 | IIIC |
| 12 | 0 | 0 | 0 | 40 | 20 | 5.8% | 0 | 0 | 0 | 83 | 41 | IIIC |
| 13 | 0 | 0 | 0 | 30 | 15 | 5.8% | 0 | 0 | 0 | 62 | 31 | IIIC |
| 14 | 0 | 0 | 0 | 30 | 15 | 5.8% | 0 | 0 | 0 | 62 | 31 | IIIC |
| 15 | 0 | 0 | 0 | 30 | 15 | 5.8% | 0 | 0 | 0 | 62 | 31 | IIIC |
| 16 | 0 | 0 | 0 | 20 | 10 | 5.8% | 0 | 0 | 0 | 41 | 21 | IIIC |
| 17 | 0 | 0 | 0 | 50 | 25 | 5.8% | 0 | 0 | 0 | 104 | 52 | IIIB-2 |
| 18 | 0 | 0 | 0 | 60 | 30 | 5.8% | 0 | 0 | 0 | 124 | 62 | IIIB-2 |
| 19 | 0 | 0 | 0 | 20 | 10 | 5.8% | 0 | 0 | 0 | 41 | 21 | IIIC |
| 20 | 0 | 0 | 0 | 250 | 125 | 5.8% | 0 | 0 | 0 | 518 | 259 | IIIB-1 |
| 21 | 0 | 0 | 0 | 30 | 15 | 5.8% | 0 | 0 | 0 | 62 | 31 | IIIC |
| 22 | 0 | 0 | 0 | 25 | 13 | 5.8% | 0 | 0 | 0 | 52 | 27 | IIIC |
| 23 | 0 | 0 | 0 | 25 | 13 | 5.8% | 0 | 0 | 0 | 52 | 27 | IIIC |
| 24 | 0 | 0 | 0 | 60 | 30 | 5.8% | 0 | 0 | 0 | 124 | 62 | IIIB-2 |
| 25 | 0 | 0 | 0 | 3 | 2 | 5.8% | 0 | 0 | 0 | 6 | 4 | IIIC |
| 26 | 0 | 0 | 0 | 3 | 2 | 5.8% | 0 | 0 | 0 | 6 | 4 | IIIC |
| 27 | 0 | 0 | 0 | 15 | 8 | 5.8% | 0 | 0 | 0 | 31 | 17 | IIIC |
| 28 | 0 | 0 | 0 | 50 | 25 | 5.8% | 0 | 0 | 0 | 104 | 52 | IIIB-2 |
| 29 | 0 | 0 | 0 | 125 | 63 | 5.8% | 0 | 0 | 0 | 259 | 130 | IIIB-2 |
| 30 | 0 | 0 | 0 | 6 | 3 | 5.8% | 0 | 0 | 0 | 12 | 6 | IIIC |
| 31 | 0 | 0 | 0 | 6 | 3 | 5.8% | 0 | 0 | 0 | 12 | 6 | IIIC |
| PERCENT | 0.20 | 0.00 | 0.00 | 99.80 | | | 0.20 | 0.00 | 0.00 | 99.80 | | |

## 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 : RIAU KAB : INDRAGIRI HILIR

( 1998 )

| LINK NO | CLASS | SURFACE | MOBIL | BUS | TRUCK | SEPEDA | TOTAL |
|---|---|---|---|---|---|---|---|
| 1 | IIIB-1 | ASP | 20 | 4 | 32 | 410 | 261 |
| 2 | IIIA | ASP | 39 | 7 | 61 | 791 | 503 |
| 3 | IIIB-1 | ASP | 31 | 6 | 49 | 630 | 401 |
| 4 | IIIB-1 | ASP | 26 | 5 | 41 | 528 | 336 |
| 5 | IIIB-1 | ASP | 20 | 4 | 32 | 409 | 260 |
| 6 | IIIB-1 | ASP | 35 | 7 | 56 | 725 | 461 |
| 7 | IIIA | ASP | 82 | 16 | 131 | 1688 | 1073 |
| 8 | IIIA | ASP | 62 | 12 | 99 | 1280 | 813 |
| 9 | IIIA | ASP | 111 | 21 | 176 | 2276 | 1446 |
| 10 | IIIA | ASP | 55 | 11 | 88 | 1138 | 723 |
| 11 | IIIA | ASP | 83 | 16 | 132 | 1707 | 1085 |
| 12 | IIIB-1 | ASP | 24 | 5 | 39 | 500 | 318 |
| 13 | IIIB-1 | ASP | 16 | 3 | 26 | 333 | 212 |
| 14 | IIIB-1 | ASP | 30 | 6 | 48 | 620 | 394 |
| 15 | IIIB-1 | ASP | 32 | 6 | 51 | 656 | 417 |
| 16 | IIIB-1 | ASP | 20 | 4 | 32 | 410 | 261 |
| 17 | IIIB-2 | KRK | 6 | 1 | 10 | 123 | 79 |
| 18 | IIIA | ASP | 142 | 27 | 225 | 2911 | 1850 |
| 19 | IIIB-2 | KRK | 7 | 1 | 10 | 134 | 85 |
| 20 | IIIA | ASP | 68 | 13 | 108 | 1398 | 888 |
| 21 | IIIB-1 | ASP | 34 | 7 | 54 | 699 | 445 |
| 22 | IIIB-2 | KRK | 9 | 2 | 14 | 181 | 116 |
| 23 | IIIB-1 | ASP | 18 | 3 | 28 | 362 | 230 |
| 24 | IIIC | KRK | 3 | 1 | 5 | 67 | 43 |
| 25 | IIIB-1 | ASP | 20 | 4 | 32 | 414 | 263 |
| 26 | IIIB-1 | ASP | 21 | 4 | 34 | 437 | 278 |
| 27 | IIIA | ASP | 46 | 9 | 72 | 937 | 596 |
| 28 | IIIA | ASP | 47 | 9 | 75 | 974 | 618 |
| 29 | IIIA | ASP | 40 | 8 | 63 | 819 | 521 |
| 30 | IIIA | ASP | 44 | 8 | 70 | 906 | 575 |
| 31 | IIIB-1 | ASP | 29 | 5 | 46 | 589 | 375 |

## 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 : INDRAGIRI HILIR

( 1000Rupiah )

| | LINK 1 | LINK 2 | LINK 3 | LINK 4 | LINK 5 | LINK 6 | LINK 7 | LINK 8 | LINK 9 | LINK 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| | 5 Km | 23 Km | 12 Km | 17 Km | 9 Km | 16 Km | 17 Km | 9 Km | 16 Km | 8 Km |
| | IIIB-1 | IIIA | IIIB-1 | IIIB-1 | IIIB-1 | IIIB-1 | IIIA | IIIA | IIIA | IIIA |
| YEAR | Surplus | Surplus | Surplus | Surplus | Surplus | Surplus | Surplus | Surplus | Surplus | Surplus |
| 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 14616 | 67558 | 28586 | 45069 | 12709 | 34252 | 89873 | 18625 | 102878 | 32450 |
| 1990 | 15495 | 67893 | 30440 | 45521 | 13528 | 36514 | 96375 | 20046 | 110236 | 34676 |
| 1991 | 16612 | 69536 | 32675 | 46388 | 14320 | 38498 | 103066 | 21527 | 118851 | 37168 |
| 1992 | 17846 | 70392 | 35003 | 47717 | 15579 | 40899 | 110458 | 23163 | 127840 | 40200 |
| 1993 | 19298 | 71783 | 37051 | 48684 | 16264 | 43719 | 118447 | 24848 | 137035 | 42872 |
| 1994 | 20355 | 73078 | 39494 | 50063 | 17187 | 46019 | 126815 | 26834 | 147736 | 46350 |
| 1995 | 21807 | 74078 | 42362 | 51929 | 18377 | 49373 | 136585 | 28857 | 158306 | 50091 |
| 1996 | 23318 | 75517 | 44921 | 53047 | 19832 | 52548 | 146008 | 30989 | 170383 | 53576 |
| 1997 | 25371 | 77004 | 47997 | 54576 | 21248 | 56044 | 157218 | 33299 | 183564 | 57841 |
| 1998 | 27001 | 78587 | 51894 | 56155 | 22568 | 59753 | 168516 | 35796 | 197264 | 62023 |
| SUM | 201719 | 725426 | 390423 | 499149 | 171612 | 457619 | 1253361 | 263984 | 1454093 | 457247 |
| COST | 90315 | 314938 | 162776 | 208374 | 51442 | 181043 | 636870 | 104370 | 757437 | 222010 |
| /Km | 18063 | 13693 | 13565 | 12257 | 5716 | 11315 | 37463 | 11597 | 47340 | 27751 |

# 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.

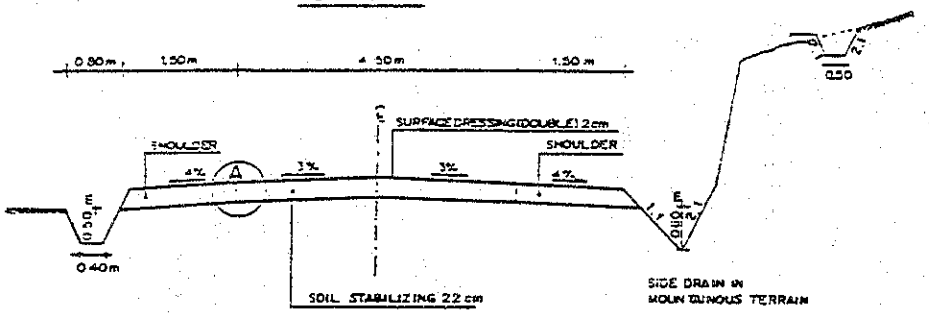
b. 10-ton truck load is applied for timber bridges on roads of III B-1, III B-2 and III C classification.

Table 3-1-1 DESIGN CRITERIA FOR KABUPATEN ROADS

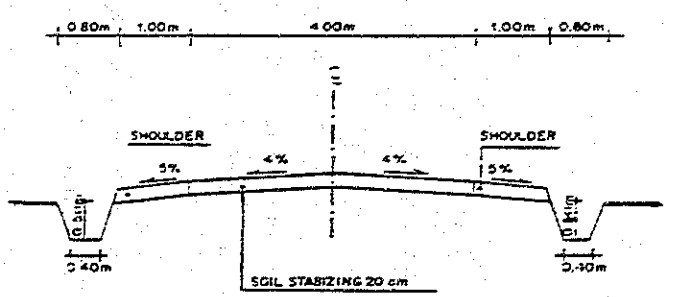
| ROAD CLASSIFICATION | | CLASS III A | | | CLASS III B-1 | | | CLASS III B-2 | | | CLASS III C | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SURFACE TYPE | | ASPHALT SEAL (DOUBLE) | | | ASPHALT SEAL (SINGLE) | | | GRAVEL | | | GRAVEL | | |
| TRAFFIC VOLUME : ADT (Forecast 10 th year 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

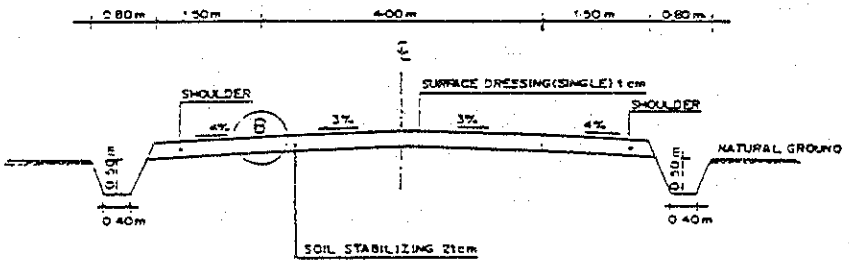
CLASS III A



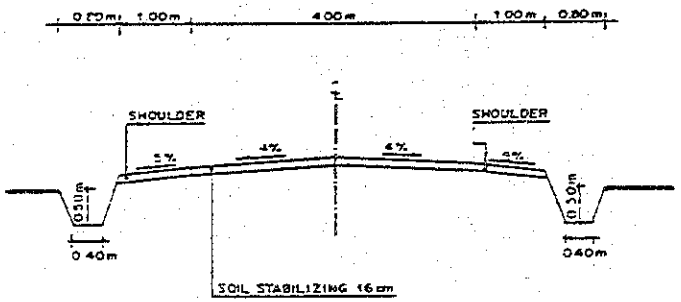

CLASS III B-2




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.

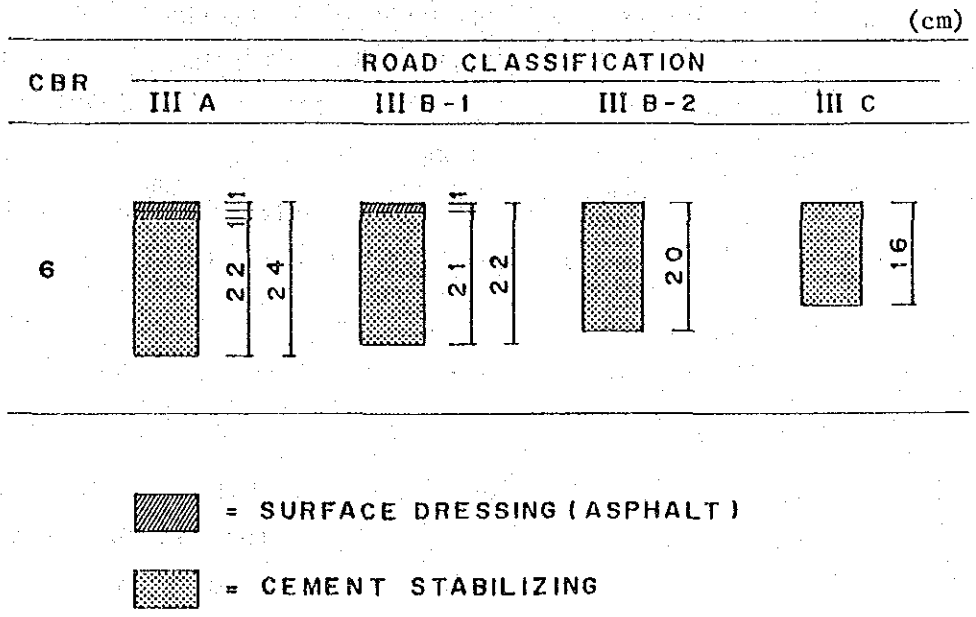
CBR of the laterite is generally in the range of CBR 4 to 10. However site CBR tests should be conducted before construction to finally decide the pavement thickness.

### 3.2.2 Pavement Structure

Fig. 3-2-1 shows the standard pavement structures adopted for the Kabupaten roads. In the Kabupaten aggregate material is difficult to obtain and so the price is extremely high, therefore the cement stabilization method is recommended for both the base and sub-base courses as a substitute for crusher run or river gravel.

Fig. 3-2-1

PAVEMENT STRUCTURE
(CEMENT STABILIZING)



## 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

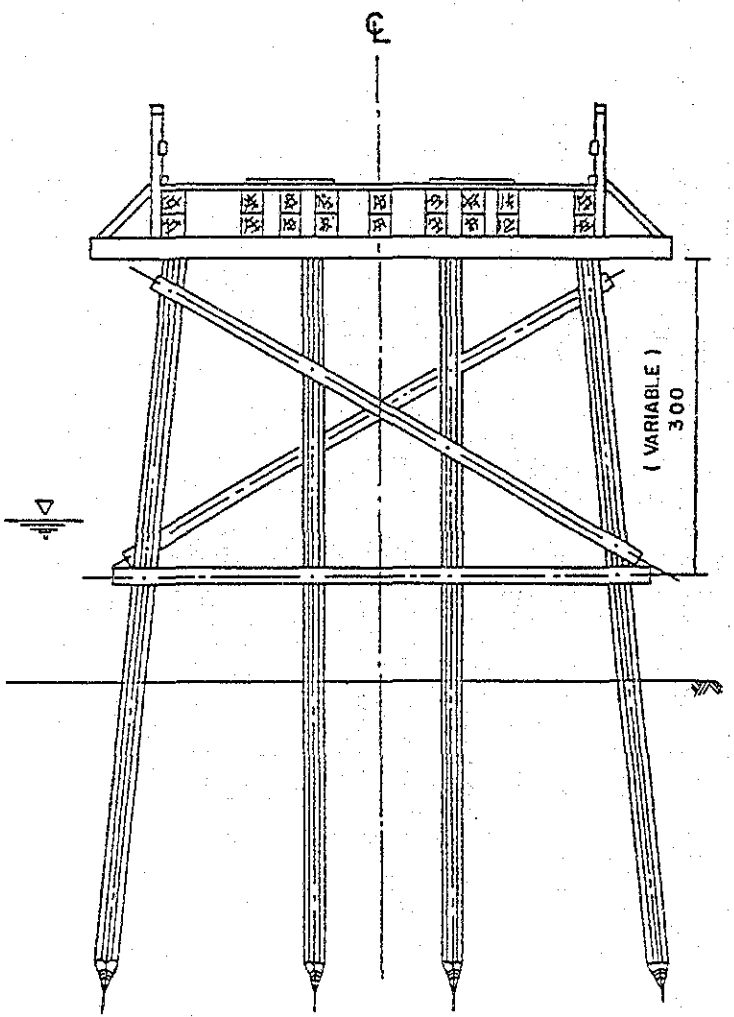
3) Foundation

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.

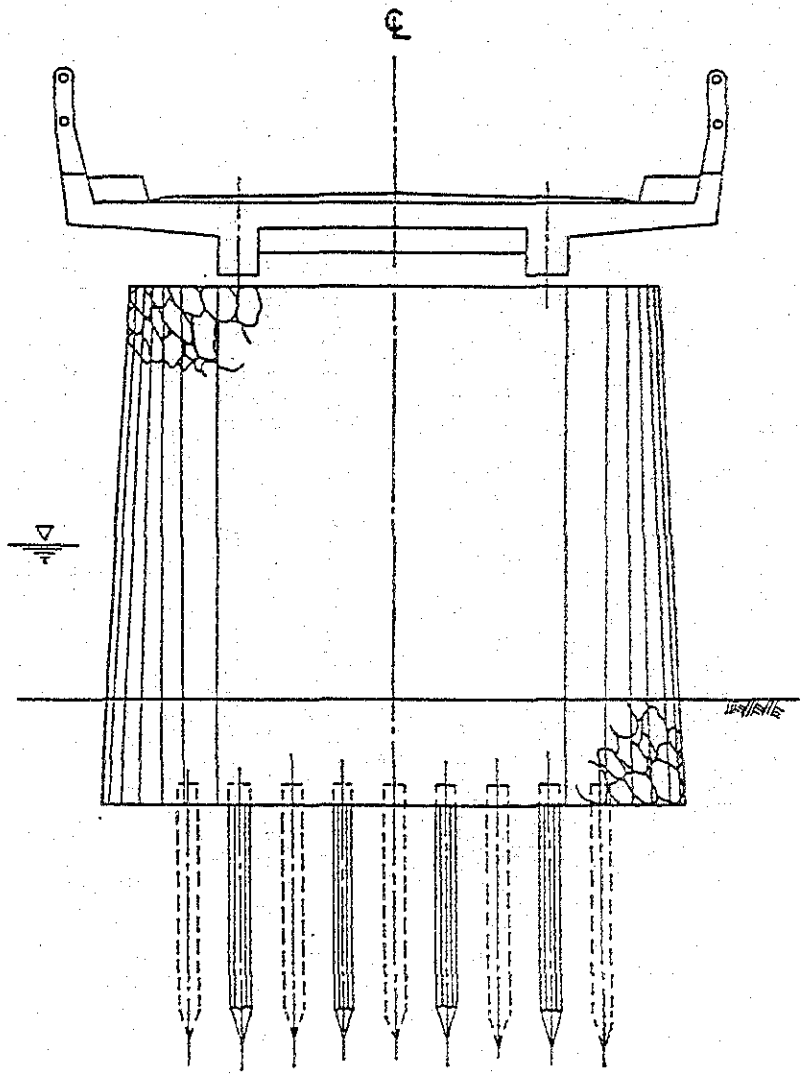
The pile length is suggested to be a minimum of 3 meters under the bottom of the foundation. The length and number of piles should be decided in order to be adequate for the condition of the foundation materials.

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 $\phi$ 80 cm
b) Rubble in mortar box culvert with RC slab 80 cm X 80 cm

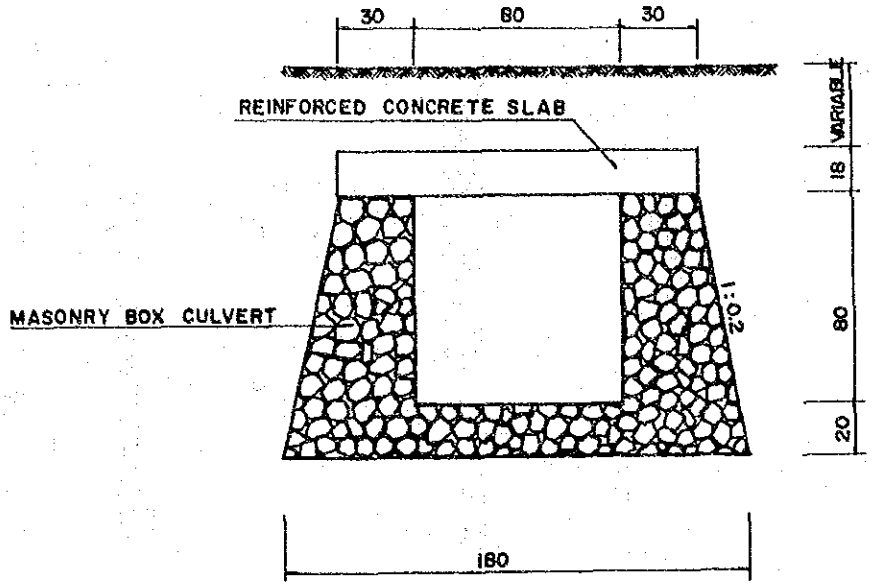
(2) Retaining Wall

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

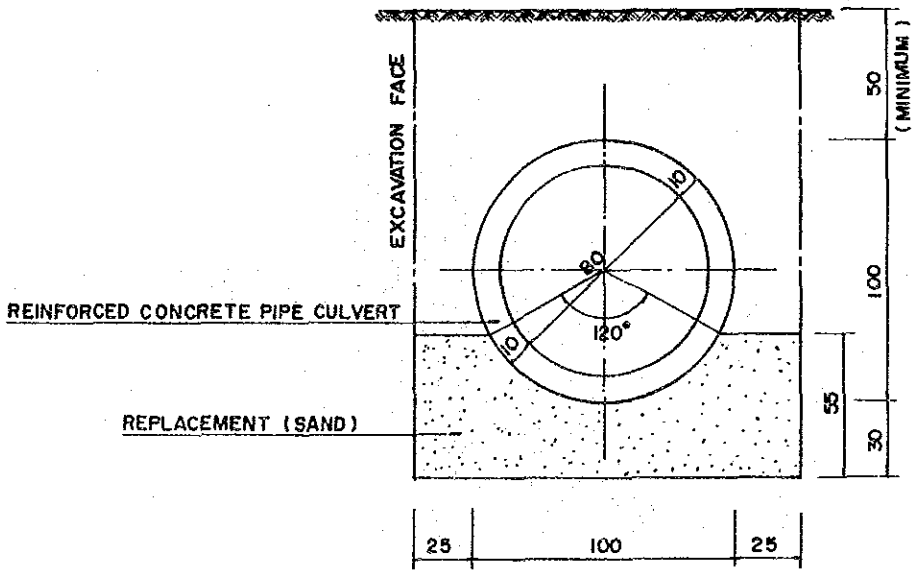
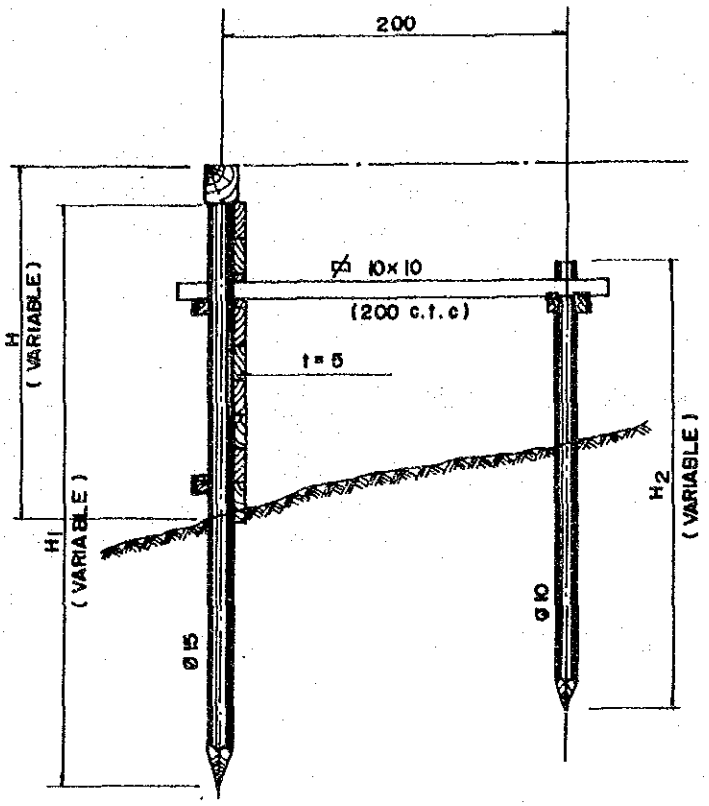
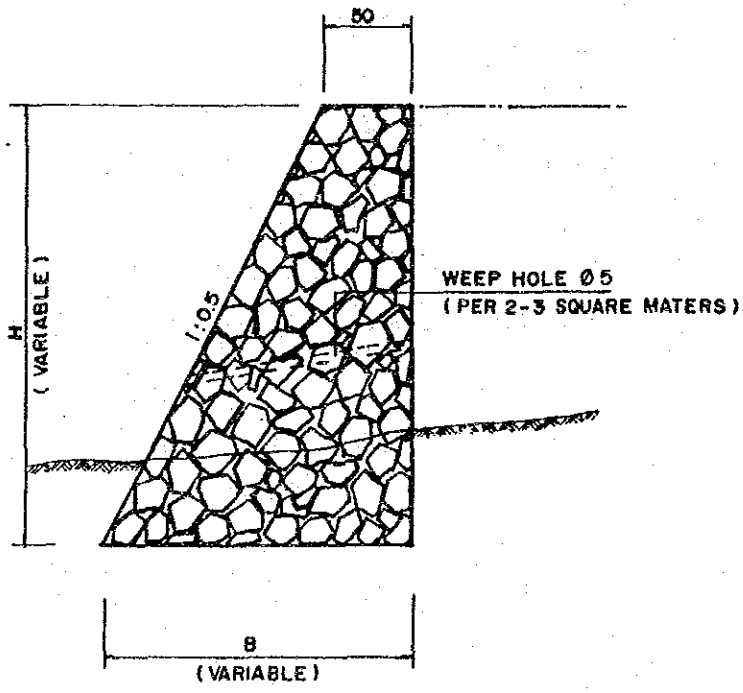


Fig. 3-3-3 STANDARD RETAINING WALLS

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<br>2- Dump Truck 3.0 Ton | 1- Wheel Loader 1.2 $m^3$ |
| 2. Excavation & Embankment | | |
| i) Normal Fill | 1- Bulldozer 90 HP<br>1- Vibratory Roller 4.0 Ton (D&T) | 1- Water Tank Truck 4,000 Ltr |
| ii) Fill by Borrow Material | 1- Bulldozer 90 HP<br>3- Dump Truck 3.0 Ton | 1- Wheel Loader 1.2 $m^3$ |
| iii) Fill in Swamp | 1- Swamp Bulldozer 90 HP<br>1- Water Tank Truck 4,000 Ltr | 1- Vibratory Roller 4.0 Ton (D&T) |
| iv) Excavation to Spoil | 1- Bulldozer 90 HP<br>1- Wheel Loader 1.2 $m^3$ | 4- Dump Truck 3.0 Ton |
| 3. Subgrade Preparation | 1- Motor Grader 75 HP<br>1- Vibratory Roller 4.0 Ton (D&T) | 1- Water Tank Truck 4,000 Ltr |
| 4. Subbase Course | 1- Motor Grader 75 HP<br>1- Vibratory Roller 4.0 Ton (D&T) | 1- Water Tank Truck 4,000 Ltr |
| 5. Base Course | 1- Motor Grader 75 HP<br>1- Vibratory Roller 4.0 Ton<br>1- Portable Crusher/Screens 30-40 Ton/H | 1- Water Tank Truck 4,000 Ltr |
| 6. Cement Stabilizing | 1- Motor Grader 70 HP<br>1- Bulldozer 90 HP<br>1- Wheel Loader 1.2 $m^3$<br>1- Flat Bed Truck 3.0 Ton | 1- Vibratory Roller 4.0 Ton (D&T)<br>1- Road Stabilizer<br>1- Water Tank Truck 4,000 Ltr |
| 7. Surface Course | 1- Asphalt Sprayer 850 Ltr<br>1- Tyre Roller 8-15 Ton<br>1- Portable Crusher/Screens 30-40 Ton/H | 1- Flat Bed Truck 3.0 Ton |
| 8. Concrete | 1- Concrete Mixer 0.5 $m^3$<br>1- Water Pump 200 Ltr/Min<br>1- Concrete Vibrator 3.3 HP | 1- Flat Bed Truck 3.0 Ton<br>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 Indragiri Hilir and other Kabupatens in Riau 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 |
|---|---|---|---|---|---|---|---|
| Indragiri Hulu | 4,400 | 3,300 | 4,400 | 4,400 | 2,750 | 3,300 | 5,500 |
| Indragiri Hilir | 4,400 | 3,250 | 4,500 | 4,500 | 2,750 | 5,000 | 5,000 |
| Bengkalis | 3,000 | 3,000 | 3,500 | 3,500 | 2,500 | 3,500 | 4,500 |
| Average | 3,800 | 3,185 | 4,135 | 4,135 | 2,667 | 3,935 | 5,000 |

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 Indragiri Hilir together with for other Kabupatens in Riau Province.

The unit price of river stone in the Kabupaten which has direct effects upon construction costs is significantly high.
Stone and sand are not produced in the Kabupaten. Therefore unit prices of these materials include the shipping cost from the producing Kabupaten.

Table 4-1-2 UNIT PRICE OF MATERIALS

(Rp)

| MATERIAL | UNIT | INDRAGIRI HULU | INDRAGIRI HILIR | BENGKALIS | AVERAGE |
|---|---|---|---|---|---|
| Bitumen | L | 400 | 750 | 350 | 500 |
| Asphalt Oil | L | 1,500 | 1,500 | 1,500 | 1,500 |
| Gasoline | L | 250 | 250 | 250 | 250 |
| Sand | $M^3$ | 4,000 | 4,500 | 15,000 | 3,667 |
| Cement | bag | 4,500 | 6,000 | 4,800 | 5,100 |
| River Stone | $M^3$ | 20,000 | 30,000 | 40,000 | 30,000 |
| Steel moulds | Set | 8,000 | 8,000 | 8,000 | 8,000 |
| Timber | $M^3$ | 85,000 | 180,000 | 110,000 | 125,000 |
| Paint | L | 2,500 | 2,000 | 2,500 | 2,333 |
| Reinforcing Steel | Kg | 500 | 1,200 | 750 | 817 |
| Tying | Kg | 1,200 | 1,000 | 1,200 | 1,133 |

### 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 : RIAU
KABUPATEN : INDRAGIRI HILIR

( 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 | 195 | 19,796 | 19,991 | 7,769 | 1,019 | 8,788 | 28,779 |
| | Bulldozer/Ripper | 120 HP | 213 | 20,802 | 21,015 | 8,499 | 1,568 | 10,067 | 31,082 |
| | Swamp Bulldozer | 120 HP | 222 | 21,044 | 21,266 | 8,880 | 1,638 | 10,518 | 31,784 |
| | Bulldozer | 90 HP | 123 | 13,742 | 13,865 | 4,914 | 644 | 5,558 | 19,423 |
| | Bulldozer/Ripper | 90 HP | 133 | 14,330 | 14,463 | 5,299 | 977 | 6,276 | 20,739 |
| | Bulldozer | 65 HP | 88 | 10,019 | 10,107 | 3,499 | 458 | 3,957 | 14,064 |
| | Bulldozer/Ripper | 65 HP | 96 | 10,466 | 10,562 | 3,819 | 704 | 4,523 | 15,085 |
| | Swamp Bulldozer | 90 HP | 133 | 14,321 | 14,454 | 5,284 | 974 | 6,258 | 20,712 |
| | Swamp Bulldozer | 65 HP | 102 | 10,025 | 10,127 | 4,049 | 747 | 4,796 | 14,923 |
| | Motor Grader | 110 HP | 173 | 16,805 | 16,978 | 6,920 | 1,276 | 8,196 | 25,174 |
| | Motor Grader | 75 HP | 120 | 11,497 | 11,617 | 4,779 | 881 | 5,660 | 17,277 |
| | Motor Grader | 65 HP | 108 | 10,064 | 10,172 | 4,299 | 793 | 5,092 | 15,264 |
| | Road Stabilizer | W=1850 mm | 215 | 3,365 | 3,580 | 8,594 | 422 | 9,016 | 12,596 |
| | Vibratory Roller | 4 ton | 73 | 5,131 | 5,204 | 2,899 | 380 | 3,279 | 8,483 |
| | Hand-guide Vib. Roller | 1000 Kg | 51 | 880 | 931 | 850 | 28 | 878 | 1,809 |
| | Tire Roller | 8-15 ton | 78 | 12,579 | 12,657 | 3,106 | 101 | 3,207 | 15,864 |
| | Vibratory Roller (D&T) | 4 ton | 73 | 5,131 | 5,204 | 2,899 | 380 | 3,279 | 8,483 |
| | Hand-guide Vib. Roller | 600 Kg | 36 | 596 | 632 | 600 | 20 | 620 | 1,252 |
| | Rough Terrain Crane | 10 ton | 251 | 19,686 | 19,937 | 10,040 | 740 | 10,780 | 30,717 |
| | Hydraulic Excavator; Wheel | 0.3 m3 | 103 | 12,477 | 12,580 | 4,109 | 538 | 4,647 | 17,227 |
| | Wheel Loader | 1.2 m3 | 176 | 12,207 | 12,383 | 7,019 | 920 | 7,939 | 20,322 |
| | Wheel Loader | 0.3 m3 | 57 | 4,351 | 4,408 | 2,269 | 297 | 2,566 | 6,974 |
| | Water Tank Truck | 4000 ltr. | 53 | 4,929 | 4,982 | 869 | 117 | 985 | 5,967 |
| | Fuel Tank Truck | 4000 ltr. | 53 | 4,935 | 4,988 | 882 | 119 | 1,001 | 5,989 |
| | Dump Truck | 3.0 ton | 89 | 5,823 | 5,912 | 1,469 | 199 | 1,668 | 7,580 |
| | Flat Bed Truck with Crane | 3.0 ton | 43 | 5,180 | 5,223 | 1,717 | 126 | 1,843 | 7,066 |
| | Dump Loader Truck | 12 ton | 96 | 34,221 | 34,317 | 3,838 | 125 | 3,963 | 38,280 |
| | Dump Truck | 5.0 ton | 132 | 9,741 | 9,873 | 2,189 | 296 | 2,485 | 12,358 |
| | Flat Bed Truck | 3.0 ton | 15 | 4,756 | 4,771 | 562 | 41 | 603 | 5,374 |
| | Portable Crusher/Screening | 30-40 t/h | 470 | 32,986 | 33,456 | 18,800 | 2,466 | 21,266 | 54,722 |
| | Concrete Mixer | 0.5 m3 | 324 | 2,617 | 2,941 | 5,400 | 412 | 5,812 | 8,753 |
| | Water Pump | 200 l/min | 12 | 432 | 444 | 188 | 6 | 194 | 638 |
| | Concrete Vibrator | 3.3 HP | 5 | 396 | 401 | 73 | 2 | 75 | 476 |
| | Asphalt Sprayer | 850 ltr. | 62 | 1,014 | 1,076 | 1,019 | 138 | 1,157 | 2,233 |

## 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 : RIAU KAB : INDRAGIRI HILIR

(Rp)

| ITEM | UNIT | LOCAL | FOREIGN | TOTAL |
|---|---|---|---|---|
| Site Clearance in Light Bush | m2 | 245 | 91 | 336 |
| Subgrade Preparation | m2 | 31 | 11 | 42 |
| Normal Fill | m3 | 2,574 | 862 | 3,436 |
| Fill in Swamp | m3 | 5,385 | 267 | 5,652 |
| Normal Excavation to Spoil | m3 | 1,495 | 522 | 2,017 |
| Cement Stabilizing | m3 | 11,814 | 14,289 | 26,103 |
| Cement Stabilizing | m3 | 11,814 | 14,289 | 26,103 |
| Shoulder | m2 | 447 | 146 | 593 |
| Asphalt Patching | m2 | 10,443 | 1,644 | 12,087 |
| Surface Dressing (Single) | m2 | 1,514 | 1,323 | 2,837 |
| Surface Dressing (Double) | m2 | 2,080 | 2,087 | 4,167 |
| Earth Drain | m | 1,336 | 119 | 1,455 |
| Earth Drain in Swamp (by machine) | m3 | 1,836 | 473 | 2,309 |
| Pipe Culvert D80cm | m | 68,867 | 58,844 | 127,711 |
| Masonry Culvert (80x80cm) | m | 118,628 | 44,536 | 163,164 |
| Retaining Wall and Wing Wall (Timber) | m2 | 18,526 | 246 | 18,772 |
| Retaining Wall and Wing Wall (Masonry) | m3 | 86,546 | 10,826 | 97,372 |
| Gabion Protection | m3 | 36,654 | 120 | 36,774 |
| Manual routine maintenance of road | Km | 220,752 | 7,236 | 227,988 |
| Routine maintenance of earth road | Km | 147,180 | 37,880 | 185,060 |
| Routine maintenance of gravel road | Km | 975,577 | 42,615 | 1,018,192 |
| Routine maintenance of asphalt road | Km | 1,044,300 | 164,400 | 1,208,700 |

### 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 : RIAU KAB : INDRAGIRI HILIR

(Rp)

| ITEM | UNIT | LOCAL | FOREIGN | TOTAL |
|---|---|---|---|---|
| Superstructure (Timber;Span 3m;10T) | m2 | 67,141 | 2,998 | 70,139 |
| Superstructure (Timber;Span 5m;10T) | m2 | 74,368 | 3,311 | 77,679 |
| Superstructure (Timber;Span 8m;10T) | m2 | 98,504 | 4,351 | 102,855 |
| Superstructure (Timber;Span 3m;BM50) | m2 | 83,252 | 3,707 | 86,959 |
| Superstructure (Timber;Span 5m;BM50) | m2 | 90,888 | 4,019 | 94,907 |
| Superstructure (Timber;Span 8m;BM50) | m2 | 115,270 | 5,088 | 120,358 |
| Superstructure (Concrete;Span 3m;BM50) | m2 | 88,097 | 127,583 | 215,680 |
| Superstructure (Concrete;Span 5m;BM50) | m2 | 91,223 | 142,694 | 233,917 |
| Superstructure (Concrete;Span 8m;BM50) | m2 | 94,543 | 155,500 | 250,043 |
| Superstructure (Concrete;Span10m;BM50) | m2 | 103,629 | 176,711 | 280,340 |
| Superstructure (Concrete;Span15m;BM50) | m2 | 112,858 | 208,298 | 321,156 |
| Substructure (Pier;for Timber;10T) | NO | 584,835 | 27,724 | 612,559 |
| Substructure (Abut;for Timber;10T) | NO | 1,667,310 | 112,169 | 1,779,479 |
| Substructure (Pier;for Timber;BM50) | NO | 860,118 | 41,015 | 901,133 |
| Substructure (Abut;for Timber;BM50) | NO | 1,874,927 | 126,412 | 2,001,339 |
| Substructure (Pier;for Concrete;BM50) | NO | 3,495,498 | 496,793 | 3,992,291 |
| Substructure (Abut;for Concrete;BM50) | NO | 7,096,827 | 953,086 | 8,049,913 |
| Demolition of Bridge (Timber->Timber) | m2 | 18,990 | 1,061 | 20,051 |
| Demolition of Bridge (Timber->Concrete) | m2 | 18,990 | 1,061 | 20,051 |
| Demolition of Bridge (Concrete) | m2 | 158,945 | 92,920 | 251,865 |
| Maintenance of Timber Bridge (New) | m2 | 12,383 | 1,009 | 13,392 |
| Maintenance of Concrete Bridge (New) | m2 | 3,698 | 3,604 | 7,302 |
| Maintenance of Timber Bridge (Exist) | m2 | 12,414 | 2,347 | 14,761 |
| Maintenance of Concrete Bridge (Exist) | m2 | 6,962 | 2,563 | 9,525 |

## 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 Indragiri Hilir are shown in Table 5-1-1.

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

KABUPATEN : INDRAGIRI HILIR

| CRITERIA NO | ROAD LINK NO |
|---|---|
| - | - |

## 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 : RIAU KABUPATEN : INDRAGIRI HILIR

| LINK NO | LENGTH | CLASS | IRR(%) | REMARK |
|---|---|---|---|---|
| 18 | 22 Km | IIIA | 31.617 | Surplus |
| 11 | 12 Km | IIIA | 12.582 | Surplus |
| 20 | 16 Km | IIIA | 11.085 | Surplus |
| 9 | 16 Km | IIIA | 6.007 | Surplus |
| 30 | 20 Km | IIIA | 3.156 | Surplus |
| 29 | 10 Km | IIIA | 0.402 | Surplus |
| 7 | 17 Km | IIIA | 0.078 | Surplus |
| 8 | 9 Km | IIIA | 0.078 | Surplus |
| 1 | 5 Km | IIIB-1 | 0.078 | Surplus |
| 10 | 8 Km | IIIA | 0.078 | Surplus |
| 2 | 23 Km | IIIA | 0.078 | Surplus |
| 12 | 9 Km | IIIB-1 | 0.078 | Surplus |
| 13 | 6 Km | IIIB-1 | 0.078 | Surplus |
| 14 | 13 Km | IIIB-1 | 0.078 | Surplus |
| 15 | 16 Km | IIIB-1 | 0.078 | Surplus |
| 16 | 10 Km | IIIB-1 | 0.078 | Surplus |
| 17 | 3 Km | IIIB-2 | 0.078 | Surplus |
| 3 | 12 Km | IIIB-1 | 0.078 | Surplus |
| 19 | 6 Km | IIIB-2 | 0.078 | Surplus |
| 4 | 17 Km | IIIB-1 | 0.078 | Surplus |
| 21 | 8 Km | IIIB-1 | 0.078 | Surplus |
| 22 | 2 Km | IIIB-2 | 0.078 | Surplus |
| 23 | 4 Km | IIIB-1 | 0.078 | Surplus |
| 24 | 3 Km | IIIC | 0.078 | Surplus |
| 25 | 7 Km | IIIB-1 | 0.078 | Surplus |
| 26 | 5 Km | IIIB-1 | 0.078 | Surplus |
| 27 | 8 Km | IIIA | 0.078 | Surplus |
| 28 | 5 Km | IIIA | 0.078 | Surplus |
| 5 | 9 Km | IIIB-1 | 0.078 | Surplus |
| 6 | 16 Km | IIIB-1 | 0.078 | Surplus |
| 31 | 13 Km | IIIB-1 | 0.078 | Surplus |

Table 5-2-2 RESULTS OF SECONDARY ANALYSIS

PROVINCE : RIAU KABUPATEN : INDRAGIRI HILIR

| LINK NO | LENGTH | CLASS | IRR(%) | REMARK |
|---|---|---|---|---|
| 9 | 16 Km | IIIB-1 | 17.164 | Surplus |
| 30 | 20 Km | IIIB-1 | 6.437 | Surplus |
| 29 | 10 Km | IIIB-1 | 4.130 | Surplus |

Table 5-2-3 RANKING OF FEASIBILITY ROAD LINKS

PROVINCE : RIAU KABUPATEN : INDRAGIRI HILIR

| LINK NO | LENGTH | CLASS | NPV (1000Rp) | B/C | IRR (%) | REMARK |
|---|---|---|---|---|---|---|
| 18 | 22 Km | IIIA | 2216729 | 2.209 | 31.617 | Surplus |
| 9 | 16 Km | IIIB-1 | 204978 | 1.307 | 17.164 | Surplus |
| 11 | 12 Km | IIIA | 101539 | 1.120 | 12.582 | Surplus |
| 20 | 16 Km | IIIA | 73469 | 1.052 | 11.085 | Surplus |
| SUM | 66 Km | | 2596715 | | | |

## 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: Indragiri Hilir

(Rpx$10^6$)

| COST | FOREIGN CURRENCY | LOCAL CURRENCY | TOTAL |
|---|---|---|---|
| CONSTRUCTION | 1,909 | 3,020 | 4,929 |
| MAINTENANCE | 56 | 477 | 533 |
| SUPPLEMENTATION | 350 | - | 350 |
| WORKSHOP EQUIPMENT & TOOLS | 28 | - | 28 |
| LABORATORY EQUIPMENT | 12 | - | 12 |
| SURVEY EQUIPMENT | 5 | - | 5 |
| TOTAL | 2,360 | 3,497 | 5,857 |

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

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

(Rpx$10^6$)

| COST | FOREIGN CURRENCY | LOCAL CURRENCY | TOTAL |
|---|---|---|---|
| CIVIL WORK | 1,460 | 3,483 | 4,943 |
| CONSTRUCTION & MAINTENANCE EQUIPMENT | 798 | - | 798 |
| SPARE PARTS | 57 | 14 | 71 |
| WORKSHOP/LABORATORY/SURVEY EQUIPMENT | 45 | - | |
| TOTAL | 2,360 | 3,497 | 5,857 |

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.

### 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 final proposal for road links to be in the Kabupaten development plan are the 6 links with a total length of 68 km which is 21% of the 330 km total length of Kabupaten roads to be studied. Road Link No 11 is a feasible road link. However it is located at the end of the local road network, therefore this road link was revenued from the list. The proposed road links are shown in Table 6-1-3.

Table 6-1-3 ROAD LINKS TO BE IMPROVED

KABUPATEN : INDRAGIRI HILIR

| REASON FOR SELECTION | ROAD LINK NO |
|---|---|
| Feasible | |
| - Primary | 18,20 |
| - Secondary | 9 |
| Engineering Point of View | 2,4,5 |
| Basic Human Needs | - |

Road Links No 2, No 4 and No 5 are trunk roads which connect the Kabupaten capital with Kecamatan capital, these road links are selected from the engineering points of view.

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

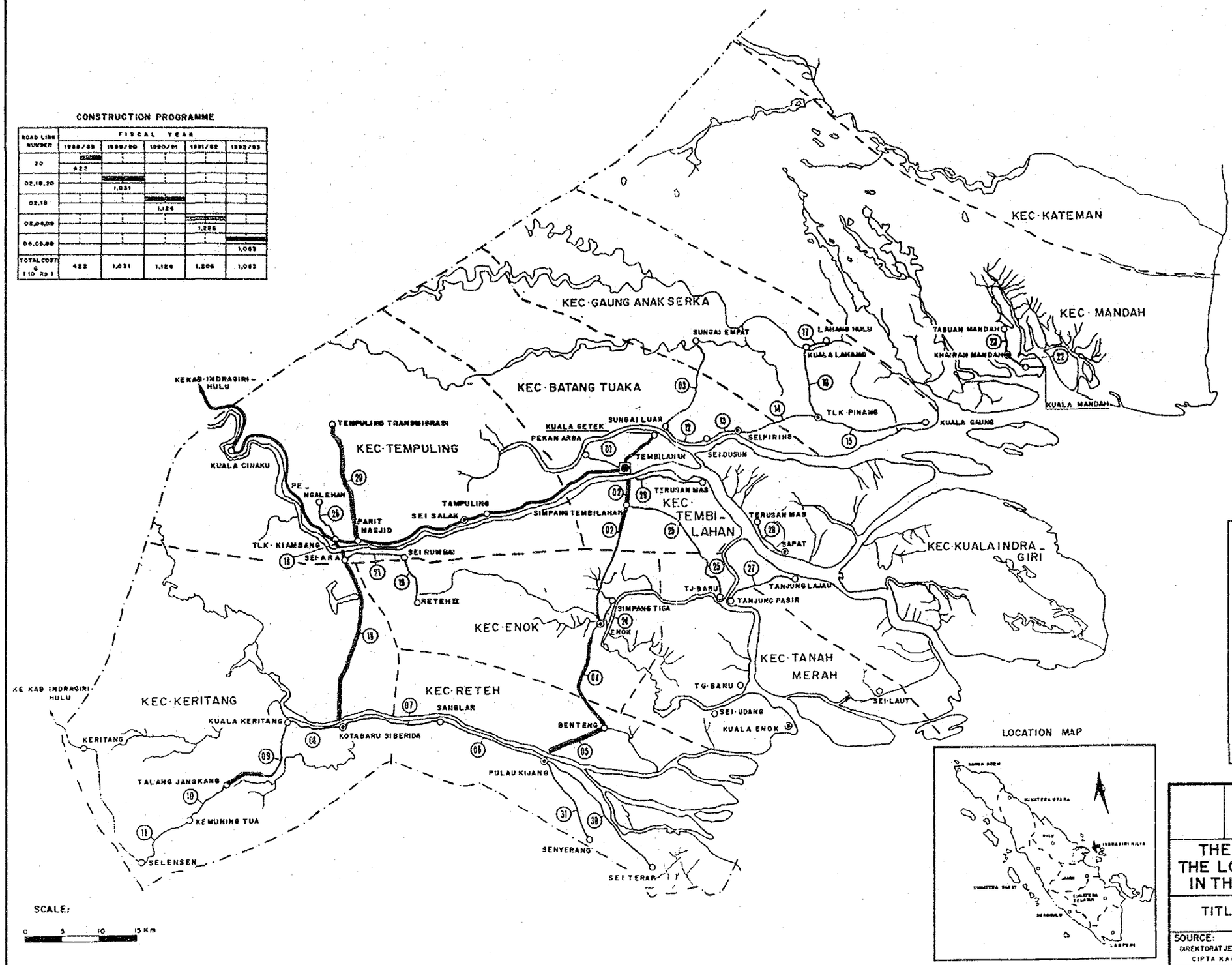
PROV : RIAU KAB : INDRAGIRI HILIR

| YEAR | LINK NO ( ) : rate |
|---|---|
| 1988 | 20 (50%) |
| 1989 | 2 (20%), 18 (30%), 20 (50%) |
| 1990 | 2 (25%), 18 (70%) |
| 1991 | 2 (55%), 4 (25%), 9 (70%) |
| 1992 | 4 (75%), 5, 9 (30%) |

# KAB · INDRAGIRI HILIR

**CONSTRUCTION PROGRAMME**

| ROAD LINE NUMBER | FISCAL YEAR 1988/89 | 1989/90 | 1990/91 | 1991/92 | 1992/93 |
|---|---|---|---|---|---|
| 30 | 422 | | | | |
| 02,19,20 | | 1,031 | | | |
| 02,18 | | | 1,124 | | |
| 02,04,09 | | | | 1,206 | |
| 06,05,09 | | | | | 1,063 |
| TOTAL COST (110 Rp.) | 422 | 1,031 | 1,124 | 1,206 | 1,063 |




LEGEND :

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

LOCATION MAP



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

TITLE : CONSTRUCTION PROGRAMME

| SOURCE: | SCALE: | PROVINCE : |
|---|---|---|
| DIREKTORAT JENDRAL CIPTA KARYA | AS SHOWN | RIAU KABUPATEN INDRAGIRI HILIR |

(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 : RIAU KAB : INDRAGIRI HILIR

( 1000Rp )

| LINK NO | LENGTH (Km) | BA (%) | SD (%) | RU (%) | RB (%) | ASPHAL (Km) | GRAVEL (Km) | EARTH (Km) | TH NO | AREA (m2) | BC NO | AREA (m2) | BRIDGE COST | LOCAL COST | FOREIGN COST | TOTAL COST |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 23 | 44.8 | 27.4 | 27.8 | 0.0 | 0 | 23 | 0 | 21 | 591.40 | 0 | 0.00 | 8,730 | 34,857 | 2,535 | 37,392 |
| 3 | 12 | 0.0 | 47.9 | 41.7 | 10.4 | 0 | 12 | 0 | 5 | 142.20 | 0 | 0.00 | 2,099 | 16,121 | 932 | 17,053 |
| 12 | 9 | 0.0 | 81.1 | 18.9 | 0.0 | 0 | 0 | 9 | 8 | 480.00 | 0 | 0.00 | 7,085 | 9,270 | 1,533 | 10,803 |
| 13 | 6 | 0.0 | 25.8 | 74.2 | 0.0 | 0 | 0 | 6 | 4 | 352.00 | 0 | 0.00 | 5,196 | 6,577 | 1,097 | 7,674 |
| 14 | 13 | 0.0 | 33.5 | 66.5 | 0.0 | 0 | 0 | 13 | 12 | 555.00 | 0 | 0.00 | 8,192 | 11,673 | 1,889 | 13,562 |
| 26 | 5 | 82.0 | 18.0 | 0.0 | 0.0 | 0 | 0 | 5 | 3 | 144.00 | 0 | 0.00 | 2,126 | 3,627 | 564 | 4,191 |
| SUM | 68 | | | | | 0 | 35 | 33 | 53 | 2264.60 | 0 | 0.00 | 33,428 | 82,125 | 8,550 | 90,675 |

### 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 Indragiri Hilir 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 4,929 x $10^6$ and maintenance cost is Rp 533 x $10^6$ which is approximately 11% of the total expenditure.

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

PROV : RIAU KAB : INDRAGIRI HILIR

( UNIT : 1000Rp )

| ITEM | ( 1988 ) | ( 1989 ) | ( 1990 ) | ( 1991 ) | ( 1992 ) | ( TOTAL ) | |
|---|---|---|---|---|---|---|---|
| LOCAL CURRENCY : | 258,820 | 628,591 | 679,736 | 779,561 | 672,957 | 3,019,665 | (61.3%) |
| Ownership Cost | 1,122 | 2,853 | 3,106 | 3,579 | 3,438 | 14,098 | ( 0.5%) |
| Operation Cost | 93,671 | 237,025 | 256,009 | 296,778 | 282,564 | 1,166,047 | (38.6%) |
| Material Cost | 92,754 | 214,806 | 231,186 | 258,448 | 190,137 | 987,331 | (32.7%) |
| Labour Cost | 37,514 | 91,917 | 100,774 | 119,074 | 109,041 | 458,320 | (15.2%) |
| Contingency | 33,759 | 81,990 | 88,661 | 101,682 | 87,777 | 393,869 | (13.0%) |
| FOREIGN CURRENCY : | 162,940 | 404,139 | 444,102 | 506,723 | 391,017 | 1,908,921 | (38.7%) |
| Ownership Cost | 32,886 | 82,998 | 89,869 | 104,045 | 100,036 | 409,834 | (21.5%) |
| Operation Cost | 4,240 | 10,727 | 11,627 | 13,401 | 13,113 | 53,108 | ( 2.8%) |
| Material Cost | 104,561 | 257,700 | 284,680 | 323,183 | 226,866 | 1,196,990 | (62.7%) |
| Labour Cost | 0 | 0 | 0 | 0 | 0 | 0 | ( 0.0%) |
| Contingency | 21,253 | 52,714 | 57,926 | 66,094 | 51,002 | 248,989 | (13.0%) |
| TOTAL COST : | 421,760 | 1,032,730 | 1,123,839 | 1,286,284 | 1,063,974 | 4,928,587 | |
| Ownership Cost | 34,008 | 85,851 | 92,975 | 107,624 | 103,474 | 423,932 | ( 8.6%) |
| Operation Cost | 97,911 | 247,752 | 267,636 | 310,179 | 295,677 | 1,219,155 | (24.7%) |
| Material Cost | 197,315 | 472,506 | 515,866 | 581,631 | 417,003 | 2,184,321 | (44.3%) |
| Labour Cost | 37,514 | 91,917 | 100,774 | 119,074 | 109,041 | 458,320 | ( 9.3%) |
| Contingency | 55,012 | 134,704 | 146,588 | 167,776 | 138,779 | 642,859 | (13.0%) |

( Contingency : 15% )

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

(MAINTENANCE)

PROV : RIAU KAB : INDRAGIRI HILIR

( UNIT : 1000Rp )

| ITEM | ( 1988 ) | ( 1989 ) | ( 1990 ) | ( 1991 ) | ( 1992 ) | ( TOTAL ) | |
|---|---|---|---|---|---|---|---|
| LOCAL CURRENCY : | 41,039 | 78,621 | 98,002 | 124,306 | 134,514 | 476,482 | (89.4%) |
| Ownership Cost | 92 | 180 | 238 | 311 | 381 | 1,202 | ( 0.3%) |
| Operation Cost | 12,875 | 24,968 | 28,690 | 33,385 | 36,419 | 136,337 | (28.6%) |
| Material Cost | 17,341 | 32,677 | 41,948 | 54,006 | 54,771 | 200,743 | (42.1%) |
| Labour Cost | 10,731 | 20,796 | 27,126 | 36,604 | 42,943 | 138,200 | (29.0%) |
| FOREIGN CURRENCY : | 4,274 | 8,297 | 10,980 | 14,678 | 17,999 | 56,228 | (10.6%) |
| Ownership Cost | 3,693 | 7,168 | 8,129 | 9,354 | 10,240 | 38,584 | (68.6%) |
| Operation Cost | 329 | 630 | 744 | 876 | 963 | 3,550 | ( 6.3%) |
| Material Cost | 252 | 491 | 2,107 | 4,448 | 6,796 | 14,094 | (25.1%) |
| Labour Cost | 0 | 0 | 0 | 0 | 0 | 0 | ( 0.0%) |
| TOTAL COST : | 45,313 | 86,918 | 108,982 | 138,984 | 152,513 | 532,710 | |
| Ownership Cost | 3,785 | 7,348 | 8,367 | 9,665 | 10,621 | 39,786 | ( 7.5%) |
| Operation Cost | 13,204 | 25,606 | 29,434 | 34,261 | 37,382 | 139,887 | (26.3%) |
| Material Cost | 17,593 | 33,168 | 44,055 | 58,454 | 61,567 | 214,837 | (40.3%) |
| Labour Cost | 10,731 | 20,796 | 27,126 | 36,604 | 42,943 | 138,200 | (25.9%) |

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

(TOTAL)

PROV : RIAU KAB : INDRAGIRI HILIR

( UNIT : 1000Rp )

| ITEM | ( 1988 ) | ( 1989 ) | ( 1990 ) | ( 1991 ) | ( 1992 ) | ( TOTAL ) | |
|---|---|---|---|---|---|---|---|
| LOCAL CURRENCY : | 299,859 | 707,212 | 777,738 | 903,867 | 807,471 | 3,496,147 | (64.0%) |
| Ownership Cost | 1,214 | 3,033 | 3,344 | 3,890 | 3,819 | 15,300 | ( 0.4%) |
| Operation Cost | 106,546 | 261,993 | 284,699 | 330,163 | 318,983 | 1,302,384 | (37.3%) |
| Material Cost | 110,095 | 247,483 | 273,134 | 312,454 | 244,908 | 1,188,074 | (34.0%) |
| Labour Cost | 48,245 | 112,713 | 127,900 | 155,678 | 151,984 | 596,520 | (17.1%) |
| Contingency | 33,759 | 81,990 | 88,661 | 101,682 | 87,777 | 393,869 | (11.3%) |
| FOREIGN CURRENCY : | 167,214 | 412,436 | 455,082 | 521,401 | 409,016 | 1,965,149 | (36.0%) |
| Ownership Cost | 36,579 | 90,166 | 97,998 | 113,399 | 110,276 | 448,418 | (22.8%) |
| Operation Cost | 4,569 | 11,365 | 12,371 | 14,277 | 14,076 | 56,658 | ( 2.9%) |
| Material Cost | 104,813 | 258,191 | 286,787 | 327,631 | 233,662 | 1,211,084 | (61.6%) |
| Labour Cost | 0 | 0 | 0 | 0 | 0 | 0 | ( 0.0%) |
| Contingency | 21,253 | 52,714 | 57,926 | 66,094 | 51,002 | 248,989 | (12.7%) |
| TOTAL COST : | 467,073 | 1,119,648 | 1,232,821 | 1,425,268 | 1,216,487 | 5,461,297 | |
| Ownership Cost | 37,793 | 93,199 | 101,342 | 117,289 | 114,095 | 463,718 | ( 8.5%) |
| Operation Cost | 111,115 | 273,358 | 297,070 | 344,440 | 333,059 | 1,359,042 | (24.9%) |
| Material Cost | 214,908 | 505,674 | 559,921 | 640,085 | 478,570 | 2,399,158 | (43.9%) |
| Labour Cost | 48,245 | 112,713 | 127,900 | 155,678 | 151,984 | 596,520 | (10.9%) |
| Contingency | 55,012 | 134,704 | 146,588 | 167,776 | 138,779 | 642,859 | (11.8%) |

( Contingency : 15% )

### 6.1.4 Construction and Maintenance Equipment Cost

#### (1) Required Number of Equipment

The required numbers of construction equipment for Kabupaten Indragiri Hilir 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.

- Nil

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

- Nil

#### (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 : RIAU KAB : INDRAGIRI HILIR

| EQUIPMENT NAME | WORKABLE | EXISTING | ( 1988 ) | ( 1989 ) | ( 1990 ) | ( 1991 ) | ( 1992 ) |
|---|---|---|---|---|---|---|---|
| Bulldozer | 220 | 0 | 0.23 | 0.56 | 0.62 | 0.70 | 0.67 |
| Bulldozer/Ripper | 220 | 0 | 0.09 | 0.23 | 0.26 | 0.30 | 0.30 |
| Swamp Bulldozer | 220 | 0 | 0.11 | 0.25 | 0.26 | 0.19 | 0.31 |
| Motor Grader | 240 | 0 | 0.42 | 1.08 | 1.21 | 1.40 | 1.35 |
| Road Stabilizer | 220 | 0 | 0.23 | 0.56 | 0.62 | 0.70 | 0.67 |
| Hand-guide Vib. Roller | 240 | 0 | 0.05 | 0.11 | 0.10 | 0.32 | 0.33 |
| Tire Roller | 220 | 0 | 0.18 | 0.43 | 0.47 | 0.53 | 0.11 |
| Vibratory Roller (DKT) | 240 | 0 | 0.48 | 1.18 | 1.31 | 1.41 | 1.44 |
| Hydraulic Excavator; Wheel | 220 | 0 | 1.71 | 4.30 | 4.35 | 5.36 | 5.37 |
| Wheel Loader | 240 | 0 | 0.39 | 0.97 | 1.09 | 1.24 | 1.19 |
| Water Tank Truck | 240 | 0 | 0.40 | 0.97 | 1.07 | 1.13 | 1.15 |
| Dump Truck | 240 | 0 | 3.59 | 9.34 | 10.34 | 11.70 | 11.39 |
| Flat Bed Truck with Crane | 240 | 0 | 0.10 | 0.18 | 0.17 | 0.31 | 0.28 |
| Flat Bed Truck | 240 | 0 | 0.52 | 1.27 | 1.40 | 1.65 | 1.14 |
| Concrete Mixer | 220 | 0 | 0.00 | 0.01 | 0.01 | 0.01 | 0.00 |
| Water Pump | 220 | 0 | 0.00 | 0.01 | 0.01 | 0.01 | 0.00 |
| Concrete Vibrator | 220 | 0 | 0.00 | 0.01 | 0.01 | 0.01 | 0.00 |
| Asphalt Sprayer | 220 | 0 | 0.18 | 0.43 | 0.47 | 0.53 | 0.11 |

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

Table 6-1-8 EQUIPMENT PURCHASE COST

PROV : RIAU KAB : INDRAGIRI HILIR

( 1000 Rp )

| EQUIPMENT NAME | CLASS | CIF (JAKARTA) | PURCHASE NO. | PURCHASE COST |
|---|---|---|---|---|
| Bulldozer | 90 HP | 49,150 | 1 | 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 | 2 | 95,600 |
| Road Stabilizer | W=1850 mm | 85,950 | 1 | 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 | 2 | 58,000 |
| Vibratory Roller | 4 ton | 29,000 | - | - |
| Rough Terrain Crane | 10 ton | 100,400 | - | - |
| Hydraulic Excavator; Wheel | 0.3 m3 | 41,100 | 2 | 82,200 |
| 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 | 1 | 25,190 |
| Flat Bed Truck | 3.0 ton | 11,275 | 2 | 22,550 |
| 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 | 1 | 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 | 798,310 |
| OWNERSHIP COST (FOREIGN) | 448,418 |
| EQUIPMENT COST SUPPLEMENTED | 349,892 |

### 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 : RIAU KAB : INDRAGIRI HILIR

| ITEM | UNIT | ( 1988 ) | ( 1989 ) | ( 1990 ) | ( 1991 ) | ( 1992 ) | ( TOTAL ) |
|---|---|---|---|---|---|---|---|
| Site Clearance in Light Bush | m2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Subgrade Preparation | m2 | 48000.00 | 128160.00 | 146675.00 | 127251.00 | 127494.00 | 577580.00 |
| Normal Fill | m3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Fill in Swamp | m3 | 4350.00 | 9600.75 | 10158.75 | 7275.23 | 11923.28 | 43308.00 |
| Normal Excavation to Spoil | m3 | 1213.00 | 2312.70 | 2479.30 | 297.50 | 697.50 | 7000.00 |
| Cement Stabilizing | m3 | 3920.00 | 10024.70 | 11134.38 | 11746.31 | 11844.02 | 48669.40 |
| Cement Stabilizing | m3 | 1960.00 | 4704.00 | 5181.75 | 6735.75 | 5743.50 | 24325.00 |
| Shoulder | m2 | 20000.00 | 55900.00 | 66325.00 | 92750.00 | 90525.00 | 325500.00 |
| Asphalt Patching | m2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Surface Dressing (Single) | m2 | 28000.00 | 67200.00 | 74025.00 | 83475.00 | 16800.00 | 269500.00 |
| Surface Dressing (Double) | m2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Earth Drain | m | 0.00 | 5320.00 | 11850.00 | 1430.00 | 0.00 | 18600.00 |
| Earth Drain in Swamp (by machine) | m3 | 30000.00 | 75600.00 | 76500.00 | 94260.00 | 94440.00 | 370800.00 |
| Pipe Culvert D80cm | m | 0.00 | 1.60 | 2.00 | 4.40 | 0.00 | 8.00 |
| Masonry Culvert (80x80cm) | m | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Retaining Wall and Wing Wall (Timber) | m2 | 0.00 | 20.00 | 25.00 | 207.50 | 522.50 | 775.00 |
| Retaining Wall and Wing Wall (Masonry) | m3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Gabion Protection | m3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Superstructure (Timber;Span 3m;10T) | m2 | 0.00 | 20.80 | 26.00 | 57.20 | 8.00 | 112.00 |
| Superstructure (Timber;Span 5m;10T) | m2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Superstructure (Timber;Span 8m;10T) | m2 | 150.00 | 240.00 | 210.00 | 294.80 | 265.20 | 1160.00 |
| 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 | 0.00 | 0.00 | 0.00 | 0.00 |
| 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 | 4.50 | 8.30 | 7.35 | 7.35 | 1.50 | 29.00 |
| Substructure (Abut;for Timber;10T) | NO | 3.00 | 6.00 | 5.70 | 18.50 | 18.80 | 52.00 |
| 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 | 0.00 | 0.00 | 0.00 | 0.00 |
| Demolition of Bridge (Timber->Timber) | m2 | 0.00 | 15.24 | 19.05 | 41.91 | 6.40 | 82.60 |
| 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 | 0.00 | 0.00 | 0.00 | 0.00 |
| Manual routine maintenance of road | Km | 34.00 | 65.70 | 81.13 | 99.68 | 106.00 | 386.50 |
| Routine maintenance of earth road | Km | 16.50 | 33.00 | 33.00 | 33.00 | 33.00 | 148.50 |
| Routine maintenance of gravel road | Km | 17.50 | 32.70 | 32.13 | 28.68 | 12.00 | 123.00 |
| Routine maintenance of asphalt road | Km | 0.00 | 0.00 | 16.00 | 38.00 | 61.00 | 115.00 |
| Maintenance of Timber Bridge (New) | m2 | 0.00 | 0.00 | 0.00 | 300.00 | 300.00 | 600.00 |
| Maintenance of Concrete Bridge (New) | m2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Maintenance of Timber Bridge (Exist) | m2 | 1132.30 | 2205.46 | 2190.68 | 2101.97 | 2188.40 | 9818.80 |
| Maintenance of Concrete Bridge (Exist) | m2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

## 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.

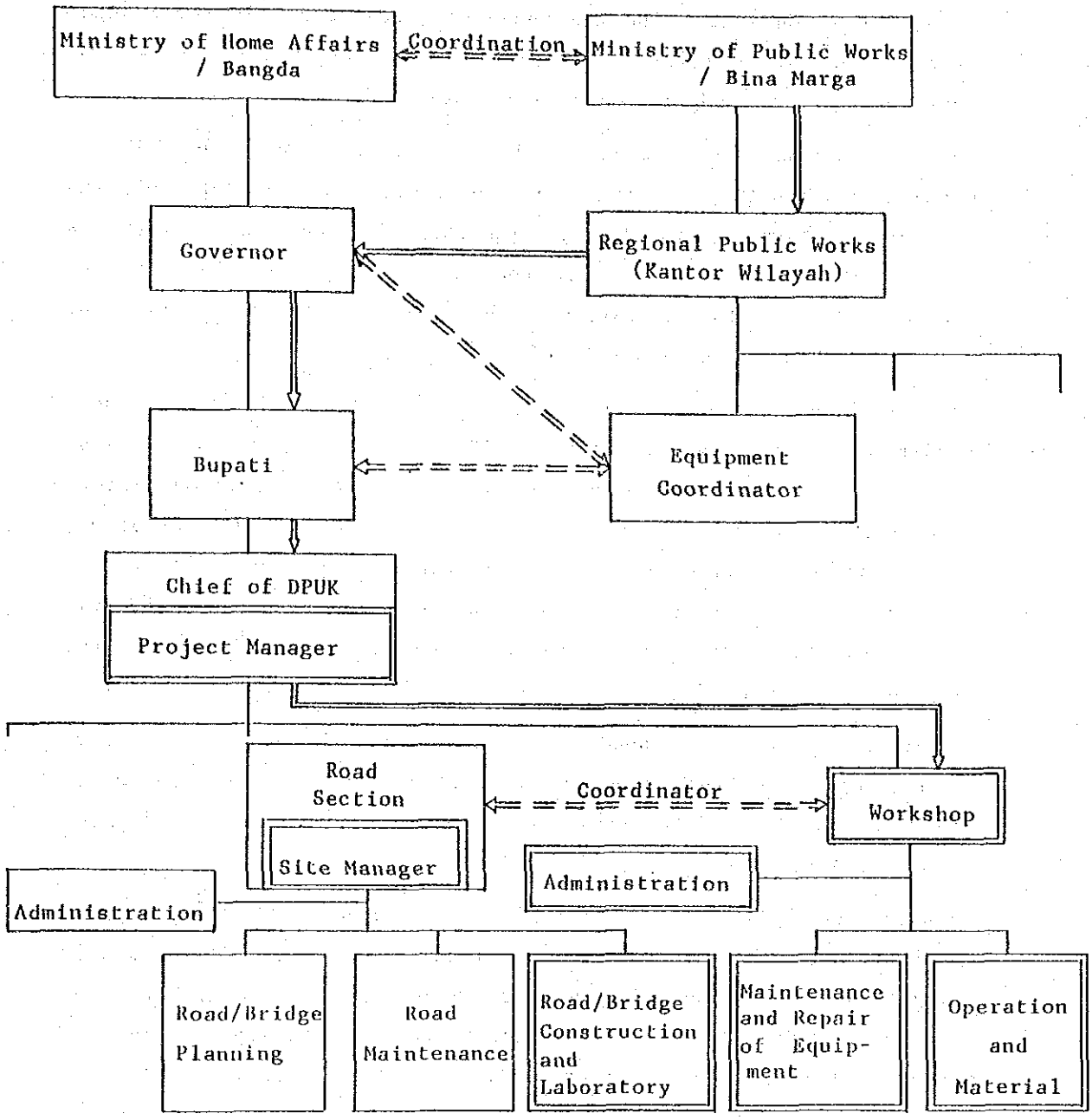
It is recommended that the workshop is newly organized to consist of three sub-sections, i.e. maintenance and repair of equipment, operation and materials, and administration to execute the main tasks described in Clause 3.5.

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




⇓ : Equipment delivery flow

▭ : New position/subsection

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