2.2.4 Other Economic Activities

As mentioned in the previous sub-clause all Project Areas are based upon agricultural activity, especially the monoculture economic structures of which paddy production is the major activity except in some regions. Because of lack of data necessary to verify this fact such as the gross domestic products by province or Kabupaten, it is explained by the data available for labour force by industrial sector and region shown in Table 2-2-9. As the table shows that the proportions of primary, secondary and tertiary industries in the islands outside Jawa are 69.4%, 11.6% and 19.0% respectively, it can be clearly seen that the industrial structure in this area leans to the primary industry of which the function of the market is typically undeveloped. The value in the table includes the value for the urban areas such as the provincial capitals and Kota-madyas in the provinces and does not represent the only rural area.

Taking into consideration the typical actual conditions of the rural area, the labour force in the rural area excluding the urban area is assumed by weighting the value for the sector as shown in Table 2-2-10. It can be assumed from the table that in the Project Area the labour force, excluding the primary industry, is less than 20% of the total. Within the secondary and tertiary industries, the weight of the sectors, construction and mining, including quarrying, and public service are rather high. The industrial activities, except the primary industry of agriculture will be stagnant in the present and the near future.

Some provinces in Kalimantan Island and Sumatera Island have rich forest resources which is one of the important national resources for export. As such the foresty sector is in an important position. However its industrial activity is not closely related to the industrial activity of the local people. The number of employees of this sector is only 0.2% to 0.4% of the local population.

In some Kabupatens in the Project Area the fishery sector could have the possibility of becomming an important future industrial activity in the region depending upon coastal geographical conditions. However because of the limitation of the basic structure and the undeveloped marketing mechanism this industrial activity will not increase rapidly in the near future.

As part of the industrial tendency mentioned above the following items are expected to be implemented for the local industrial activities:

1) Diversification of the primary industry
2) Added value production to the primary industry
3) Development of commerce which supplies and distributes local production through the marketing mechanism
4) Fostering the transportation and communication sector.

Table 2-2-9

LABOUR FORCE BY INDUSTRIAL SECTOR IN ISLANDS OUT OF JAWA

Year : 1982

(person)

SECTOR		SUMATERA	KALIMANTAN	SULAWESI	OTHER ISLANDS	TOTAL
Primary Industry	Agriculture, foresty & Fishery	6,957,283 (74.4)	1,809,889 (65.7)	2,030,141 (60.8)	2,748,195 (67.4)	13,545,508 (69.4)
Secondary Industry	Manufacture	82,822	27,244	11,902	33,558	
	Energy	12,399	1,795	2,768	2,540	
	Mining	619,270	241,554	310,388	315,558	
	Construction	285,566	91,113	99,625	131,798	
	Sub Total	1,000,057 (10.7)	361,706 (13.1)	424,683 (12.7)	483,454 (11.8)	2,269,900 (11.6)
Tertiary Industry	Trading	144,571	240,315	341,461	409,742	
	Transportation & Communication	262,678	67,774	107,123	67,532	
	Business Service	14,293	2,609	3,551	3,671	
	Public Service	977,205	274,881	431,837	367,268	
	Others	382	-	-	330	
	Sub Total	1,397,124 (14.9)	585,579 (21.2)	883,972 (26.5)	848,543 (20.8)	3,715,223 (19.0)
	T o t a l	9,354,469 (100)	2,757,174 (100)	3,338,796 (100)	4,080,192 (100)	19,530,631 (100)

Notes :

1. Source : Statistical Yearbook of Indonesia 1984 published by The Central Statistic Bureau.
2. The value in ( ) denotes the proportion in %.

Table 2-2-10 ASSUMED LABOUR FORCE IN RURAL AREA BY INDUSTRIAL SECTOR

(x 1,000 person)

SECTOR	SUMATERA	KALIMANTAN	SULAWESI	OTHER ISLANDS	TOTAL
Primary Industry	6,600 (85.1)	1,719 (79.1)	1,930 (76.1)	2,610 (83.4)	12,859 (82.4)
Secondary Industry	753 (9.7)	275 (12.7)	333 (13.1)	268 (8.6)	1,629 (10.5)
Tertiary Industry	400 (5.2)	178 (8.2)	273 (10.8)	249 (8.0)	1,100 (7.1)
Total	7,753 (100)	2,172 (100)	2,536 (100)	3,127 (100)	15,588 (100)

Note : The value in ( ) denotes the proportion in %.

2.2.5 Vehicle Registration

The number of registered vehicles in a district fluctuates according to the conditions of the socio-economic structures in the district. While traffic composition corresponds to the service level of the roads.

In other words it can be said that the number of registered vehicles and their composition reflect the conditions of the socio-economic structures and the accumulation of investment for the road infra-structure.

Table 2-2-11 shows the number and growth rate of registered motor vehicles in the Project Area for each Province together with the values for both Indonesia and the metropolitan area of Jakarta (DKI Jakarta) which is the most advanced area. From the table it can be observed that in general the distribution of vehicles (persons per vehicle) in the provinces is less than the average value in Indonesia and the proportion of 2 - wheel type vehicles (motor cycles) is in some extent high. These facts show that modernization of the socio-economic structures is behind and the service level of roads is comparatively low in these particular provinces. However, the average annual growth rates of registered vehicles in the provinces are higher than the annual average growth rates in both Indonesia and DKI Jakarta.

The distribution of vehicles in the provinces is expected to increase continuously.

Thus the Project Area has a background from which an improvement in the service level of the roads is expected.

During the study of the number of registered vehicles it was found in some Kabupatens that the place where vehicles have been registered differs from the place where the vehicles are mainly used. It needs to be recognized that the number of registered vehicles in the district does not show the number of vehicles used in the same district.

However, it can be assumed that the number of vehicles registered in a province shows the number of vehicles used in that province.

Table 2-2-11 NUMBER AND GROWTH RATE OF REGISTERED MOTOR VEHICLES BY PROVINCE CONCERNED

Description	Sedan		Bus		Truck		Sub. Total		Motor Cycle		Total		Population (X 1000)	Persons / Vehicle
	1981	1982	1981	1982	1981	1982	1981	1982	1981	1982	1981	1982	1982	1982
Riau	4592	6042	737	1152	7421	9595	12750	16789	45402	62058	35451	47818	2306.3	48.2
G.R %	31.5		56.3		29.3		31.6		36.6		34.9			
Sumatera Selatan	21655	25069	5314	5998	25592	28635	52561	59702	122346	149640	113734	134522	4944.3	36.8
G.R %	15.7		12.8		11.9		13.5		22.3		18.3			
Lampung	8656	10020	986	1113	13715	15346	23357	26479	43179	52812	44947	52885	5176.0	97.9
G.R %	15.8		12.9		11.9		13.4		22.3		17.7			
Kalimantan Tengah	803	1001	38	49	1510	1919	2351	2969	13039	15696	8871	10817	1021.4	94.4
G.R %	24.6		28.9		27.0		26.3		20.4		21.9			
Kalimantan Timur	8290	10202	3579	4196	10193	12641	22692	27039	42746	55624	44065	54851	1362.8	24.8
G.R %	14.4		17.2		24.0		19.2		30.1		24.5			
Kalimantan Selatan	6457	8051	530	604	3679	4675	10666	13330	56391	67884	38862	47272	2155.7	45.6
G.R %	24.7		14.0		27.0		25.0		20.4		21.6			
Nusa Tenggara Timur	2107	2514	1951	2295	2429	2848	6487	7657	11410	14916	12192	15115	2846.4	188.3
G.R %	19.3		17.6		17.2		18.0		30.7		24.0			
Sulawesi Utara	9445	9886	2856	3415	7153	8570	19454	21871	21377	27968	30143	35855	2215.3	61.8
G.R %	4.7		19.6		19.8		12.4		30.8		18.9			
Sulawesi Selatan	15360	18499	3254	3630	26358	31241	44972	53370	133839	157164	111892	131952	6278.2	47.6
G.R %	20.4		11.6		18.5		18.7		17.4		17.9			
Sulawesi Tenggara	827	1214	191	278	2365	2803	3383	4295	11403	13390	9085	10990	1002.1	91.2
G.R %	46.8		45.5		18.5		26.9		17.4		21.0			
D.K.I Jakarta	247066	275139	38478	49827	95858	112494	381402	437460	495768	570972	629286	722446	7038.1	9.7
G.R %	11.3		29.4		17.3		14.6		15.2		14.9			
Indonesia	710946	791019	109986	135151	575426	657104	1396358	1583274	3163284	3764492	2978000	3465495	154661.7	44.6
G.R %	11.2		22.8		14.1		13.3		19.0		16.4			

NOTE :

TOTAL = Sub Total + 1/2 Motor Cycle

Table 2-2-12 shows details of vehicle registration in the provinces and Kabupatens of the Study.
It should be noted that the weight of the provincial capital takes up a big proportion of the provincial value which does not reflect the conditions in the Kabupatens. However in the case of a province where the trunk roads have been improved the vehicles registered in the provincial capital might be used in the Kabupatens near the provincial capital.

(1) Riau Province

In this province there have been remarkable recent annual average growth rates.
The present distribution of vehicles is slightly lower than the national average and is fifth within the 10 provinces concerned with the Study.
The proportion of 2-wheel type vehicles in the province is higher than the average in Indonesia.
The growth rates of both bus and 2-wheel type vehicles are high. Active movement of personnel in the province is observed and an increase of road service level is desirable.

(2) Sumatera Selatan Province

In this province there is a high distribution of vehicles being higher than the national distribution and the second highest in the 10 provinces following Kalimantan Timur Province.
The composition of vehicles and the annual growth rates of vehicles are both almost the same as the national value.
Palembang, the second largest city in Sumatera Island being in the province influences the facts.
Therefore the number of registered vehicles in the Kabupatens undoubtedly shows a less advanced characteristic.

(3) Lampung Province

This province is notable for its low distribution of vehicles, being ninth within the 10 provinces, even through the existence of a developed railway as an alternative means of transportation

could be an influence.
The recent growth rates of registered vehicles are almost the same as the national rates and are not remarkable. Reliability of the data is doubtful.

(4) Kalimantan Tengah Province

Since the major transportation system of the province is river transportation a low vehicle distribution rate is clearly to be expected and is in fact eighth within the 10 provinces at less than half of the national rate.
However, the average annual growth rates of vehicles are higher than the national rates.
Therefore the increase of vehicles can be assumed to depend upon the development of the province.

(5) Kalimantan Timur Province

In this province the distribution of vehicles is the highest in the 10 provinces concerned with the study and is approximately twice the national value. The average annual growth rates of vehicles are also high.
It should be noted that the influence the two Kotamadyas of Samarinda and Balikpapan in the province and of oil bases around Balikpapan is rather large.
The growth rates of both truck type and 2 - wheel type vehicles are distinctly high.

(6) Kalimantan Selatan Province

The distribution of vehicles in the province is almost the same as the national value. The current proportion of 2 - wheel type vehicles is the highest in the 10 provinces.
However, recent growth rate of the total number of vehicles is higher than the national rate. The growth rate of 4 - wheel type vehicles (sedans and trucks) is especially high.

(7) Nusa Tenggara Timur Province

In this province the distribution of vehicles is very low and is approximately a quarter of the national value. This is because the province consists of islands formed of volcanic mountains. However, the growth rate of vehicles is quite high and ranks in a high position within the 10 provinces concerned with the study. The growth rate of 2 - wheel type vehicles is especially high. This reflects the present road service level of the province.

(8) Sulawesi Utara Province

In this province the distribution of vehicles is lower than the national value. However, the proportion of 4 - wheel type vehicles is the highest in the 10 provinces concerned with the study. This reflects the improved conditions of the trunk roads.
However in the present situation it is noted that the growth rate of 2 - wheel type vehicles is high and the growth rate of sedans is low.

(9) Sulawesi Selatan Province

In this province the distribution of vehicles is higher than the national value and is the second highest in the 10 provinces concerned with the study.
The current growth rates of total vehicles and vehicles by type are both almost the same as the national rates. It can be assumed that Ujung Pandang, the capital of the province, tends toward a high distribution of vehicles.

(10) Sulawesi Tenggara Province

In this province the current low distribution of vehicles is notable and is approximately half the national value. However the current growth rates for vehicles are higher than the national rates. The growth rates of sedans and buses which are means of passenger transportation are especially high even through the absolute number of these vehicles is low.

Table 2-2-12 NUMBER OF REGISTERED MOTOR VEHICLES IN THE PROJECT AREA

PROVINCE	KABUPATEN	SEDAN	BUS	TRUCK	SUB TOTAL	MOTOR CYCLE	TOTAL	G.R (%)	PERSONS VEHICLE	SURVEY YEAR
RIAU		6042	1152	9595	16789	62058	47818	34.9	48.2	1982
	Indragiri Hulu	251	103	555	909	2579	2199	-	117.8	1983
	Indragiri Hilir	3	13	2124	2140	2285	3283	-	129.3	1984
	Bengkalis	365	89	698	1152	10608	6456	21.6	93.9	1982
SUMATERA SELATAN		25069	5998	28635	59702	149640	134522	18.3	36.8	1982
	Musi Rawas	130	267	485	882	-	-	-	-	1982
	Musi Banyuasin	122	352	295	769	4857	3198	5.6	169.1	1984
	Bangka	762	324	871	1957	17867	10890	18.1	39.3	1983
	Belitung	11	76	1161	1248	-	-	-	-	1984
LAMPUNG		10020	1113	15346	26479	52812	52885	17.7	97.9	1982
	Lampung Tengah	0	91	1289	1380	8623	5692	12.8	306.6	1984
KALIMANTAN TENGAH		1001	49	1919	2969	15696	10817	22.0	94.4	1982
	Kotawaringin Timur	22	0	17	39	818	448	3.1	655.8	1984
	Kapuas	-	-	-	757	-	-	24.5	-	1982
	Barito Selatan	91	0	83	174	1362	855	14.2	146.2	1983
	Barito Utara	-	-	-	-	-	-	-	-	-
KALIMANTAN TIMUR		10202	4196	12641	27039	55624	54851	24.5	24.8	1982
	Pasir	4	3	161	168	1246	791	13.1	119.6	1984
	Kutai	-	-	-	431	-	-	-	-	1980
	Berau	2	32	58	92	1023	604	9.8	81.0	1984
	Bulungan	0	295	104	399	5535	3167	10.4	62.7	1984
KALIMANTAN SELATAN		8051	604	4675	13330	67884	47272	21.6	45.6	1982
	Tanah Laut	-	-	-	-	-	-	-	-	-
	Kota Baru	120	0	45	165	2120	1225	6.7	206.9	1984
	Banjar	767	0	210	977	-	-	-	-	1982
	Barito Kuala	0	0	0	0	256	128	32.4	1549.1	1984
	Tapin	89	0	110	199	1455	927	36.9	125.0	1984
	Hulu Sungai Selatan	30	1	0	31	6835	3448	62.2	54.3	1984
	Hulu Sungai Tengah	17	1	103	121	5746	2994	18.0	68.6	1984
	Hulu Sungai Utara	36	4	125	165	4086	2208	5.6	112.7	1984
	Tabalong	266	4	451	721	3215	2328	10.8	55.9	1984
NUSA TENGGARA TIMUR		2514	2295	2848	7657	14916	15115	24.0	188.3	1982
	Sumba Barat	0	20	1359	1379	250	1504	14.6	174.0	1984
	Ende	0	431	414	845	1602	1646	-	130.4	1984
	Ngada	0	20	60	80	322	241	211	761.5	1982
SULAWESI UTARA		9886	3415	8570	21871	27968	35855	16.9	61.8	1982
	Minahasa	153	1175	578	1906	4618	4215	0.6	169.3	1984
SULAWESI SELATAN		18499	3630	31241	53370	157164	131952	17.9	47.6	1982
	Gowa	50	33	250	333	3502	2084	4.8	176.1	1984
	Pangkajene Kepulauan	49	81	441	571	3019	2080	22.4	108.0	1984
	Barru	334	33	52	419	2433	1636	-	84.6	1983
	Soppeng	660	35	200	895	3854	2822	--	84.6	1983
	Wajo	0	35	220	255	4715	2613	10.0	144.4	1982
	Tana Toraja	0	39	31	70	130	135	8.4	2518.6	1984
	Mamuju	0	70	66	136	1014	643	-	193.3	1984
SULAWESI TENGGARA		1214	278	2803	4295	13390	10990	21.0	91.2	1982
	Muna	48	19	296	363	2117	1422	22.3	132.0	1984
	Kolaka	198	91	87	376	1925	1339	-	119.3	1983

2.3 Present Status of Kabupaten Roads

2.3.1 Road Inventory

Road inventories showing the existing conditions of the Kabupaten roads were prepared by the Kabupatens concerned with the Study. From the road inventory data, the number and total length of Kabupaten roads to be studied in the 38 Kabupatens are confirmed as 2,246 links and 18,814 km respectively. In the above figures Kabupaten roads with no data are not included.

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

(1) Development Level of Kabupaten Roads

The distribution rate of roads is generally presented by the length per district area or the road area per district area.

The density of Kabupaten roads in the Project Area for each province is shown in Table 2-3-1(1).
Since the total area and population in the Project Area are 62,576,696 ha and 11,993,429 persons respectively, road length per area and road length per person become 0.30^{m}/ha and 1.57^{m}/person respectively as shown in the table. The densities of Kabupaten roads in Jawa Island, excluding DKI Jakarta, and in Indonesia are 2.11 ^{m}/ha and 0.48 ^{m}/ha respectively which are approximately 7 times and 1.6 times the average density for the Project Area. Thus, the Project Area lags behind in density of Kabupaten roads.

From the table the following can be observed:

- Provinces which have lower densities than the national value:

  Kalimantan Tengah, Kalimantan Timur, Riau and Sumatera Selatan

- Provinces which have almost the same densities as the national value :

  Kalimantan Selatan, Sulawesi Tenggara and Sulawesi Selatan

- Provinces which have higher densities than the national value :

  Sulawesi Utara, Nusa Tenggara Timur and Lampung.

Table 2-3-1 (1) DENSITY OF KABUPATEN ROADS

PROVINCE	NO OF KABS	NO OF LINKS	ROAD L (km)	POPULATION	AREA (ha)	ROAD L POPULATION (m/persons)	ROAD L AREA (m/ha)
Riau	3	131	1,882	1,323,222	5,907,756	1.42	0.23
Sumatera Selatan	4	268	2,905	1,867,806	5,760,614	1.56	0.50
Lampung	1	137	1,231	1,745,433	840,890	0.71	1.46
Kalimantan Tengah	4	56	1,076	909,384	20,474,710	1.18	0.05
Kalimantan Timur	4	190	1,340	782,219	20,796,700	1.71	C.06
Kalimantan Selatan	9	639	3,030	1,839,829	3,938,091	1.65	0.77
Nusa Tenggara Timur	3	151	1,882	659,880	967,138	2.85	1.95
Sulawesi Utara	1	153	1,470	704,024	432,200	2.09	3.40
Sulawesi Selatan	7	395	2,730	1,814,187	2,104,377	1.50	1.30
Sulawesi Tenggara	2	126	1,268	347,443	1,374,220	3.65	0.92
TOTAL	38	2,246	18,814	11,993,427	62,576,696	1.57	0.30
Jawa Is (Excluding DKI Jakarta)			27,715	91,126,900	13,159,700	0.30	2.11
Indonesia			92,038	161,579,500	191,944,300	0.57	0.48

Note :

The source of data for Jawa Island and Indonesia is STATISTICAL YEARBOOK OF INDONESIA 1983.

Table 2-3-1(2) shows ten Kabupatens out of 38 which have higher densities of Kabupaten roads than the density for Jawa Island excluding DKI Jakarta.

Table 2-3-1(3) shown eight Kabupatens out of 38 which have distinctly lower densities of Kabupaten roads than the average density for the Project Area.

(2) Kabupaten Road Surface Types

The type of surface of the Kabupaten roads in the Project Area for each province is shown in Table 2-3-2.
The proportions of surface types in the Project Area, Jawa Island and Indonesia are as follows:

	ASP	KRK/BTB	TNH/LL
Project Area.	12.3%	29.8%	57.9%
Jawa (excluding DKI Jakarta)	56.2	25.0	18.8
Indonesia	23.6	23.1	53.3

Thus, in the Project Area the proportion of Kabupaten roads with asphalt surface is lower than the national value and much lower than Jawa Island excluding Jakarta. The proportion of low grade roads in the Project Area such as earth roads and others is distinctly high. This means that the road classification in the Project Area is low.
The following four Kabupatens out of 38 are the only Kabupatens in which the road classification is almost the same as the national level.

	ASP	KRK/BTB	TNH/LL
Minahasa	57.5%	7.8%	34.7%
Tapin	29.2	42.0	28.8
Soppeng	27.5	51.4	21.1
Pangkajene Kepulauan	24.6	57.8	17.6

Table 2-3-1 (2)

DENSITY OF KABUPATEN ROADS
With Higher than of Jawa Island

KABUPATEN	DENSITY (m/ha)
Pangkajene Kepulauan	3.87
Minahasa	3.40
Ngada	3.08
Soppeng	2.94
Barru	2.92
Tana Toraja	2.48
Gowa	2.37
Ende	2.34
Hulu Sungai Tengah	2.33
Hulu Sungai Selatan	2.28

Table 2-3-1 (3)

DENSITY OF KABUPATEN ROADS
With Lower than of the Project Area

KABUPATEN	DENSITY (m/ha)
Kapuas	0.02
Berau	0.02
Kutai	0.04
Barito Utara	0.08
Bulungan	0.08
Barito Selatan	0.10
Mamuju	0.18
Kota Baru	0.19

Table 2-3-2

EXISTING SURFACE TYPE OF KABUPATEN ROADS

PROVINCE	NO OF KABS	ROAD LENGTH (Km)	SURFACE TYPE (km)					PROPORTION (%)				
			ASP	KRK	BTB	TNH	LL	ASP	KRK	BTB	TNH	LL
Riau	3	1,882	56	439	87	1,157	230	3.0	18.7	4.6	61.5	12.2
Sumatera Selatan	4	2,905	398	304	6	928	1,269	13.7	10.5	0.2	31.9	43.7
Lampung	1	1,231	183	217	383	260	188	14.9	17.6	31.1	21.1	15.3
Kalimantan Tengah	4	1,076	0	247	65	748	16	0.0	23.0	6.0	69.5	1.5
Kalimantan Timur	4	1,340	78	334	169	694	65	5.8	24.9	12.6	51.8	4.9
Kalimantan Selatan	9	3,030	317	850	395	1,219	249	10.5	28.1	13.0	40.2	8.2
Nusa Tenggara Timur	3	1,882	30	144	354	1,316	38	1.6	7.7	18.8	69.9	2.0
Sulawesi Utara	1	1,470	845	55	61	443	66	57.5	3.7	4.1	30.1	4.5
Sulawesi Selatan	7	2,730	355	687	567	1,030	91	13.0	25.2	20.8	37.7	3.3
Sulawesi Tenggara	2	1,268	54	170	159	664	221	4.3	13.4	12.5	52.4	17.4
Total	38	18,814	2,316	3,360	2,246	8,459	2,433	12.3	17.9	11.9	45.0	12.9
Jawa Is (Excluding DKI Jakarta)		27,715	15,562	6,936		5,217		56.2	25.0		18.8	
Indonesia		92,038	21,728	21,298		49,012		23.6	23.1		53.3	

Notes : ASP : Asphalt

KRK : Gravel

BTB : Stone and Water Bound Macadam

TNH : Earth

LL : Other

Notes :

1. ASP - Asphalt
2. KRK - Gravel
3. BTB - Split stone/Telford/Mountain stone
4. TNH - Earth
5. LL - Other

In particular the sealed road portion of Kabupaten Minahasa is almost the same as that of Jawa Island. However, in the remaining 34 Kabupatens the roads are distinctly low grade.

(3) Surface Condition of Kabupaten Roads

The surface condition of the Kabupaten roads in the Project Area, classified as good, fair, poor and bad, are summarized in Table 2-3-3.

Comparison of the proportions of the various surface conditions of the Kabupaten roads in the Project Area with Jawa Island and Indonesia is as follows:

	GOOD	FAIR	POOR	BAD
Project Area	34.7%	29.1%	26.8%	9.4%
	63.8		36.2	
Jawa (excluding DKI Jakarta)	45.6	28.8	19.6	5.0
	75.4		24.6	
Indonesia	43.5	21.8	21.1	13.6
	65.3		34.7	

The surface condition levels of the Kabupaten roads in the Project Area are almost the same as the average of Indonesia, and lower than those of Jawa Island.
The proportion in good condition is relatively low in the Project Area. Therefore improvement of Kabupaten roads in poor or bad condition is desirable.

Provinces where the proportion of poor and bad conditions is relatively high are the provinces of :

- Kalimantan Selatan;
- Nusa Tenggara Timur;

Table 2-3-3 EXISTING SURFACE CONDITIONS OF KABUPATEN ROADS

PROVINCE	NO. OF KABS.	ROAD LENGTH (Km)	SURFACE CONDITIONS (KM)				PROPORTION (%)			
			GOOD	FAIR	POOR	BAD	GOOD	FAIR	POOR	BAD
Riau	3	1,882	757	568	488	69	40.2	30.2	25.9	3.7
Sumatera Selatan	4	2,905	1,258	921	503	223	43.3	31.7	17.3	7.7
Lampung	1	1,231	577	418	233	3	46.8	33.9	18.9	0.2
Kalimantan Tengah	4	1,076	329	271	403	73	30.6	25.2	37.5	6.7
Kalimantan Timur	4	1,340	511	398	310	121	38.1	29.7	23.2	9.0
Kalimantan Selatan	9	3,030	799	1,035	951	245	26.4	34.2	31.4	8.0
Nusa Tenggara Timur	3	1,882	259	555	577	491	13.8	29.5	30.7	26.0
Sulawesi Utara	1	1,470	530	289	415	236	36.0	19.6	28.2	16.0
Sulawesi Selatan	7	2,730	1,123	745	705	157	41.1	27.3	25.8	5.8
Sulawesi Tenggara	2	1,268	388	273	466	141	30.6	21.5	36.8	11.1
Total	38	18,814	6,530	5,473	5,051	1,759	34.7	29.1	26.8	9.4
Jawa Is (1980)		21,198	9,609	6,327	4,159	1,043	45.6	29.8	19.6	5.0
Indonesia (1980)		52,214	22,736	11,378	11,030	7,070	43.5	21.8	21.1	13.6

- Sulawesi Utara;
- Sulawesi Tenggara

In more than half of the 38 Kabupatens, the proportion of poor and bad conditions is higher than the average value of the Project Area. Kabupatens in which the proportion of poor and bad conditions combined is more than 50% are as follows:

	GOOD	FAIR	POOR	BAD
Ende	4.6	20.9	45.3	29.2
Ngada	16.3	20.2	29.0	34.5
Indragiri Hilir	8.5	31.8	43.6	16.1
Mamuju	19.3	28.2	48.5	4.0

(4) Terrain Conditions of Kabupaten Roads

Difficulty of road improvement is mainly dependent upon the terrain conditions.

The terrain conditions of the Kabupaten roads in the Project Area are classified as flat, hilly, mountainous and swampy, and are summarized in Table 2-3-4 (1). The average proportions of terrain conditions in the Project Area are 58.8% flat, 26.2% hilly, 7.7% mountainous and 7.8% swampy. These proportions are considered as showing relatively gentle terrain conditions. However the following particular conditions can be observed by provinces:

- Provinces with relatively gentle terrain conditions:
  Sumatera Selatan, Lampung, Kalimantan Timur and Kalimantan Selatan.
- Provinces where the total proportion of hilly and mountainous conditions is rather big :
  Nusa Tenggara Timur, Sulawesi Utara and Sulawesi Selatan
- Mountainous province :
  Sulawesi Tenggara
- Provinces where the proportion of swampy condition is approximately more than 30% :
  Riau and Kalimantan Tengah

Table 2-3-4 (1) TERRAIN CONDITIONS OF KABUPATEN ROADS

PROVINCE	NO. OF KABS	ROAD LENGTH (Km)	TERRAIN CONDITION (KM)				PROPORTION (%)			
			FLAT	HILLY	MOUNT.	SWAMPY	FLAT	HILLY	MOUNT.	SWAMPY
Riau	3	1,882	981	320	7	574	52.1	17.0	0.4	30.5
Sumatera Selatan	4	2,905	2,110	657	3	135	72.6	22.6	0.2	4.6
Lampung	1	1,231	1,195	2	0	34	97.1	0.1	0.0	2.8
Kalimantan Tengah	4	1,076	326	370	60	320	30.3	34.4	5.6	29.7
Kalimantan Timur	4	1,340	770	398	159	13	57.5	29.7	11.8	1.0
Kalimantan Selatan	9	3,030	1,807	550	251	421	59.6	18.2	8.3	13.9
Nusa Tenggara Timur	3	1,882	895	776	207	4	47.6	41.2	11.0	0.2
Sulawesi Utara	1	1,472	749	607	112	2	51.0	41.3	7.6	0.1
Sulawesi Selatan	7	2,730	1,284	1,051	372	23	47.0	38.5	13.6	0.9
Sulawesi Tenggara	2	1,268	770	197	271	30	60.7	15.5	21.4	2.4
Total	38	18,814	10,877	4,938	1,442	1,556	57.8	26.2	7.7	8.3

Table 2-3-4(2) shows the Kabupatens where road construction is anticipated to be difficult because of a large proportion of hills and mountains.
Table 2-3-4(3) shows the Kabupatns where the road construction is anticipated to be difficult because of a large proportion of swamp.

2.3.2 Bridge Inventory

Bridge inventories showing the existing condition of bridges by construction material type and span length are prepared in each Kabupaten Report.

The inventory shown on Table 2-3-5 indicates a total of 5,295 bridges of which 3,935 or 74.3% are timber and 716 or 13.5% are concrete. Steel bridges account for only 118 or 2.2% of the total.

On the other hand 1,215 bridges with a cumulate length of 24,458 m are recorded in the Kabupaten road inventory as deficient.
The proportion of timber bridges is generally high, especially in the provinces of Riau, Kalimantan Tengah, Kalimantan Timur, Kalimantan Selatan and Sulawesi Tenggara where approximately 90% of the bridges are timber. In the provinces of Lampung, Nusa Tenggara Timur, Sulawesi Utara and Sulawesi Selatan the proportion of concrete bridges is rather high because of the higher availability of material.

The life of timber bridges is generally short. Therefore the replacement of these bridges with steel or concrete structures in accordance with the increase of traffic volume and change of vehicle type will be a big item in the future.

2.3.3 Traffic

(1) Average Daily Traffic

Inventories of the average daily traffics (ADT) on the Kabupaten roads were prepared by each Kabupaten.
ADTs on the Kabupaten roads are generally small and there are many road links with zero ADT. Thus the road links are not always used for motor vehicles at present. This depends not only upon the socio-economic conditions but also upon the geographical condition of the Project Area. However,

Table 2-3-4 (2) TERRAIN CONDITIONS OF KABUPATEN ROADS
Hilly and Mountainous Kabupatens

KABUPATEN	FLAT (%)	HILLY (%)	MOUNT. (%)	SWAMPY (%)
Tana Toraja	6.2	74.2	19.4	0.2
Ende	19.6	74.9	5.6	0.5
Barru	29.2	29.2	41.6	0.0
Bulungan	30.8	48.3	20.3	0.6
Mamuju	30.7	46.0	18.3	5.0
Ngada	41.5	38.8	19.4	0.3
Muna	41.4	19.9	35.8	2.9
Tabalong	48.8	24.4	20.5	6.3
Tapin	54.2	13.2	26.4	6.2
Kota Baru	53.5	26.4	12.8	7.5

Table 2-3-4 (3) TERRAIN CONDITIONS OF KABUPATEN ROADS
Swampy Kabupatens

KABUPATEN	FLAT (%)	HILLY (%)	MOUNT. (%)	SWAMPY (%)
Barito Kuala	0.0	0.0	0.0	100.0
Indragiri Hilir	2.4	0.0	0.0	97.6
Kotawaringin Timur	22.4	9.6	16.0	52.0
Kapuas	16.4	47.4	0.0	36.2
Bengkalis	64.0	0.0	0.0	36.0
Banjar	56.1	13.2	8.9	21.8
Hulu Sungai Utara	62.5	17.9	2.7	16.7

Table 2-3-5 BRIDGES ON KABUPATEN ROADS

PROVINCE	NO. OF KABS	BRIDGE LENGTH (m)	NO. OF EXISTING BRIDGES BY TYPE						BRIDGE DEFICIENCIES	
			BJ	BT	PB	KY	LL	TOTAL	NO.	LENGTH (m)
Riau	3	5,980	3	3	0	379	27	412	64	1,127
Sumatera Selatan	4	8,231	29	196	0	597	119	941	69	1,971
Lampung	1	1,455	2	71	0	11	64	148	14	231
Kalimantan Tengah	4	3,951	1	2	0	333	32	368	142	5,094
Kalimantan Timur	4	2,808	2	3	0	258	6	269	13	275
Kalimantan Selatan	9	19,209	8	9	1	2,107	112	2,237	95	2,696
Nusa Tenggara Timur	3	608	12	26	0	8	35	81	221	3,292
Sulawesi Utara	1	397	9	30	0	9	0	48	10	2,212
Sulawesi Selatan	7	5,048	52	372	0	129	117	670	312	4,368
Sulawesi Tenggara	2	1,313	0	4	0	104	13	121	275	3,192
Total	38	49,000	118	716	1	3,935	525	5,295	1,215	24,458
Proportion (%)			2.2	13.5	0.1	74.3	9.9	100		

Notes : BJ : Steel
BT : Concrete
PB : Stone
KY : Timber
LL : Others

the present road condition of low classification is the main influence.

It is difficult to itemize the characteristics of the present ADT for each by province because fluctuation from one Kabupaten to another is rather large.

From the vehicle proportions of ADTs for each Kabupaten it can be noted that in most of the Kabupatens the proportion of 2-wheel type vehicles, i.e. motorcycles, is more than 50%. However in the case of Kabupaten Ende, Kabupaten Ngada and Kabupaten Minahasa, the proportion of 2-wheel type vehicles is within the range 30% to 40%. ADTs for each Kabupaten are given in each Kabupaten Report.

(2) Traffic Survey

In the Phase I Study traffic surveys were carried out by Bina Marga and the Study Team in six (6) out the seven (7) model Kabupatens.

The purposes of conducting surveys were to obtain the basic data needed to estimate the future traffic traffic volume such as traffic characteristics, weekly traffic volume change, etc. to examine the reliability of the ADT data of the inventory prepared by the Kabupatens and to perform technology transfer through surveying and data analyzing.

Outline and result of the traffic surveys are shown in the Interim Report.

Chapter 3 FUTURE TRAFFIC VOLUME

Chapter 3 FUTURE TRAFFIC VOLUME

3.1 Conditions for Estimation of Future Traffic Volume

Local traffic demand is generally linked directly with the social and economic activities of the region. It is a fact that the traffic means and traffic facilities, i.e. vehicles and roads, are indispensable conditions for realization of road traffic demand.

Therefore, the tendency of social and economic activities, the fluctuation in the number of registered vehicles and also the development trend of road serviceability are the main factors related to future traffic volume. Among the above factors the tendency of social and economic activities is the key factor in deciding potential traffic demand, while the other two are indirect factors.

From the above point of view, the majority of the activities in both the social and economic fields in the Kabupatens of the Study are related to the primary industry which is mainly agriculture. Also most of these Kabupatens are included in the national transmigration programme.

According to statistics, the agricultural sector at both national and regional levels shows a favorable growth rate in recent years and this favorable growth seems likely to be maintained in the future with the same growth trend as at present.

With the exception of Kabupaten Bangka and Kabupaten Belitung in Sumatera Selatan Province the main agricultural production of the Kabupatens in the Project Area is paddy. In Kabupaten Bangka and Kabupaten Belitung the main agricultural production is plantation crops, i.e. rubber, coconut, clove, cocoa, coffee, etc. with paddy production being rather minor.

The number of registered vehicles in the Kabupatens of the Study is relatively low at present. However the recent annual vehicle growth rate is favorable which indicates that the traffic situation in all the Kabupatens concerned is passing out of its less advanced stage and is moving towards a modernized pattern under the influence of mobility.

Promotion of the development of the serviceability of Kabupaten roads has been emphasized by the Government of Indonesia since the Third

Five-Years Plan (PELITA III) and has been increasing continuously during the Fourth Five-Years Plan.

From the above background it can be assumed that the development of major industry in the Kabupatens, which will have a direct effect on the traffic potential demand on the Kabupaten roads, will create a real traffic volume, based on the assumption of an increase in the number of registered vehicles and on the development of the road service level.

Essentially, for estimation of future traffic volume a reasonable traffic growth rate is decided from both the result of quantitative analysis using past and present traffic data such as origin and destination survey data, traffic count data, vehicle registration data, and the estimated growth values (number of trip ends, number of trips per vehicle, trip length per vehicle, etc.) obtained from interrelative analysis with the tendency of social and economic activities. However the data obtained for the study were that showing a fluctuation in the number of registered vehicles, which was incomplete, and traffic count data for each road link in 1984 or 1985 which was of low reliability. Therefore the quantitative analysis approach was not used and a qualitative analysis based on social and economic activities was adopted.

Taking into consideration the conditions mentioned above it was recommended that the traffic growth rates of the future traffic volume on the Kabupaten roads in the Project Area were estimated from the calculation process described in section 3.2.

3.2 Traffic Growth Rate

The traffic growth rate was estimated using the following formula:

Growth of Production Basis "A":

$$= \sqrt{\text{Annual Population Growth of the Kabupaten} \times \text{Growth of the Total Cultivated Area}} \qquad (1)$$

Growth of Productivity "B":

$$= \sqrt{\text{Growth of the Total Paddy Field Area} \times \text{Growth of the Paddy Production per ha.}} \qquad (2)$$

Traffic Growth Rate: Initial estimated figure:

$$GR' = \sqrt{A \times B} \qquad (3)$$

Traffic Growth Rate $\overline{GR}$ = Final adjustment figure

$$= \sqrt{GR' \times \text{Trend of GDP/Capita of the Province concerned}} \qquad (4)$$

Formula (1) uses a geometrical mean estimated from the growth rates of the population and the total agricultural cultivated areas in the particular Kabupaten to obtain the growth of production basis "A"

Formula (2) uses a geometrical mean estimated from the growth rates of both the paddy field area and the yield rate in the particular Kabupaten for the growth of productivity "B".

Formula (3) uses a geomentrical mean estimated from the growth rates of both the production basis and the productivity to estimate the initial figure of the traffic growth rate GR'.

In order to avoid an extreme maximum GR' rate a final $\overline{GR}$ is estimated from the initial estimated GR' and gross domestic product per capita of the particular province using formula (4).

In the cases of Kabupatens Bangka and Belitung, the growth rates of the plantation field area and yield rate were adopted in formula (2) instead of the paddy field area and yield rate.

Traffic growth rates for each Kabupaten obtained from these formula are shown in Table 3-2-1.

3.3 Future Traffic Volume

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

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

Where :

Tn : Traffic volume n years later

Te : ADT in 1984 or 1985

r : Traffic growth rate shown in Table 3-2-1.

The results are shown in each Kabupaten report together with the traffic volumes in 1984 or 1985.

Table 3-2-1 TRAFFIC GROWTH RATE

PROVINCE	KABUPATEN	TRAFFIC GROWTH RATE (%)
RIAU	Indragiri Hulu	4.17
	Indragiri Hilir	5.76
	Bengkalis	6.58
SUMATERA SELATAN	Musi Rawas	4.83
	Musi Banyuasin	6.37
	Bangka	4.68
	Belitung	4.91
LAMPUNG	Lampung Tengah	4.02
KALIMANTAN TENGAH	Kotawaringin Timur	6.17
	Kapuas	6.31
	Barito Selatan	5.55
	Barito Utara	6.61
KALIMANTAN TIMUR	Pasir	4.99
	Kutai	7.94
	Berau	4.11
	Bulungan	5.06
KALIMANTAN SELATAN	Tanah Laut	5.60
	Kota Baru	6.18
	Banjar	6.96
	Barito Kuala	5.10
	Tapin	5.66
	Hulu Sungai Selatan	4.97
	Hulu Sungai Tengah	5.05
	Hulu Sungai Utara	5.22
	Tabalong	4.93
NUSA TENGGARA TIMUR	Sumba Barat	7.06
	Ende	6.33
	Ngada	6.58
SULAWESI UTARA	Minahasa	3.65
SULAWESI SELATAN	Gowa	4.24
	Pangkajene Kepulauan	4.85
	Barru	5.25
	Soppeng	5.67
	Wajo	5.39
	Tana Toraja	4.54
	Mamuju	5.54
SULAWESI TENGGARA	Muna	5.07
	Kolaka	5.97
AVERAGE		5.47

Chapter 4 SIMPLIFIED METHODOLOGY

Chapter 4 SIMPLIFIED METHODOLOGY

4.1 Policy for the Improvement and Maintenance of Kabupaten Roads

4.1.1 Necessity for Establishing of a Simplified Feasibility Evaluation Methodology

The number and total length of the road links to be studied in 38 Kabupatens of 10 provinces have been approximately 2,200 and 19,000 Km respectively. Since the Study of so many road links is to be completed within a limited period, it is not possible to carry it out using the generally used feasibility evaluation methods. For this reason it is necessary to establish simplified methods suitable for this study.

Most of the Project Area is within the developing area of the low population density islands outside Jawa. The Desa's boundaries have not been established clearly and topographic maps reflecting the present conditions have not been prepared. Thus there are limitations to the available data. It is not possible to adopt to the Project Area the feasibility evaluation methods which had been used in Jawa and other places. /1

Therefore a simplified feasibility evaluation methodology using data of the accuracy available was established through a pilot study carried out on seven (7) selected model Kabupatens in the Phase I Study.

4.1.2 Policy for the Feasibility Evaluation and Implementation Programming

The feasibility evaluation is carried out for each road link by micro-computers using the results of IRR estimated for each link. An IRR of 12% has been usually adopted for projects in Jawa. However, an IRR of 10% was used for evaluating the feasibility of road links in this Project taking into consideration the location of the Project Area, i.e. islands outside Jawa. Selection of road links to be improved, as a rule, should be confined to those which are basically feasible.

In the Project Area, population and employment are low and the main industry is agriculture. Therefore the benefits produced by road improvements are generally small.

Taking these matters into consideration, low cost pavements and low cost structures such as timber bridges are adopted in general for the roads to be improved. The adoption of high cost pavement such as hot mixed asphalt pavement is not pursued.

Improvement of all Kabupaten roads within the Project period is not possible therefore the road links to be improved should be selected from those of high priority.

However to obtain more effective development from the road improvement a road link connecting to a road link feasible from the engineering point of view may be selected for improvement together with the feasible road link.

In areas of low population, development of the Kabupaten can be realized only when the infrastructure is provided as has been shown by the transmigration scheme. In order to provide the infrastructure desirable for basic human needs some road links, even if they are evaluated as infeasible from the results of the economical feasibility evaluation may be sometimes selected to be improved.

The unselected road links, such as links already improved and low priority links, are to be routinely maintained to keep their present value. Equipment for this purpose is provided.

After discussion with Bina Marga the Project period was decided as five years. The starting year of the road construction works was decided as the latter half of 1988. The completion year of the Project, called "the target year", was decided to be 1993 for the following reasons.

- Judging from the operation period during which the equipment can be maintained in good condition an appropriate construction period is five years.
- Judging from the normal socio-economic fluctuations such as the progress of various developments, a five years programme is an acceptable period for coping with unforeseen variations in the future.

4.1.3 Data for Carrying out the Study

(1) Inventory Data

Inventories showing the existing conditions of Kabupaten roads have been prepared by the Kabupatens under the instructions of Bina Marga. The inventory data for the seven model Kabupatens were submitted to Bina Marga and stored in Bina Marga's computers as IJ Kabupaten data before the commencement of the Phase I Study in November, 1984. Most of the data for the remaining 31 Kabupatens had been collected up to the end of August, 1985 in the Phase II Study. The cost and price data for the model Kabupatens were re-collected in June 1985 to unify the data level with that of the 31 Kabupatens.

A list of the inventory data is shown in Table 4-1-1.

Table 4-1-1 INVENTORY DATA

DATA NO.	DESCRIPTION
IJ KAB. - 00	GENERAL OBSERVATION ON ROAD CONDITIONS AND CIRCUMSTANCES
IJ KAB. - 01	GENERAL DESCRIPTION OF ROAD CONDITIONS
IJ KAB. - 02	ROAD INVENTORY DATA
IJ KAB. - 03	BRIDGE INVENTORY DATA-GENERAL DESCRIPTION
IJ KAB. - 04	BRIDGE INVENTORY DATA-PROFILE
IJ KAB. - 05	QUARRY DATA
IJ KAB. - 06	OTHER DATA RELATED TO THE ROAD CONSTRUCTION - EXISTING EQUIPMENT DATA - EXISTING STAFF LIST FROM PUK/PU SECTION - LABOUR COST PER DAY - MATERIAL PRICE - UNIT COST BY WORK TYPE
IJ KAB. - 07	EVALUATION OF THE SURVEY RESULT
PHOTO	
ROAD LINK MAP	

(2) Engineering and Socio-Economic Data

In the Phase I Study, data necessary for the engineering study and economic evaluation had been collected by the Study Team during a site reconnaissance carried out on the seven model Kabupatens.

Socio-economic data at the Kecamatan level were used for economic evaluation. Taking into consideration the accuracy of the economic evaluation, socio-economic data at Desa level are desirable. However, it is not possible to show the boundaries of Desas clearly on topographic maps. Even if it is assumed that data collection at Desa level would have been possible, the micro-computer could not completely carry out the computation because of the enormous quantity of data. Furthermore, evaluation using a large scale computer is out of the scope of a simplified feasibility evaluation method such as this one. Desa level data is therefore not adopted.

In the Phase II Study, engineering and socio-economic data of the 38 Kabupatens have been prepared by the Kabupatens following intructions from Bina Marga using the data format recommended by the Study Team. The data were submitted to Bina Marga together with the inventory data mentioned above.

Lists of the engineering and socio-economic data are shown in Tables 4-1-2 and 4-1-3 respectively.

/1 Refer to the following reports.

- The Local Road Support Work Study in Seven Provinces, JICA August 1980;
- Rural Road Study Project, ENEX of New Zealand and BIEC International Inc., February 1982;
- Rural Road Study, Central and East Java, Hoff & Overgaard A/S; and
- Local Roads Component, Technical Assistance under ADB Sixth Road Project, Hoff & Overgaard A/S and Kampsax International A/S.

Table 4-1-2 ENGINEERING DATA

DATA NO.	DESCRIPTION
E-01	ROAD LINK DATA
E-02	TYPICAL CROSS SECTION OF KABUPATEN ROAD
E-03 (1)	LOCATION AND COSTS OF THE KABUPATEN ROADS AND BRIDGES CONSTRUCTED OR IMPROVED IN 1980/1981 AND LOCATION MAP
(2)	" 1981/1982 AND LOCATION MAP
(3)	" 1982/1983 AND LOCATION MAP
(4)	" 1983/1984 AND LOCATION MAP
(5)	" 1984/1985 AND LOCATION MAP
E-04	EXISTING ORGANIZATION OF KABUPATEN
E-05	EXISTING STAFF RESOURCES OF BINA MARGA SECTION OF PU KABUPATEN
E-06	LOCATION AND AREA OF DPUK WORKSHOP
E-07	LAND ACQUISITION COST
E-08	CLASSIFICATION OF LOCAL CONTRACTORS AT KABUPATEN LEVEL
E-09	LIST OF EXISTING EQUIPMENT OF LOCAL CONTRACTOR
E-10	LIST OF EXISTING EQUIPMENT OF PU KABUPATEN
E-11	LIST OF EXISTING EQUIPMENT OF LEASE COMPANY
E-12	METEOROLOGICAL DATA
E-13	TOPOGRAPHIC MAP OF KABUPATEN
E-14	LOCATION MAP OF QUARRIES

Table 4-1-3 SOCIO - ECONOMIC DATA

DATA NO.	DESCRIPTION
SE-01	POPULATION
SE-02 (1)	EMPLOYED POPULATION, YEAR 1979
(2)	" 1980
(3)	" 1981
(4)	" 1982
(5)	" 1983
(6)	" 1984
SE-03	HOUSEHOLD
SE-04 (1)	CULTIVATED LAND AREA & PRODUCTION.CROP: WET PADDY
(2)	" : UPLAND PADDY
(3)	" : MAIZE
(4)	" : OTHER (INCLUDING VEGETABLE)
SE-05 (1)	PRODUCTION COST PER HECTARE.CROP: WET PADDY
(2)	" : UPLAND PADDY
(3)	" : MAIZE
(4)	" : CASSAVA
SE-06 (1)	NON-AGRICULTURAL ITEMS FOR PRODUCTION PER HECTARE.CROP : WET PADDY
(2)	" : UPLAND PADDY
(3)	" : MAIZE
(4)	" : CASSAVA
SE-07	AGRICULTURAL CONSUMTION PER PERSON
SE-08	PLANTATION
SE-09	SHIPMENT TO MARKET : LIVE STOCK
SE-10	" : FISH
SE-11	" : TIMBER
SE-12	MANUFACTURING
SE-13	MINING
SE-14 (1)	LAND USE YEAR : 1979
(2)	" 1980
(3)	" 1981
(4)	" 1982
(5)	" 1983
(6)	" 1984
SE-15	NUMBER OF REGISTERED VEHICLES
SE-16	NUMBER OF REGISTERED BOATS & VESSELS
SE-17	AVERAGE TRANSPORTATION CAPACITY PER VEHICLE
SE-18	QUESTIONNAIRE
	(1) POPULATION
	(2) LAND USE
	(3) AGRICULTURE
	(4) ECONOMIC ACTIVITY
	(5) VEHICLE REGISTRATION

(3) Topographic Map and Road Link Map

Topographic maps of 1/50,000 or 1/100,000 scale were obtained to cover the seven model Kabupatens in the Phase I Study. The topographic maps of 1/50,000 scale covering Kabupaten Banjar were prepared in the 1970s, while the maps for Kabupaten Musi Rawas were prepared in the 1920s and therefore cannot reflect existing conditions. Because of their age and variations in accuracy these topographic maps could not be used for the basic Study data other than for reference.

The Study Team had requested through Bina Marga that the Kabupatens would submit the relevant topographic maps to Bina Marga together with other data necessary for the Phase II Study. However, most of the Kabupatens did not submit them.

The topographic maps used for the Study are mainly AGRARIA maps in the Phase I Study and maps of 1/250,000 scale from Cipta Karya in the Phase II Study.

As the road link maps which the Kabupatens have submitted to Bina Marga are in general of poor accuracy, the basic road link maps for the Study should be prepared by the Study Team using the above mentioned topographic maps in order to achieve uniformity of accuracy.

4.2 Outline of the Methodology

4.2.1 Simplified Feasibility Evaluation

A flow chart of the established simplified feasibility evaluation methodology is shown in Fig. 4-2-1.

The outline of the methodology is as follows:

(1) Compilation of the survey data (Bina Marga inventory data) and input into the Study Team's computers.

(2) Preparation of the road link maps for the 38 Kabupatens

(3) Selection by preliminary screening of road links to be evaluated

- Improved and low priority road links are screened out by the cut-off criteria.

(4) Estimation of the future traffic volume on each road link based upon Bina Marga inventory data using the growth rate shown in Chapter 3

- The future traffic volume is ADT in 1998.

(5) Classification of the road links

- Road classification and pavement type for the road links are decided by design criteria in accordance with the future traffic volume.

(6) Quantity estimation for each road link

- The unit quantities of standard structures and quantities per unit length of typical cross sections of the roads are estimated.

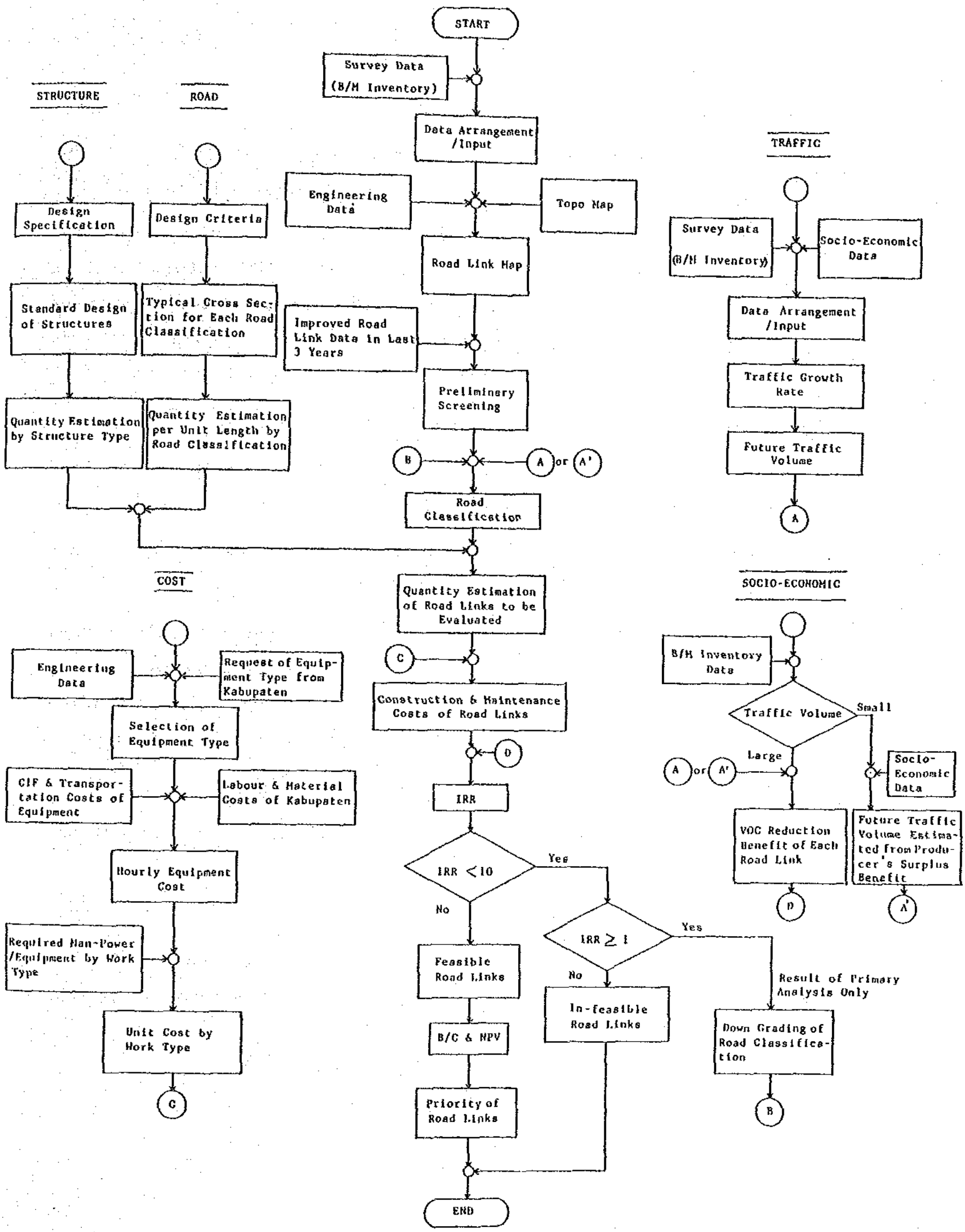
- Quantities of each road link, i.e. quantities of structures, earth works and pavement structures are estimated using unit quantities and Bina Marga inventory data.

(7) Construction and maintenance costs estimation for each road link

- Suitable equipment types are selected and hourly equipment costs are estimated.

- Labour and material costs for each Kabupaten are obtained from the engineering data.

Fig. 4-2-1 FLOW CHART SIMPLIFIED FEASIBILITY EVALUATION



- Combinations of equipment and unit costs for each work item are estimated.
- Construction and maintenance costs for each road link are estimated using quantities obtained in (6) above and the unit costs of each work item.

(8) Benefit estimation for each road link

- As a benefit of the road link, reduction benefit of VOC is calculated based upon the future traffic volume.
- In cases where the future traffic volume on a road link as estimated in (4) above is small, the future traffic volume is re-estimated based upon a producer's surplus benefit and reduction benefit of VOC is calculated. Road classification of the road link is modified if necessary.

(9) Primary feasibility evaluation of the road links

- The road links of which IRRs are 10% and more are defined as feasible.

(10) Down grading of road classification of infeasible road links for the secondary feasibility evaluation

- The unfeasible road links of which IRRs are not less than one (1) %, i.e road links which have a possibility of being feasible are down graded in their road classification and their quantities, costs and benefits are re-estimated.
- Secondary feasibility evaluation is carried out
- The road links of which IRRs are 10% and more are defined as feasible.

(11) Priority of road links

- B/C and NPV of feasible road links are estimated
- Economic priority of the road links is estimated in the order of the NPVs.

4.2.2 Simplified Implementation Programme

The flow chart of the established simplified implementation programme is shown in Fig.4-2-2.

The outline of the methodology is as follows:

(1) Selection of road links to be improved

- The road links to be improved are finally selected from among the feasible road links taking into consideration the current annual budget for Kabupaten roads, the priority of the road links, GOI and results of economic evaluation and other conditions.
- From the engineering point of view infeasible road links which are effective in bringing about development from the road improvement may be selected
- From among infeasible road links those which can be recognized as infrastructures desirable for basic human needs may be selected to be improved.

(2) Selection of road links to be maintained

- From among road links not selected for improvement including those screened out by preliminary screening, road links to be maintained are selected.
- Remaining road links are not to be not considered for inclusion in the programme.

(3) Quantity estimation for both construction and maintenance.

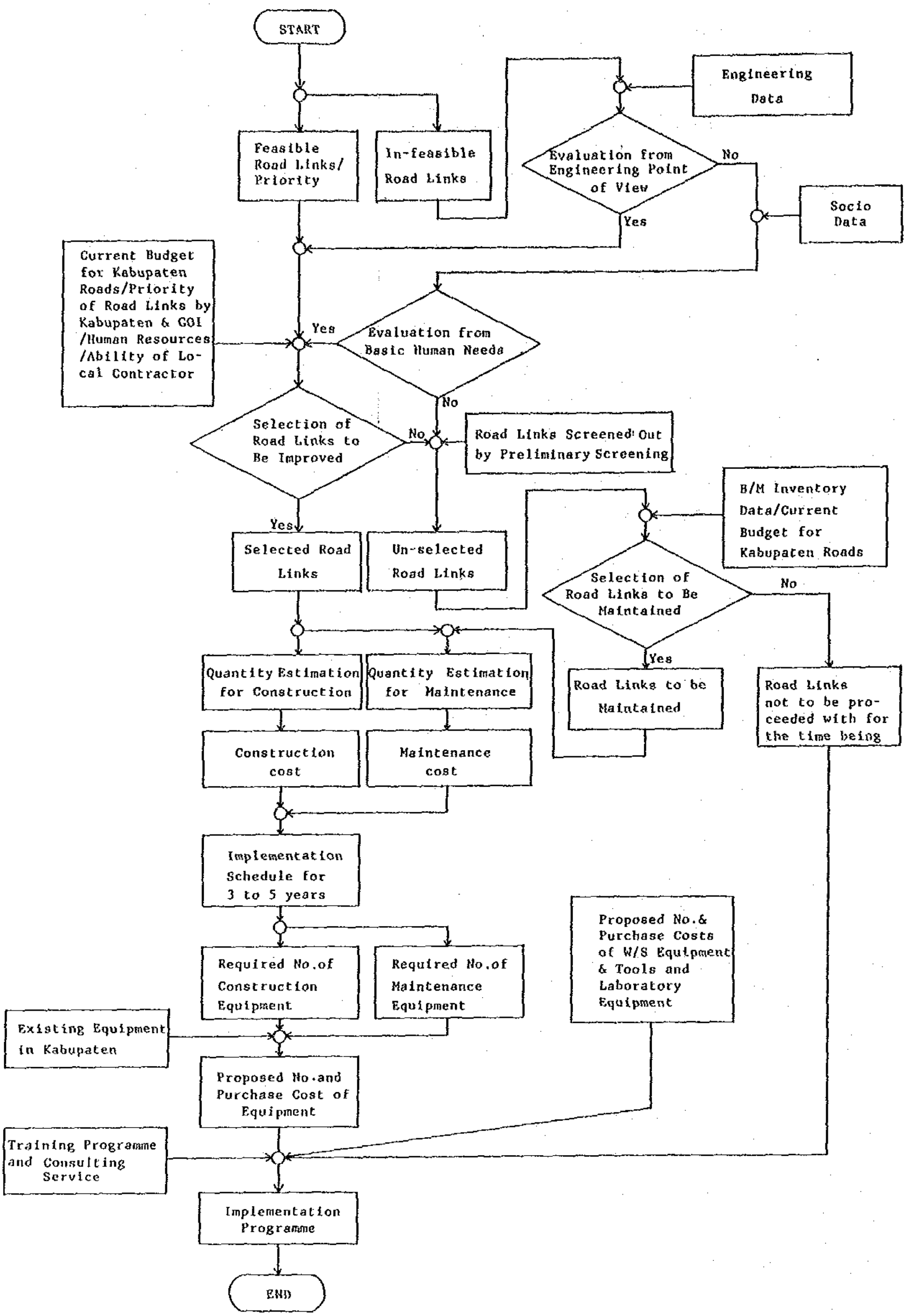
(4) Construction and maintenance costs estimation

(5) Implementation schedule for 3 to 5 years

(6) Proposed numbers and purchase cost of equipment

- Required numbers of equipment for both construction and maintenance are estimated.
- Proposed numbers of new equipment is decided by taking into consideration existing equipment in the Kabupaten.
- Purchase cost of equipment is estimated.

Fig. 4-2-2 FLOW CHART SIMPLIFIED IMPLEMENTATION PROGRAM



(7) Implementation programme

- Implementation programme for each Kabupaten is decided taking into consideration the construction cost, maintenance cost, purchase cost of equipment, purchase cost of workshop equipment & tools and laboratory equipment, and training programme and consulting service costs.

4.3 Project Screening, Evaluation and Selection

4.3.1 Preliminary Screening

The road links to be improved should be effective for development of the Project Area. Since it is inefficient to evaluate all road links listed in the inventory, taking into consideration that the evaluation method is to be simplified, road links where improvements are assumed to be inefficient for development of the Project Area are 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) Roads in good condition according to the Bina Marga road inventory which lists improvement projects 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

4.3.2 Estimation of Benefit

(1) General

Generally, estimation of the benefit from road projects is made by analyzing the direct benefit. This is the sum total of the VOC reduction benefit, the time saving benefit, the traffic accident decrease benefit and other benefits which are estimated by comparing "with project" and "without project" based upon the traffic volume on the road.

However, in this study taking into consideration the socio-economic level of the Project Area and quantitative and qualitative traffic conditions of the Kabupaten roads the time saving benefit and the traffic accident decrease benefit are not estimated as part of the direct benefit. Consequently, only the VOC reduction benefit should be applied for the Study.

As can be seen from the inventory data the existing traffic volume on the Kabupaten roads of the study is generally rather small and there are some road links with no vehicle operations at present. The reasons for this are not only the low socio-economic level of the Project Area but also the present poor road service conditions which are not satisfactory for vehicle operations all year round.

In cases where there is no vehicle operation or traffic volume is smaller than a certain value, the VOC reduction benefit can not be analyzed using future and present traffic volume.

Taking into consideration the above a method to estimate the producer's surplus benefit was established for the Study. Producer's surplus benefit is an indirect benefit which is based upon such conceptions that due to the road improvement productivity will increase and traffic will be generated and increase in the influence area.

Therefore, it is concluded that depending on the present traffic volume on the particular Kabupaten road either the VOC reduction benefit or the producer's surplus benefit is adopted for the benefit calculation.

The reasons why time saving benefit and traffic accident decrease benefit were not adopted are as follows.

i) <u>Time Saving Benefit</u>

A saving in travelling time is automatically yielded by road improvement. However, study should be made as to whether the saving in travel time should be applied to the benefit calculation or not, taking into consideration the balance conditions of the labour supply and demand in the influence area of the project.

Since the Project Areas for the Study are generally the developing regions of Indonesia, detailed data of the labour supply and demand are not available. However Table 4-3-1 shows in simplified form the existing conditions of labour supply and demand although the accuracy of the data is rather low. From this table the percentage of the invisible unemployment in the Project Area can be assumed to be comparatively high.

Accordingly adoption of the time saving benefit is not recommended for the Study in order to avoid over calculation of the benefit due to the socio-economic conditions in the Project Area.

Table 4-3-1 LABOUR SUPPLY AND DEMAND CONDITIONS

PROVINCE	NO.OF KABS.	EMPLOYABLE (PERSONS)	EMPLOYED (PERSONS)	EMPLOYED (%)	UNEMPLOYED (PERSONS)	UNEMPLOYED (%)
RIAU	3 (2)	637,904	435,431	68.3	202,473	31.7
SUMATERA SELATAN	4 (3)	643,062	573,217	89.1	69,845	10.9
LAMPUNG	1 (1)	781,934	319,774	40.9	462,160	59.1
KALIMANTAN TENGAH	4 (2)	121,032	85,876	71.0	35,156	29.0
KALIMANTAN TIMUR	4 (2)	112,779	64,047	56.8	48,732	43.2
KALIMANTAN SELATAN	9 (5)	520,137	383,931	73.8	136,206	26.2
NUSA TENGGARA TIMUR	3 (3)	380,632	361,646	95.0	18,986	5.0
SULAWESI UTARA	1 (0)	-	-	-	-	-
SULAWESI SELATAN	7 (5)	592,936	418,154	70.5	174,782	29.5
SULAWESI TENGGARA	2 (1)	122,083	59,866	49.0	62,217	51.0

Notes : 1. The population of Kabupatens for which there is no data is not included

2. The value in ( ) denotes the number of Kabupatens considered.

ii) Traffic Accident Decrease Benefit

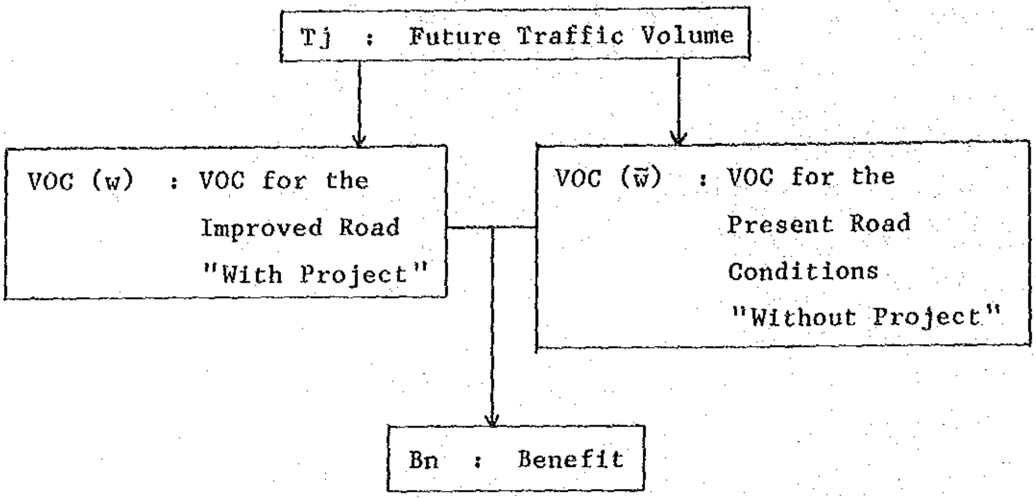
If the cause of traffic accidents is mainly due to problems of the road structure itself or due to large traffic volume, then traffic accidents can be expected to decrease following road improvement. Accordingly the benefit from reduction in traffic accidents seems to be reasonable for a direct benefit.

However because of the quantitative and qualitative conditions of both present and future traffic the frequency of traffic accidents is and will remain rather low. Furthermore there is insufficient data of accident for a meaningful estimation. Accordingly traffic accident decrease benefit is not adopted for the study.

(2) VOC Reduction Benefit

A flow chart for the estimation of VOC reduction benefit using traffic volume is shown in Fig. 4-3-1.

Fig. 4-3-1 VOC REDUCTION BENEFIT



The formulae used for estimation of the VOC reduction benefit are as follows:

$$VOC(w) = Cw \times Tj \times Ln$$

$$VOC(\bar{w}) = C\bar{w} \times Tj \times Ln$$

$$Bjn = VOC(\bar{w}) - VOC(w)$$

$$= (C\bar{w} - Cw) \times Tj \times Ln$$

Where :

- W : With project
- $\bar{W}$: Without project
- Tj : Traffic volume j years later
- Cw : VOC "With Project"
- $C\bar{w}$: VOC " Without Project"
- Ln : Length of road link n
- Bjn : Benefit of road link n, j years later

The VOC in Rp/Km by road surface type, surface condition and vehicle type prepared by Bina Marga in 1984 and shown in Table 4-3-2 is adopted.

Table 4-3-2 VEHICLE OPERATION COST ON KABUPATEN ROADS

(Rp/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.

(3) Producer's Surplus Benefit

As already explained in (1) of this sub-section, if the direct benefit of the road project due to traffic volume can not be adopted then the producer's surplus benefit will be adopted.

The producer's surplus benefit is an indirect benefit of all the benefits arising from the effect of the road improvement. It is based on the fact that if transportation from the producing districts to the facilities related to production and distribution activities, such as markets, becomes more convenient then the productive activity will be enhanced accordingly and the net output of production will be increased.

However, there is no standard formula for the estimation of this benefit such as the formulae used for estimating the direct benefit. This is because the structure and system of each production and distribution market do not always follow a common pattern.

Taking into consideration the socio-economic conditions of the Project Area and the data which could be obtained, the model shown in Fig. 4-3-2 is recommended for estimation of the benefit.

This model is based on the results of the case study carried out on the seven model Kabupatens in the Phase I Study. The process of selection of the model Kabupatens is described in sub-clause 4.3.2 of the interim report published in March, 1985.

The formulae used for estimation of the producer's surplus benefit are as follows:

$$Pj(w) = PA\ (1 + r_1)^{j-i} \times Y\ (1 + r_2)^{j-1}$$

$$APJ(w) = AP\ (1 + r_3)^{j-1}$$

$$NTB(w) = Pj(w) + G \times Pj(w) - APj(w) \times C + PGj(w)$$

$$Tj(\bar{w}) = Te\ (1 + r_4)^{j-1}$$

$$Tj(w) = Tj(g) + Tj(\bar{w})$$

$$Bn(\ Tj(g)\ ) = A\ (C\bar{w} - Cw) \times (\ Tj(w) - Tj(\bar{w})\ )$$

$$Bn(\ Tj(\bar{w})\ ) = (C\bar{w} - Cw) \times Tj(\bar{w})$$

$$Bjn = Bn\ (\ Tj(g)\ ) + Bn\ (\ Tj(\bar{w})\ )$$

$$= A\ (C\bar{w} - Cw) \times (\ Tj(w) - Tj(\bar{w})\ ) + (C\bar{w} - Cw) \times Tj(\bar{w})$$

Where :

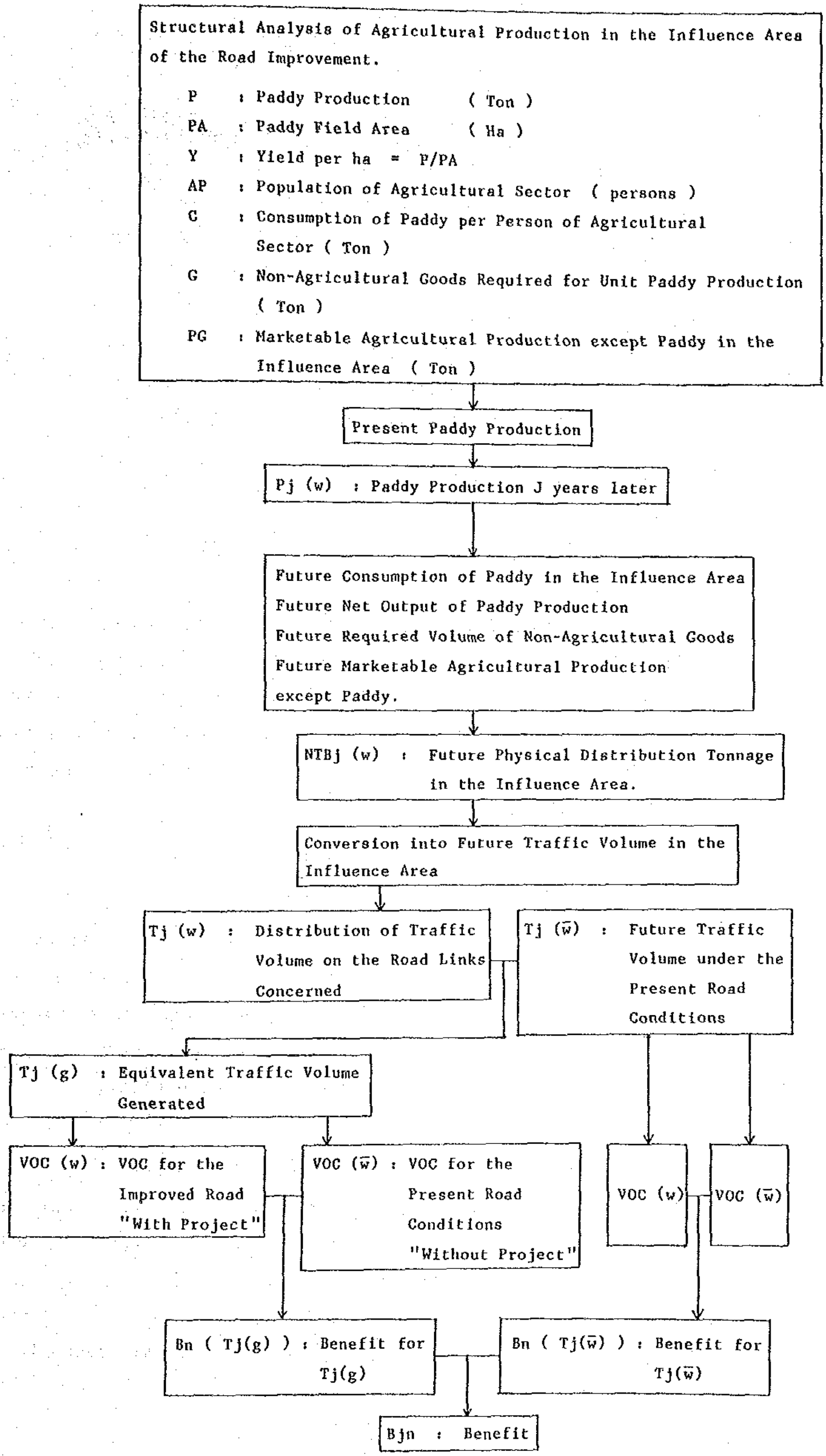
$$A = 1$$

$$Bjn = (C\bar{w} - Cw) \times Tj(w)$$

Where :

$Pj(w)$	:	Paddy production with project, j years later
$APj(w)$	:	Population of agricultural sector with project, j years later
$NTBj(w)$	:	Physical distribution tonnage in the influence area with project, j years later
$PGj(w)$	:	Marketable agricultural production except paddy with project, j years later
$Tj(w)$	:	Traffic volume with project, j years later
$Tj(\bar{w})$	:	Traffic volume without project, j years later
$Tj(g)$	:	Equivalent traffic volume generated with project, j years later

Fig. 4-3-2 CALCULATION MODEL OF PRODUCER's SURPLUS BENEFIT



Te	:	Present traffic volume
Cw	:	VOC with project
Gw	:	VOC without project
Ln	:	Length of road link n
Bjn	:	Benefit of road link n, j years later
r_1	:	Growth rate of paddy field with project
r_2	:	Growth rate of yield with project
r_3	:	Growth rate of population of agricultural sector with project
r_4	:	Growth rate of traffic volume without project
A	:	Benefit ratio for generated traffic

Details of the methodology are as follows:

1) Conversion of Future Physical Distribution Tonnage into Traffic Volume

Taking into consideration the available data, an estimation of NTBj (w) is carried out at kecamatan level. The number of trucks for physical distribution in the particular kecamatan is estimated using the average freight tonnage by vehicle. This number was distributed to each Kabupaten road using the following coefficient.

$$\frac{\text{Length of proposed road links in Kecamatan : Ln}}{\text{Total road length in Kecamatan : } \Sigma \text{ Ln}}$$

If transportation by trucks of the production is realized, traffic volume of other kinds of vehicles will be at the same rate as the existing average composition number by vehicle mode. The future traffic volume on each Kabupaten road can be estimated based on this assumption.

2) Growth Rates r_1, r_2 and r_3 as the Estimation Factors

In the producer's surplus benefit calculation model adopted for the Study, key factors are the annual average growth rates of the cultivated area, the yield per ha and the population of the agricultural sector, based on the assumption that the road improvement will be implemented.

This assumption should be established based upon positive analysis of the correlation of the area "with" the road improvement and "without" the road improvement, however this analysis is not possible for the kabupatens in the Study due to lack of available data.

Consequently, the growth rate of the cultivated area "r_1" and the growth rate of yield per ha "r_2" are decided from the logistic curve shown in Fig. 4-3-3 as being the tangents of the curve at a particular year after the improvement of the project between 1989 and 1992 based upon the assumption mentioned later.

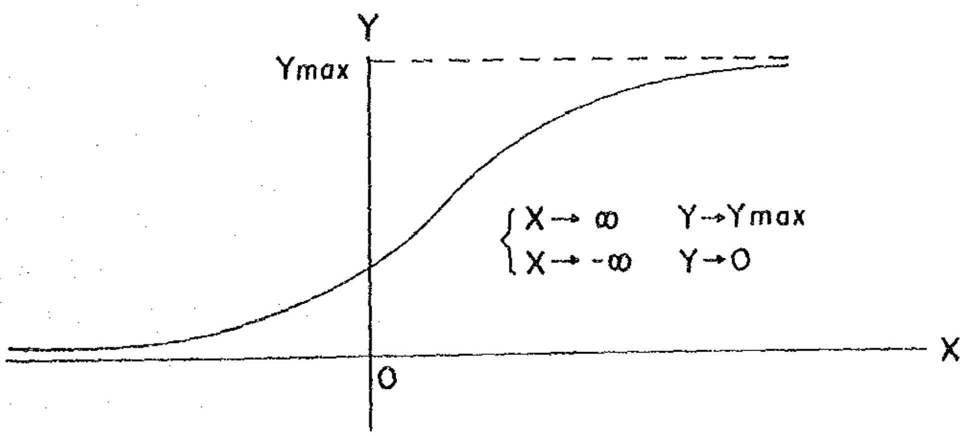
The formula for the curve is as follows :

$$Y = \frac{Y\ max}{1 + A_e{}^{-Bx}}$$

where :

X	:	Year
Y	:	Cultivated area or yield per ha
A and B	:	Constants > 0

Fig. 4-3-3 LOGISTIC CURVE



i) Cultivated Area

The maximum value of the cultivated area, Y max, is estimated from analysis of the un-used cultivatable area according to the present land use data taking into consideration the topographic conditions. The growth curve of the cultivated area is decided by substituting the actual cultivated areas in two selected years between 1980 and 1984.

ii) Yield per ha

The maximum value of the yield per ha, Y max, is estimated from comparison with the actual yield in developed areas in the province. The growth curve of the yield per ha is decided by substituting the actual value of yield per ha in two selected years between 1980 and 1984.

The growth rate of the population in the agricultural sector is estimated by projecting the trend of the growth rate for the Kabupatens, taking into account the relationship of the provincial growth rates of both the population of the agricultural sector and the cultivated areas, and also the actual progress of the transmigration programme.

The growth rate of traffic volume for present road conditions is estimated using the formulae referred to in the clause 3.2. It is desirable that each average annual growth rate by Kecamatan should be estimated. However, from the results of case studies of the benefit estimation using both the growth rates by Kecamatan, and a single growth rate in the Kabupaten, it is noted that the difference between the results is generally rather small. Futhermore, if the growth rates by Kecamatan were adopted the efficiency of the analysis by the micro computer would be reduced because of the capacity of the computer. Taking the above into consideration and to simplify the estimation growth rates by Kabupaten are adopted.

3) Benefit Ratio for Generated Traffic

The benefit ratio for generated traffic is generally assumed as 0.5 approximately. Taking into consideration undeveloped road conditions in the Project Area, the benefit ratio of 1.0 is adopted.

(4) Partial Modification of Calculation Model of Producer's Surplus Benefit

All Kabupatens in the Project Area are monocultural societies. Most of the agricultural production in 36 of the Kabupatens out of the 38 to be studied is rice which is shipped out of the Kabupaten. In the remaining two Kabupatens namely Bangka and Belitung of Sumatera Selatan Province, the agricultural structure is different from the structure in the others.

Both Kabupatens are islands in the Jawa sea located southeast of Sumatera. The main agricultural production is from plantations i.e coconuts, paper, rubber, cocoa, clove, etc. Paddy production is minor and approximately 80% of the rice requirement is brought in from other Kabupatens.

Thus, it can be considered that these Kabupatens have a socio-economic structure in which it is desirable that both the producer's surplus benefit and the consumer's surplus benefit are used to estimate the benefit, based upon the data of the terms of value in money.

However, since this situation was not anticipated through the case studies carried out in the Phase I Study, the simplified methodology established could not cope with the situation due to the limitation of the available data. An approach using the terms of value in money was tried in the Phase I Study. However, satisfactory results could not be obtained because of the limitation of the available data as shown in Sub-Clause 4.3.2 of the interim report. Therefore, in the cases of Kabupatens Bangka and Belitung, the benefits should be estimated by modifying the factors of the producer's surplus benefit calculation model.

Factors in the formulae of the model are modified as follows:

PA = Plantation area instead of paddy field area

P = Plantation production instead of paddy production

C = Consumption of agricultural sector = 0 (Zero)

PG = " Shortage of paddy (imported rice) in the influence area" instead of "marketable agricultural production except rice in the influence area".

Modification of the growth rates "r_1" and "r_2" in the model is described in detail in the Kabupaten reports.

(5) Adoption of Benefit Estimation Method for the Road Links

In general the benefit is estimated as the VOC reduction benefit using traffic volume. However for the following road links it is 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.

This decision was made because the direct benefit through the generated traffic volume estimate, based upon the present traffic volume, is rather small and it is difficult to evaluate the feasibility of the improvement of the road links.

It is assumed that two 2-wheel vehicles are equivalent to one 4-wheel vehicle.

(6) Residual Value

The project life time is set at 10 years. This means that the first year of project implementation will be 1988 and the last year will be 1998. The road construction cost will therefore be written off over the 10 years project life time, if construction cost only is considered.

However, there should be some remaining residual value in the road even 10 years after its construction. This residual value is included in the estimation of road benefits and should be appropriated in the target year of the project cash flow.

This residual value is taken into account as a road benefit, and the value for the road pavements and bridges will be estimated by the following criteria.

1) Criteria

a) Pavement

III A	Surface Dressing	Nil
	Base Course	25%
	Subbase Course	80%
III B-1	Surface Dressing	Nil
	Base Course	20%
	Subbase Course	70%
III B-2	Base Course	Nil
	Subbase Course	50%
III C	Base Course	Nil
	Subbase Course	40%
AWCAS		Nil

b) Bridge

	Concrete	50%
	Timber	Nil

2) Formula

a) Pavement

Base Course R.V = L x W x H1 x $\alpha 1$ x Unit Cost

Subbase Course R.V = L x W x H2 x $\alpha 2$ x Unit Cost

Where :

R.V = Residual value

L = Road link length in M

W = Pavement width in M

H_1 = Base course thickness in M

H_2 = Subbase course thickness in M

$\alpha 1$ or $\alpha 2$ = Residual Value Factor

Road Classification	H1	H2	$\alpha 1$	$\alpha 2$
III A	0.08	0.14	0.25	0.80
III B-1	0.07	0.14	0.20	0.70
III B-2	-	0.14	-	0.50
III C	-	0.12	-	0.40

b) Bridge

RC bridge R.V = Total Cost X 0.5

4.3.3 Economic Feasibility Evaluation

(1) Cash Flow Analysis

The economic feasibility evaluation is carried out by cost benefit analysis based upon the assumption that the project life is determined as 10 years, the first year of the project implementation being 1988 and the last year of the project being 1998.

The evaluation items are the internal rate of return (IRR), the net present value (NPV) and the benefit cost ratio (B/C). The cost in cash flow consists of the construction cost and maintenance cost which are described in Chapter 6, and the benefit in cash flow consists of the annual benefits and residual value. The IRRs are estimated using the cost and benefit mentioned above. The NPVs and B/Cs are estimated by discounting the cash flow using the discount rate of 10% (the capital opportunity cost) and are judged as reasonable from the present conditions of the Study Area. All the above estimations are carried out using two sets of micro-computers.

(2) Primary and Secondary Analyses

The Kabupaten roads are classified based upon the future traffic volume on the road links in 1998. The improvement level of each road link is decided by design criteria based upon the road classification refered to in Chapter 5. The construction and maintenance costs of the road link are estimated by the method described in Chapter 6.

The primary analysis of the IRR is carried out using the costs in cash flow mentioned above. Road links where IRRs are more than 10% are defined as feasible links.

Road links where the IRRs are between 1% and 10%, i.e. road links which have the possibility of being feasible, should be down graded in their road classification by one rank and their costs should be re-estimated.

Using these costs, a secondary analysis of the IRR is carried out. This reflects that even though the road classification is rather low the road link should be improved because the project is in a developing area.
From the results of the primary and secondary analyses, road links where the IRRs were more than 10% are selected and their NPVs and B/Cs are estimated.

For the estimation of the construction cost there are many indefinite engineering conditions such as the alignment of the road links, topographic and geological conditions of the Project Area, etc. Therefore a sensitivity analysis is not carried out due to the lack of precision.

(3) Priority

The final selection of the road links to be improved is described later. The priority derived from the economic evaluation is determined by the order of the NPVs, i.e. the larger the NPV the higher the road link priority.

4.3.4 Selection of Road Links to Be Improved

As described in the Interim Report the starting year of the construction of the local road development project is estimated to be the 1988/89 fiscal year, and the completion year of the project, called "the target year", is decided to be the 1992/93 fiscal year. The road links to be improved in these 5 years are 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 need

(1) Feasible Road Links

The road links to be improved are confined to those which are basically feasible from the result of primary or secondary evaluation. These feasible road links are selected in order of preference from the highest Net Present Value (NPV) obtained by the economic evaluation.

However the following two exceptions are also selected.

(2) Road Links Selected from Engineering Points of View

The following road links may be selected regardless of any result of economic evaluation:

- The key road link which is located at the strategie point to complete the local road network consisting of feasible road links;
- Road links which are effective in providing more effective development from the road improvement; and
- New roads which contribute heavily to development of the area.

(3) Road Links Selected Because of Basic Human Needs

In those Kabupatens which have no feasible road links from the economic evaluation, the following minimum required road links may be selected regardless of any result of economic evaluation from the view point of basic human needs:

- Road links which connect the Kabupaten capital with the Kecamatan capital provided the population density of the Kecamatan is greater than the mean for the Kabupaten; and
- Road links connecting isolated Kabupaten or Kecamatan capitals to a trunk road.

For final selection the priority given to the road link by the Kabupaten and by the government of Indonesia is also considered. In Kabupatens where the total length of the selected road links is rather short, a three or four years programme may be adopted. This is because if the five years programme is applied the road construction costs allocated for each year of the five year programme would be less than the current annual budget for the Kabupaten roads.

If the total construction costs for the five years programme would be more than the amount of the current annual budget for the Kabupaten roads for five years, feasible road links where the priorities are rather low would not be selected to be improved. Distribution of the total construction costs to each fiscal year is generally decided taking into consideration the proportions shown in Table 4-3-4 for the following reasons :

- In the 1988/89 fiscal year, delivery of the equipment will start from the month of July and the intensive field training conducted by the consultants, as referred to in Clause 8.3, will start in order of delivery of equipment to the Kabupatens. Since the six months from July are scheduled as a period of intensive field training through the pilot project, the effective construction volume in this period is estimated rather small.
- As the staff will become skilled in the operation of equipment, construction techniques, etc. the construction volume will increase year by year and peak in the fourth year of the programme.
- In the fifth year of the programme effective working time of the equipment will decrease because of increasing repairs to the equipment.

Table 4-3-4 STANDARD PROPORTIONS FOR ANNUAL CONSTRUCTION COSTS

(%)

PROGRAMME PERIOD (YEARS)	1988/89	1989/90	1990/91	1991/92	1992/93
5	9	21	23	24	23
4	11	28	30	31	-
3	17	40	43	-	-

The order of proceeding with improvement of the Kabupaten roads should be decided in principle taking into consideration the following conditions:

- Priority of the road links obtained from the results of NPV estimation.
- Road links proposed by the central government or the Kabupatens
- Road links connecting with the trunk roads

4.3.5 Selection of Road Links to Be Maintained

It is desirable that all Kabupaten roads are maintained. However, because of the limited budget, it is unavoidable 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. It is very difficult to decide the range of road links to be maintained because of the different conditions of the road links.

Therefore, full consideration should be given to the following points in the selection of road links to be maintained.

(1) Budget for Routine Maintenance of Road Links

The range of the budget for routine maintenance of road links is approximately 10% to 30% of the total budget for Kabupaten roads in general.

(2) Minimum Road Links to be Maintained

The following road links should be maintained:

a) Road links improved after the year 1981/82

b) Road links selected to be improved in this Study

(3) Road Links Screened Out by Basic Principles

Road links to be maintained should have the potential to expect steady future traffic growth. Therefore the following road links are screened out from the selection.

a) Road links not more than 2.5 m wide

b) Road links on which future traffic volume in 1998, estimated by the producer's surplus benefit, is not more than 30 vehicles per day

c) Road links of which not less than 25% of the existing surface conditions is very bad

d) Road links of which not less than 50% of the existing surface condition is poor and very bad

e) Road links with bridges not more than 2 m wide or with no bridges

(4) Priority of Road Links to be Maintained

The priority of road links to be maintained is decided in the following order:

1) Asphalt road
2) Gravel road
3) Earth road.

Chapter 5 ENGINEERING

Chapter 5 ENGINEERING

5.1 Design Criteria and Specification

5.1.1 General

The structure of a road must guarantee safe and smooth flow of traffic by taking into consideration the topographical and geological features, the climate and the estimated traffic conditions of the area where the construction of the road will take place.

The design standard is established to be used as general guidelines in road design so that the road will satisfy the above conditions. Currently a technical standard for improvement of Kabupaten roads i.e. PETUNJUK TEKNIS INPRES PENUNJANGAN JALAN KABUPATEN, TAHUN 1984-1985 is being established by Bina Marga.
The geometric design criteria of the above standard is 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 5-1-1.

5.1.2 Geometric Design Criteria

The geometric design criteria adopted for the Project make topographical divisions between flat areas, hilly areas and mountainous areas and a division by road classification. The values for the design speed, the maximum gradient, the pavement, shoulder and road bed widths, the right of way and the road camber are determined for each road classification and terrain.

However, it is impossible and unnecessary to design detailed plan/profile alignments for each Kabupaten road considering the vast project area and the study level. Accordingly, the geometric design in the study is confined to determination of the standard cross sections recommended for the Kabupaten road structures. An outline of the main items is listed below.

(1) Design Speed

To promote low cost and efficient service, the areas have been divided into the three categories mentioned above, and design

Table 5-1-1

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 PRACTICABLE
	MINIMUM	30	30	30	30	30	AS PRACTICABLE	30	30	AS PRACTICABLE	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		

speed has been established at 70 Km/hr maximum and is decreased according to the road classification and topography.

(2) Roadway Width

The Kabupaten road consists of one traffic lane. The pavement width is decided to allow the use of shoulders for the purpose of vehicles passing or overtaking each other. According to the results of site reconnaissance of the Kabupatens, the typical pavement width of Kabupaten roads is currently 4.0 m for all pavement types. When applying class III A of the design criteria for improvement of the existing 4.0 m pavement road the existing pavement width needs to be increased by 0.25 m each side. However, since the work of widening such a small area is in practice difficult and unprofitable, it has been agreed during discussions with Bina Marga that adoption of a pavement width of 4.0 m for road classification III A is permitted in the case of road improvement.

Since the existing shoulder width of the Kabupaten roads is generally 1.0 m, adoption of a 1.0 m shoulder width is allowed if necessary.

(3) Gradient

The maximum gradient in the design criteria is determined from the ability of vehicles to climb the grade, and is indicated in general by the minimum tolerable speed of 100% of design speed for passenger cars and 50% for commercial vehicles.

(4) Standard Cross Section

The cross sections shown in Figs.5-1-1 (1) and (2) are adopted for the standard road structures in the Project.

5.1.3 Loading Specification

The LOADING SPECIFICATIONS FOR HIGHWAY BRIDGES BY DIRECTORATE GENERAL BINA MARGA is used in principle as the basic specification of loading. 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 load. However, as a result of discussions with Bina Marga the following loads were decided as the design live loads for the standard bridges of the Kabupaten roads:

Fig. 5-1-1 (1) STANDARD ROAD CROSS SECTIONS

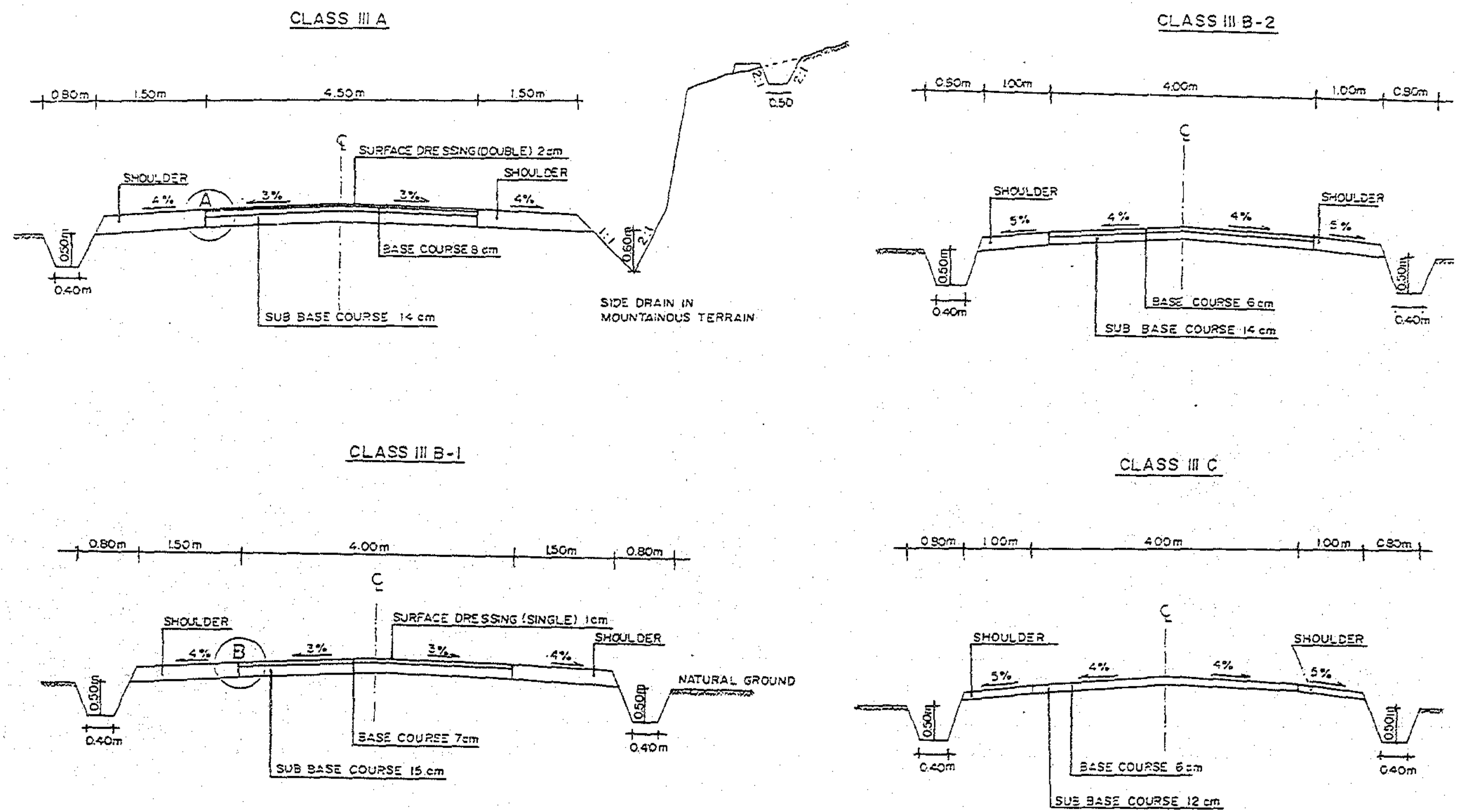
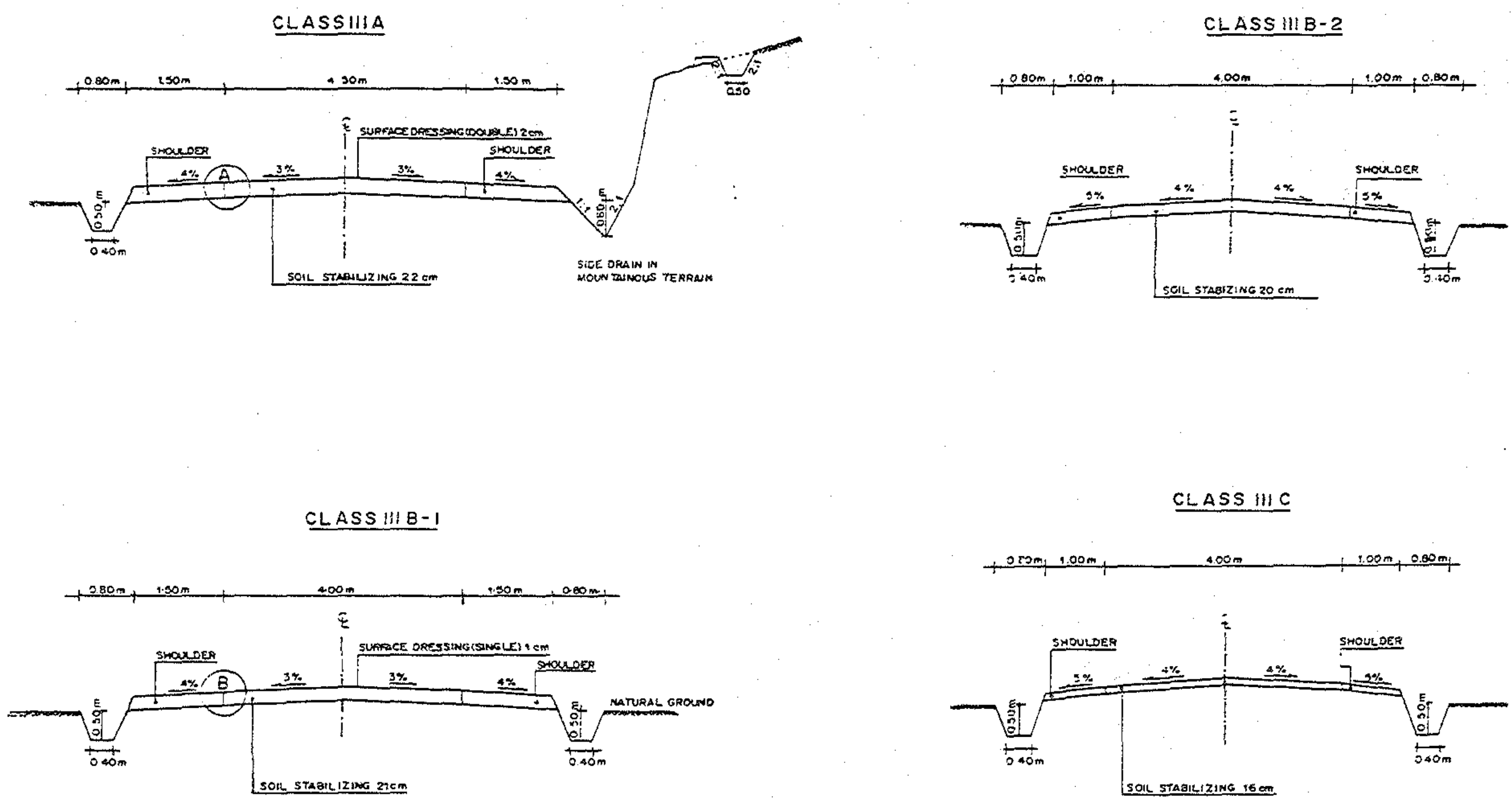


Fig. 5-1-1 (2) STANDARD ROAD CROSS SECTIONS



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

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

The reasons for deciding on the loads mentioned above are as follows:

- Standard bridges of BM 50 designed by Bina Marga have been actually in service on the national and provincial low grade district roads. Taking into consideration the traffic characteristics of the Kabupaten roads and the carrying capacity of the bridges, BM 70 used in both the existing and sample designs provided by PU is rather large. BM 50 is therefore adopted for the design of bridges on class III A roads.

- Timber bridges are assumed as temporary use because the life time is generally 5 to 10 years. Since BM 50 is still large for timber bridges constructed on roads of less than 500 vpd in ADT, 10-ton truck load, which is approximately equivalent to BM 35, is therefore adopted as being adequate for the design of timber bridges on low class roads.

- Because existing bridges in Riau Province of Sumatra and Tengah, Timur and Selatan Province of Kalimantan are mostly made of timber and many of them are constructed on roads of more than 500 vpd in ADT, BM 50 is also applied to the design of timber bridges on class III A roads in such areas.

5.2 Pavement Design

5.2.1 Design Policy

According to the field survey, it is noted that the pavement structure of the Kabupaten roads seems to have been inadequately decided without design calculation, therefore many damaged pavements have been observed resulting from insufficient capacity. For highway pavement design the following standards are generally used:

- Road Note 29, A Guide to the Structural Design of Pavements for New Roads.
- Road Note 31, A Guide to the Structural Design of Bituminous Roads in Tropical and Subtropical Countries.
- AASHTO, Interim Guide to Pavement Design.

However, these standards are considered not suitable for Kabupaten roads because the traffic volume of the Kabupaten roads is generally low and the axle load is small, so that these design methods for highway pavement have not been actually used in determining the required pavement thickness. Therefore a formula suitable for small traffic volume is recommended for the pavement design of the Kabupaten roads as described later. In addition, it is also proposed that the cumulative effect of the axle load over the pavement life of the Kabupaten roads should be considered.

5.2.2 Outline of Pavement Structure

The pavement in general consists of the subgrade, subbase, base and surface courses in that order from the bottom.
The various layers differ in function, and their materials should be selected accordingly to form an economical pavement structure. An outline of the pavement structure is as follows.

(1) Surface Course

This is the layer most exposed to the influence of traffic load and weather conditions. It must be able to resist the wear and shearing forces of vehicle loads, and it must be smooth but not slippery so as to permit comfortable travelling of vehicles. Permeation of surface water into the sub-soil must be prevented. Double and single layer bitumonous surface dressings are recommended as the surface course of road class III A and III B-1 respectively. However, surface course is not adopted for roads classified as III B-2 and III C because of their small traffic volume.

(2) Base Course

The base course has the vital function of dispersing the traffic load sustained by the surface layer and safely transmitting it to the subbase. For the base course material crusher run is generally recommended in the Project.

(3) Subbase

The subbase course is laid directly on top of the subgrade to prevent the rise of underground water and the infiltration of soil from the subgrade. Also, together with the base course, the subbase distributes the traffic load and safely transmits it to the subgrade. Generally, for the subbase economical local materials are used and in the Project the use of river gravel is recommended.

(4) Cement Stabilized Base Course

In some Kabupatens where aggregate material is difficult to obtain resulting in the price being extremely high the cement stabilization method is recommended for both the base and sub-base courses as a substitute for crusher run or river gravel.

5.2.3 Design Conditions

Both traffic volume and strength of roadbed are important factors in the design of pavement thickness. Details of these criteria are as follows.

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

The range of ADT for the class III A road varies from 3,000 to 500 vpd. However, because the maximum traffic volume in 1998 on the Kabupaten roads to be improved is estimated to be less than 1,000 vpd this figure is adopted for the design traffic volume.

From the inventory data it is estimated that the heavy vehicles ratio for the ADT volume is 20% for road classes III A, III B-1, and III B-2, and 15% for road class III C.

It was observed during the field survey that most of the existing heavy vehicles on the Kabupaten roads are pick-ups with a total weight of approximately 2.5 ton including over loading.

However, since the road improvement will generate an increase in axle loads a total vehicle weight of 5.0 ton, which is assumed as the overloaded state of a 2.5 ton truck, is considered for the pavement design in expectation of future traffic growth.

2) Strength of Roadbed

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

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

5.2.4 Design of Pavement Thickness

(1) Pavement Thickness

The required pavement thickness is calculated from the following formula.

$$H = \frac{28.0 \times N^{0.1}}{CBR^{0.6}}$$

Where :

H = Pavement thickness in cm

N = Total of equivalent 5-ton wheel loads in one direction to be expected during the project period of 10 years following construction.

CBR = Design CBR

The total number of equivalent 5-ton wheel loads (N) shall be obtained as follows:

$$N = N5 \times 365 \times 10$$

$$N5 = V5 \times \frac{B}{100} \times No$$

$$= V10 \times \frac{(1 + \frac{a}{100})^5}{(1 + \frac{a}{100})^{10}} \times \frac{B}{100} \times No$$

$$No = \Sigma Ai$$

$$Ai = \left(\frac{Pi}{5} \right)^4$$

where :

V5 = The mean value of ADT volume in the project period of 10 years, i.e. the 5 th year's value

V10 = Design ADT volume in the target year of 1998, derived from the design traffic volume

a = Average traffic volume growth rate during the project period assumed as 5%

B = Heavy Vehicles Ratio assumed as 20% for road classes III A,III B-1 and III B-2, and 15% for class III C

No = Number of equivalent 5-ton wheel loads of the heavy vehicle.

N5 = Average daily volume of traffic load of equivalent 5-ton wheel loads

Pi = Wheel loads of heavy vehicle
Front wheel load : 0.8-ton
Rear wheel load : 1.7-ton

Ai = Rate of structural damage caused to road pavement by wheel load Pi tons, where Ai for a 5-ton wheel load equals 1.

The results of the calculations are shown in Table 5-2-1.

Table 5-2-1 REQUIRED PAVEMENT THICKNESS

(cm)

CBR	ROAD CLASSIFICATION			
	III A	III B-1	III B-2	III C
3	36	34	31	25
6	24	22	20	16
9	19	18	16	13
12	16	15	14	11

(2) <u>Pavement Structure</u>

Fig. 5-2-1 shows the standard pavement structures adopted for the Project, and Fig. 5-2-2 shows the case where cement stabilization base course is used.

Fig. 5-2-1 PAVEMENT STUCTURE

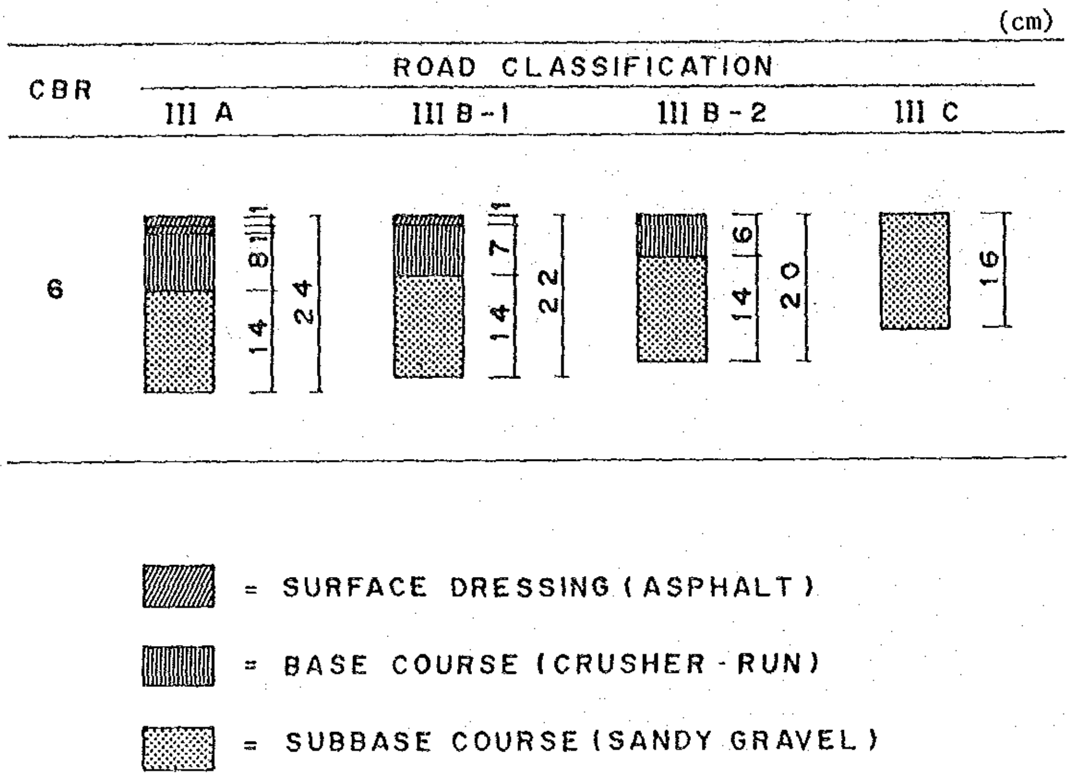
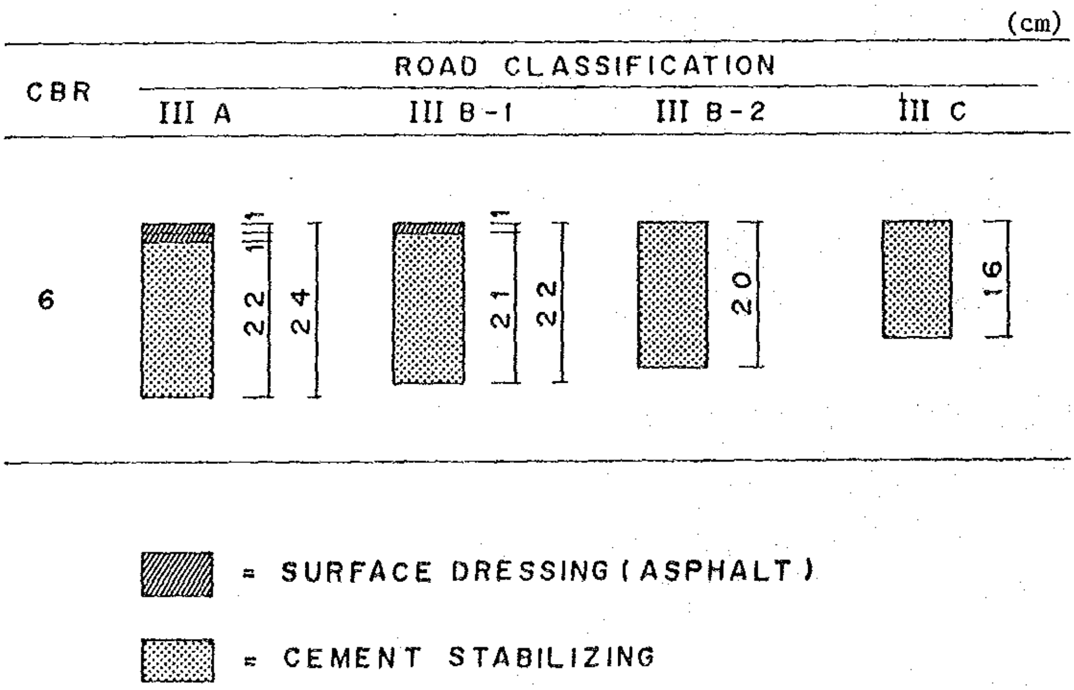


Fig. 5-2-2 PAVEMENT STUCTURE

(CEMENT STABILIZING)



5.3 Design of Bridges and Other Structures

5.3.1 Standard Bridges

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

(1) Bridge Type

1) Superstructure

The following two types have been finally selected after discussion with Bina Marga following study of acutal rural conditions for bridge construction. Fig. 5-3-1 shows the cross sections of standard types.

a) Timber beam bridge (hereinafter timber bridge)

b) Reinforced concrete T-girder bridge (hereinafter RC-bridge)

The reasons for the selection of timber bridge are as follows:

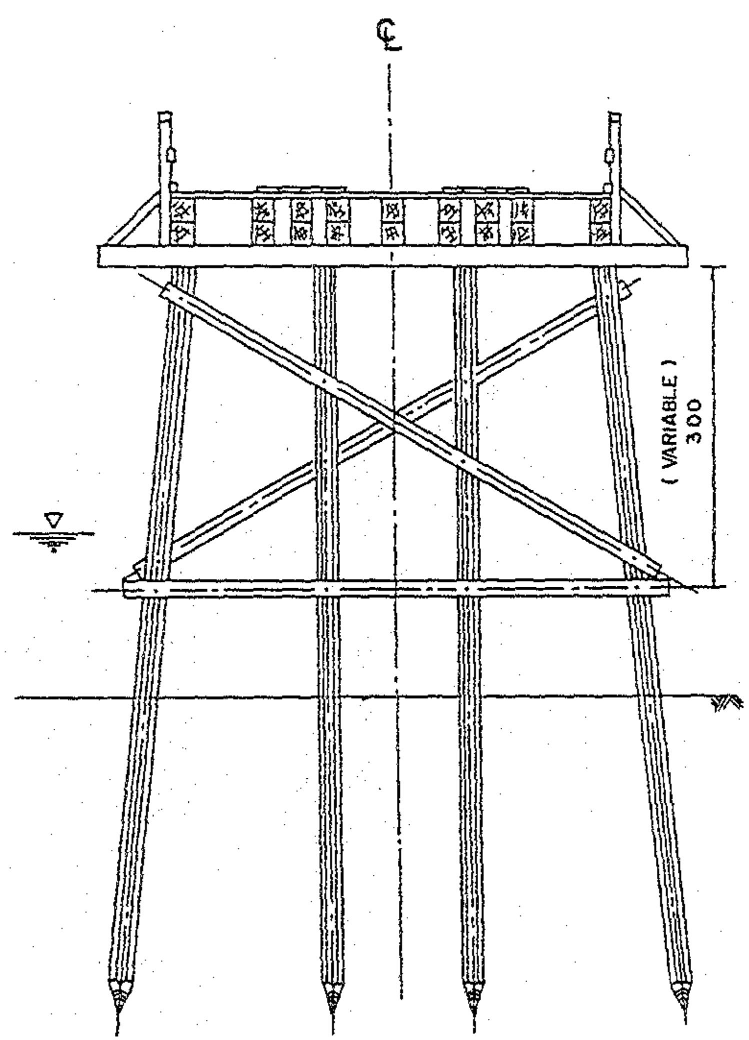
- Most of the existing bridges in the Project Area are timber.
- The procurement of bridge material is comparatively easy and economical.
- The erection of timber bridges is comparatively easy and suitable for manpower execution.
- Timber bridge has sufficient strength and durability for light traffic volumes and loadings.

The reasons for the selection of RC bridge are as follows:

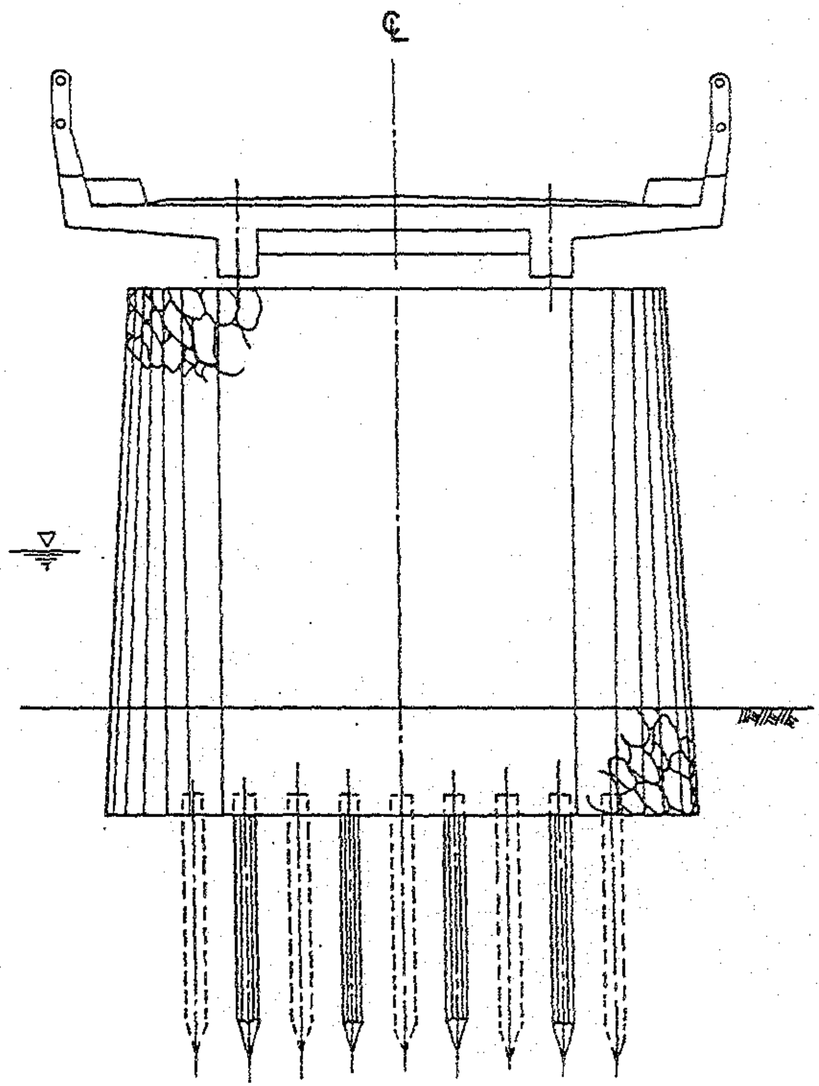
- RC bridge has a suitable carrying capacity and durability for heavy traffic volumes and loadings.
- Use is now widespread in Sumatra Selatan and Sulawesi Selatan Provinces, materials are easily available and construction simple.

Fig. 5-3-1 CROSS SECTIONS OF STANDARD BRIDGES

TIMBER BRIDGE



REINFORCED CONCRETE BRIDGE



A few steel girder and pipe bridges were observed during the field survey, however these types are not recommended as standard. Construction is considered difficult from the respect of procurement of bridge materials and equipment and in addition maintenance costs are high.

Some timber truss bridges were observed during the field survey. The span length of this type of bridge is generally longer than that of the timber beam type. However, since the erection of a truss needs complicated techniques and since it is not so economical this type is not considered suitable as standard.

2) Substructure

Taking into account the actual combinations of super and substructure types noted from the field survey, the following two types are recommended for standard because of easy 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 more than 3 meters under the bottom of the foundation or river bed. The length and number of piles should be decided in order to be adequate for the site condition of foundation materials.

(2) Bridge Width

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

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

The reasons for the selection are as follows:

- Most of the Kabupaten roads have a pavement width of 4.0 m and all the timber bridges have only one lane, moreover the vehicles are restricted on the bridge to the wheel lane which is fixed by the structure of the bridge. Besides, it does not seem necessary to provide enough width for vechicles to pass each other for the light traffic of the Kabupaten roads.
- For RC-bridges the decision of the required width takes into account the future traffic growth, which accordingly will necessitate sufficient width for vehicles to at least be able to pass each other. This is because the RC-bridge has a comparatively long life.

(3) Span Length

After due discussion with Bina Marga about the range of span lengths the standard lengths have been finalised as follows:

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

The reasons for the decision are as follows:

- From the inventory data it is noted that the span length of most of the timber bridges is within the range of 3 m to 5 m, and there are few span lengths of more than 8 m. From the general practicable range of timber spans, the furnishing of materials and erection of spans of over 8 m presents difficulties.
- The distribution of the span length of RC bridges in the inventory data tends to be concentrated mainly in short spans and there are many bridges of approximately 3 m span.
- From study of the total construction cost of super and substructures of RC bridges, the most economical span length is estimated to be approximately 10 m. Where a long span bridge is required at a wide water course the 15 m span is additionally recommended.

5.3.2 Application of Standard Bridges

(1) Bridge Improvement

Based on the various data of the bridge inventory the bridges to be improved are selected according to the following conditions:

- Bridge of less than 3 m width;
- Bridge of which either the super and/or substructure is seriously damaged; and
- Bridge required where there is none existing.

In the Project bridge improvement means new construction or re-construction. A bridge classified in the rating good and/or damaged should be excluded from the improvement schedule. Such bridges should be treated under maintenance.

Since there is no data of either the design load or structural details of existing bridges, a study of the possibility of reinforcing or widening existing bridges has not been performed. Therefore measures of reinforcing or widening are not included in the engineering study.

(2) Selection of Bridge Type

From the bridge inventory data differences of tendencies in each region of the Project Area on the distribution of bridges are noted as follows:

- Kalimantan:

  Almost all of the existing bridges are timber with the exception of a few cases.

- Sulawesi and Sumatera:

  Most of the existing bridges are timber, however there are many bridges of other types. In the case of Sulawesi Selatan Province approximately half of the existing bridges are RC bridges.

After due consideration of the availability of material, familiarity of construction methods and technical abilities in the Kabupatens as well as the above conditions, the applicable standard bridge type for each region is recommended as follows:

- Kalimantan :

  Timber bridge regardless of traffic volume

- Sulawesi, Sumatera and Nusa Tenggara:

  RC bridge for class III A road and timber bridge for road class III B-1, III B-2 and III C

(3) Selection of Number of Spans and of Span Length

1) Timber Bridge

In the case of re-construction as a rule the span arrangement should be designed to be the same as the existing. However, when the existing span length is more than 8 m or the bridge is to be newly constructed, the span length should be selected in such a way as to minimize the number of spans within the maximum span length of the standard types.

For the multi-short-span bridge of less than 3 m in each span, the span arrangement should be revised in such a way as to reduce the number of spans increasing the span lengths to about 3 m.

2) RC Bridge

The span length should be decided in such a way as to minimize the number of spans within the maximum span length of the standard types. Particularly for a long bridge the economical span arrangement should be considered by combining the cost comparison of the super and substructures.

5.3.3 Other Structures

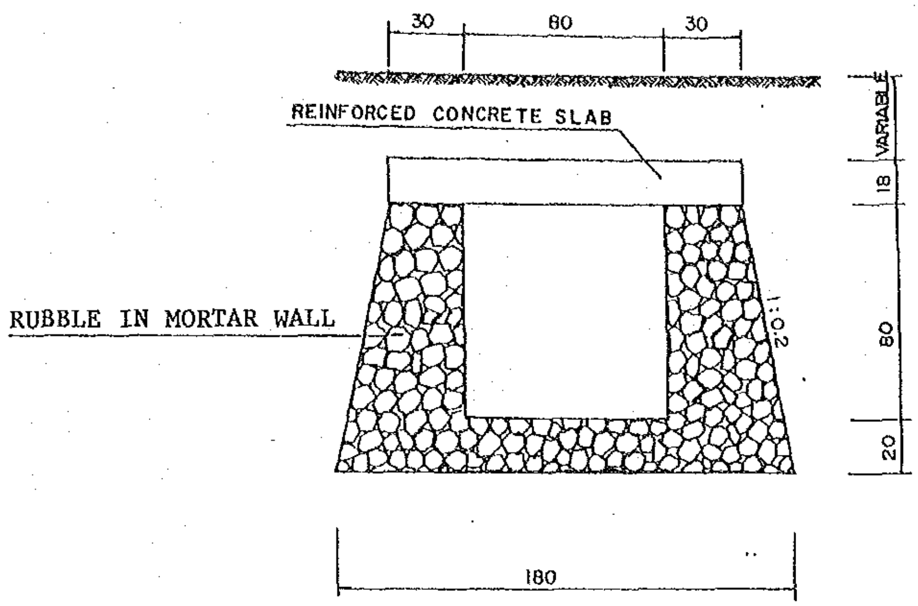
Culverts and retaining walls as shown in Fig. 5-3-2 and Fig. 5-3-3 are recommended as standard structures.

(1) Culvert

The following two culvert types are adopted for transverse drainage after discussions with Bina Marga on the Study Team's recommendation.

Fig. 5-3-2 STANDARD CULVERTS

80 x 80 RUBBLE IN MORTAR BOX CULVERT



Ø 80 REINFORCED CONCRETE PIPE CULVERT

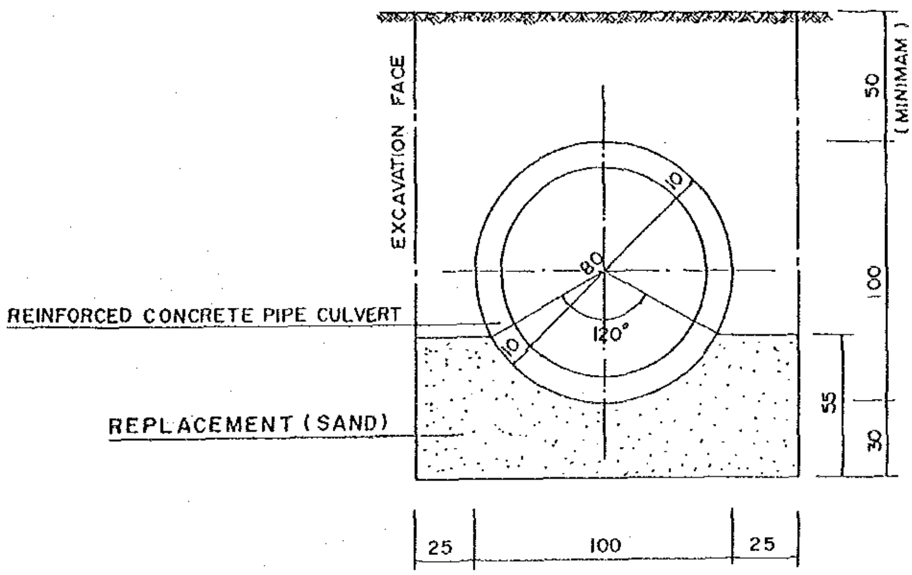
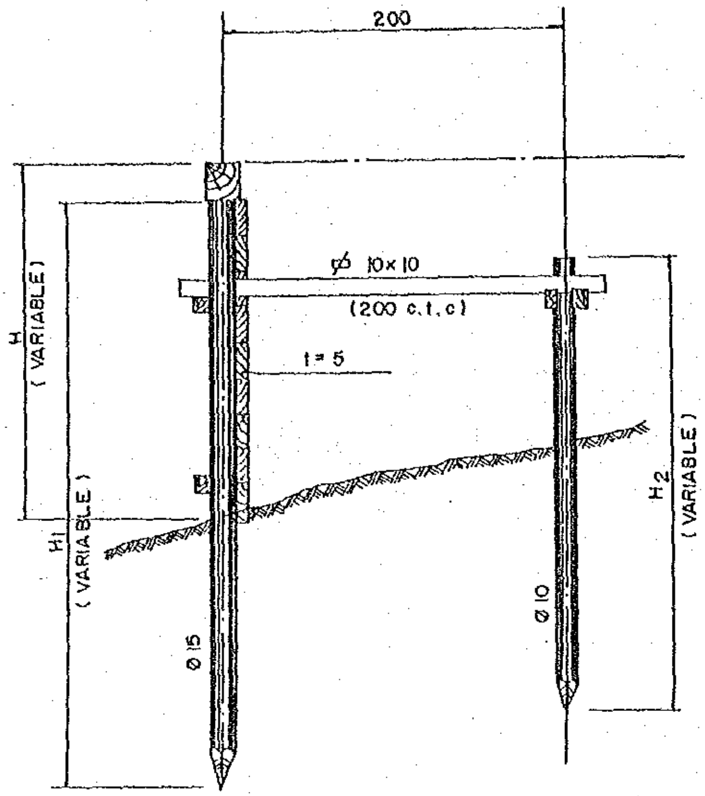
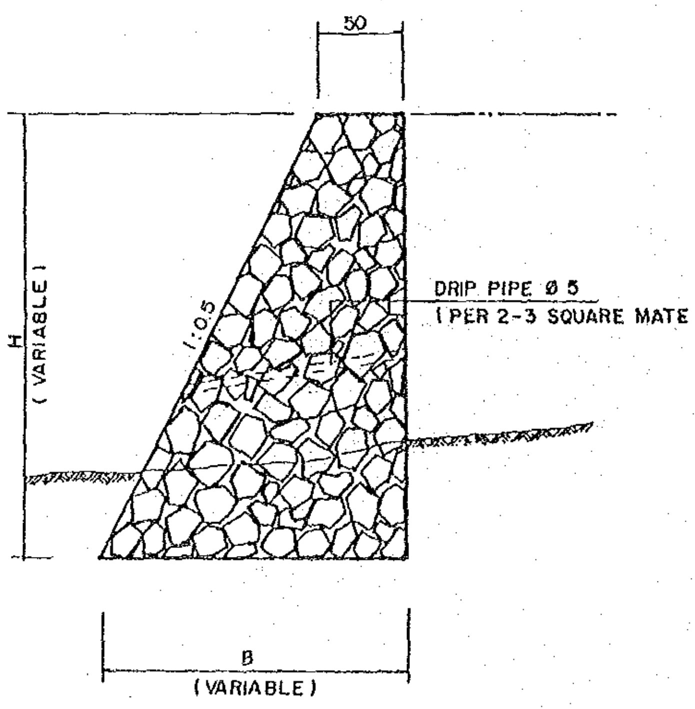


Fig. 5-3-3 STANDARD RETAINING WALLS

TIMBER RETAINING WALL



RUBBLE IN MORTAR WALL



a) Reinforced concrete pipe culvert 80 cm diameter

b) Rubble in mortar box culvert with RC slab 80 cm x 80 cm

RC pipe culvert of 80 cm diameter is recommended because of its duarability and economy. More than 50 cm earth cover should be provided on the RC pipe to avoid the direct action of wheel loads.

For locations where it is difficult to ensure the minimum earth cover of 50 cm on the RC pipe, a rubble in mortar box culvert with RC slab should be employed. In addition damaged existing timber culverts should be replaced by rubble in mortar culvert.

(2) Retaining Wall

The following two types of retaining walls are adopted because of easy construction, economy and familiarity in Indonesia.

a) Rubble in mortar retaining wall

b) Timber retaining wall

5.4 Selection of Equipment Type

5.4.1 Comparison of Equipment Intensive Method with Labour Intensive Method

There are two types of Kabupaten road construction methods, i.e. equipment intensive method and labour intensive method.

In most of the Kabupatens in the Project Area the labour intensive method is generally currently adopted for both improvement and maintenance of the roads. This is concluded from the results of the engineering survey which show that in most of the Kabupatens both DPUKs and local contractors do not have construction equipment. In Kabupatens where DPUKs have equipment the numbers of equipment, such as bulldozer and motor grader which are necessary for the equipment intensive method, are few.

Sometimes the Kabupaten roads are constructed and maintained through 'Gotong royong' (Mutual aid or co-operative operation) completely by man-power.

In the Telford type of road improvement by the labour intensive method, the road is in general paved with stones broken by man-power and opened for public traffic without any compaction works. Therefore generally stability of the road is very low and the surface roughness is very high.

In a mountainous area where site reconnaissance was carried out by the Study Team, it was necessary to construct a Kabupaten road with grade more than 15% because large scale cut work could not carried out by the traditional labour intensive method.

Experience in the first local road project, where assistance was given by OECF, ADB and IBRD, showed that road construction by the traditional labour intensive method by local contractors could not be completed within the contract period, whereas road construction by the equipment intensive method by force account was on schedule.

Thus, construction by the equipment intensive method is desirable for stable road construction, with a 10 year life and a smooth surface. However, to decide the construction method adopted for the Project the following conditions should be considered:

- Since most of the Study Area is a developing area, benefits brought by the road development project would in general be relatively low. From the view point of economic feasibility evaluation, low cost construction, i.e. construction by the equipment intensive method, is desirable to obtain the required IRR.

- If all the works are scheduled by the equipment intensive method only, the initial investment would become a huge amount.

- It is desirable to make a contribution towards employment opportunity and to raise the regional inhabitant's income level by realization of the Project.

The advantages and disadvantages of applying the equipment and labour intensive methods for local road development projects are shown in Table 5-4-1.

Table 5-4-1 COMPARISON OF EQUIPMENT AND LABOUR INTENSIVE METHODS

DESCRIPTION	EQUIPMENT INTENSIVE METHOD	LABOUR INTENSIVE METHOD
Construction Volume per Day	High	Low
Construction Quality Control	Easy	Difficult
Unit Cost by Work Type	Low	High
Initial Investment	Large	Small
Regional Employment Opportunity	Poor	Good

Taking into consideration the conditions mentioned above, construction methods for major works were basically decided as shown in Table 5-4-2.

Table 5-4-2 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.

5.4.2 Points to be Considered for the Selection of Equipment Type

Full consideration is 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 withstand heavy rainfall and poor soil quality. If necessary equipment for construction in swampy areas is to be considered.

d. The 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 frequent equipment transfer will be necessary, wheel type equipment is selected as much as possible as this can move by itself or be moved by towing.

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

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

5.4.3 Combinations of Equipment for Major Works and Maintenance

The combinations of equipment for major works and maintenance are listed in Tables 5-4-3 and 5-4-4 respectively.

Table 5-4-3 EQUIPMENT OF ONE WORK GANG FOR MAJOR TYPES OF WORK

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

Table 5-4-4 EQUIPMENT OF ONE WORK GANG FOR MAINTENANCE

TYPE OF WORK	MAIN EQUIPMENT
Road	1- Motor Grader
	1- Tire 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

5.5 Workshop and Laboratory

5.5.1 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.

The mechanics will go to the job site by a service car and will exchange parts, lubricate, and carry out maintenance and if neccessary repair on site.

Otherwise equipment to be repaired will normally be transported to the bay of the workshop, for the repairs.

The workshop will record the condition of each item of equipment through routine maintenance, and plan a schedule for large scale repairs, adjustment and overhaul of equipment in advance, in order to ensure smooth cooperation with the provincial workshop or the regional workshop of Bina Marga.

Because of the nature of the Project the equipment will operate far from the workshop and will often move to new work sites. Under these circumstances it is very difficult to keep the equipment in good condition and ensure a good operating ratio at all times. To solve this problem it is recommended that a traveling service team consisting of four members is provided. The team will travel at regular intervals two or three times every week to inspect equipment and to directly hear about the condition of the equipment from the operators. If possible the team will also deal at the job site with equipment which is out of order. In cases where immediate repair is necessary but impossible the team will order delivery of tools, equipment and vehicles from the workshop, or else arrange to transport the broken equipment to the workshop. A periodical maintenance plan will be made based on the reports prepared by the team.

Spare parts and lubricants which are used in routine works will be stored in and provided from the Kabupaten workshop, but other spare parts will be supplied from the warehouse of the provincial workshop or the regional workshop of Bina Marga. Supply of urgent materials and lubricants, and transporting the unit will be carried out by the Kabupaten workshop, but supply of the scheduled ordered materials will be carried out by the provincial workshop or the regional workshop of Bina Marga.

The area required for the Kabupaten workshop is approximately two hectares and the layout of the workshop is recommended to be as shown in the separate drawing accompanying this report. The existing layout prepared by Bina Marga is basically adopted although it is modified after considering the following needs:

- Provision of a machine shop in the workshop;
- Provision of a warehouse consisting of a tool room and a parts store; and
- Provision of a laboratory for soil and concrete tests.

The area of each room in the workshop will be as follows:

Description	Size (m x m)	Area (m^2)
Office	8 x 10	80
Warehouse (tools & parts)	5 x 12	60
Laboratory	6 x 8	48
Repair Bay (4)	4 - 5 x 12	240
Electric & Battery	5 x 8	40
Machine Shop		30
Others		54
Total		552

5.5.2 Workshop Equipment and Tools

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

Table 5-5-1 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
Drum Pump	2
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
Mechanic Tool Set, Heavy Equipment	1
Mechanic 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

Continued

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

5.5.3 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 5-5-2.

Table 5-5-2 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 Mold (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 5-5-3 is recommended.

Table 5-5-3 SURVEYING EQUIPMENT

DESCRIPTION	QUANTITY
Transit	1
Level	1
Staff	3

5.6 Construction and Maintenance

5.6.1 Earth and Pavement Works

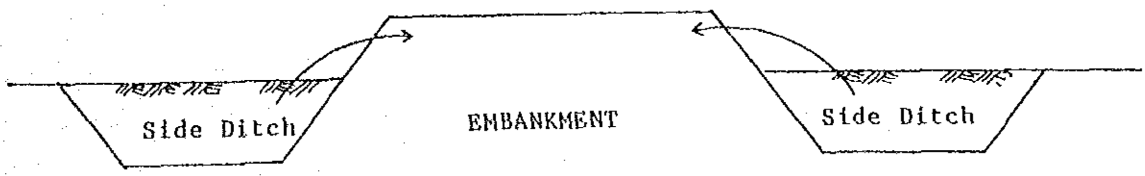
(1) Earthwork

Road earthwork is the initial and fundamental process of road construction, and under normal conditions remains unchanged. In other words earthwork is very difficult to alternate during or after construction. If unsuitable materials or treatments are used in the earthwork harmful effects may influence the base courses or pavement such as corrugation, subsidence or upheaval of the road surface. Therefore, earthwork should be adequately carried out to satisfy the prescribed requirements. Many of the Kabupatens in this project have swampy areas in their territories, particularly the Kabupatens of Indragiri Hulu and Indragiri Hilir in Riau Province, Kotawaringin and Kapuas, Barito Selatan in Kalimantan Tengah Province and Barito Kuala in Kalimantan Selatan Province.

It is uneconomical and of considerably trouble for such Kabupatens to introduce suitable materials from another area. Consequently the Kabupatens are obliged to used the excavated materials for fill work as shown in Fig. 5-6-1.

The fill material is directly excavated from both side ditches and placed on the road way without soil stabilization as has been carried out up to now in the Kabupatens. Soil stabilization is too costly to be practicable in this Project Area. However, it is suggested that swamp bulldozers are provided for these Kabupatens.

Fig. 5-6-1 EMBANKMENT IN SWAMPY AREA



(2) Sub-Base and Base Courses

Base course is generally divided into sub-base and base courses. Material is utilized according to the requirements for each course respectively i.e. low price material may be applicable for the sub-base course within a certain range, but the base course should be a selected durable material with high bearing capacity.

1) Sub-Base Course

Natural river gravel is suggested for use as sub-base course because it is available locally and so is rather cheap in many of the Kabupatens. It is also suggested that pit-run gravel is placed directly on the sub-grade without the process of mechanical stabilization. After that, oversized pieces can be removed by hand.

2) Base Course

Materials for base course should be crushed stone or crushed gravel, or natural gravel if applicable. The materials should be selected to satisfy the prescribed quality requirement. It is preferable that the quarry or gravel pit is located as close to the construction site as possible.

3) Cement Stabilized Sub-Base and Base Courses

Some Kabupatens produce only small quantities of stones or gravels so that the prices become rather expensive due to transportation costs. This is particularly so in the seven Kabupatens Indragiri Hilir and Bengkalis in Riau Province, Kotawaringin Timur, Kapuas, Barito Selatan and Barito Utara in Kalimantan Tengah Province and Barito Kuala in Kalimantan Selatan. However, even in these Kabupatens sand is available at a comparatively low price. Therefore, cement stabilization is recommended for the base course as a substitute for using crushed stone or gravel. After comparing mixed-in-place method with central mixing plant method, the former method was selected due to the high cost of plant for the latter method.

Mixed-in-place method is executed as follows :

Sand is spread on the subgrade and sacked cement is laid at a certain spacing on it and then cement spread with a rake. Following that, dry mixing is carried out by a road-stabilizing machine and then finally mixed by adding water. Mixing work should be carried out immediately after spreading the cement.

(3) Surface Course

The execution method for bituminous surface dressing is that aggregates are initially placed and compacted, then bituminous material is spread. Placing the aggregate and sand is carried out by manpower, compacting by tire-roller and applying bitumen by pressure distrubutor. Bituminous material should be applied in a uniform, continuous spread over the section to be treated and it should penetrate satisfactorily. Care should be taken that the application of bituminous material at the junctions of spreads is not in excess of the normal amount.

(4) Shoulder

The earth shoulder adopted in this Project conforms to Bina Marga technical standard. A motor grader is suggested for placing the material and vibratory roller for compaction, but the combination of bulldozer and hand-guided vibratory roller is a practical alternative. In each case machines should be chosen according to the site conditions.

Care should be given to the drainage of the shoulder. If the shoulder surface is inadequately constructed puddles may form which will probably induce a harmful influence on the roadway. Therefore, it is advisable that the surface of the shoulder should be constructed with a sufficient grade, generally more than 4 percent and to the required full compaction.

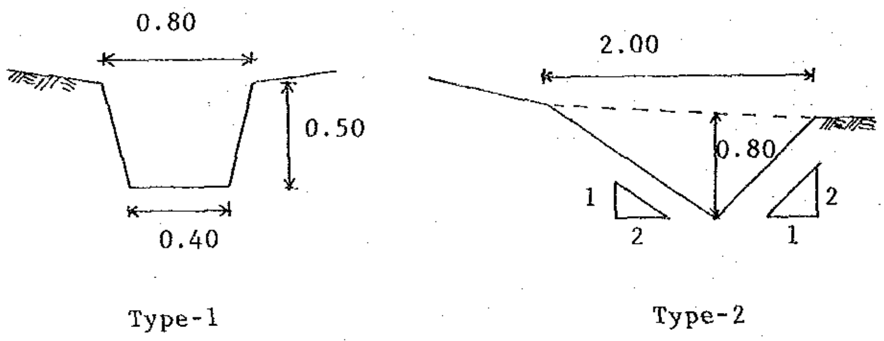
(5) Drainage

a. Earth Drain

Drainage is an essential element of road structures for the purpose of preventing water infiltration and slope erosion, and for draining underground water. While Bina Marga technical standard has two types of ditches as shown in Fig.5-6-2, Type-1 is adopted for this Project because Type -2 is generally utilized for earth roads.

Although it is suggested that the earth drain is excavated by manpower, mechanical excavation can also be considered when the equipment for excavation is not engaged in other works.

Fig. 5-6-2 STANDARD DRAIN DITCH



b. Earth Drain in Swampy Area

Excavation of the earth drains in swampy areas is best carried out by machines because the size of both side ditches is large due to the volume of fill material required for the embankment, as was mentioned in "Earthwork".

5.6.2 Bridges and Other Structures

From the site reconnaissances and engineering inventory surveys it is noted that there are some essentials for the construction of bridges and other structures in the local road.

However, for quality control, justification and reliability of structures there seems to be yet much scope for further improvement. The standardization of design and construction methods, if compatible with the local construction ability, seems to be a profitable and practicable measure rather than the supply of new techniques and equipment.

Rubble in mortar adopted as a standard is the conventional method in Indonesia well known as 'Pasangan Batu', and is performed entirely by manpower. It is usually comprised of stones, irregular in size and shape, and should not be confused with ashlar stone masonry.

In Indonesia there is plenty of timber, for which the major types indicated below are well known for their superior quality.

- 'Kayu Jati' (Teak) produced in Jawa
- 'Kayu Ulin' produced in Kalimantan
- 'Kayu Besi' (Iron Wood) produced in Sumatra.

These timbers are quite hard and suitable for structures. They are mostly used after the process of producing solid sawn timber, but for piles or columms solid logs of small size diameter are also used.

5.6.3 Maintenance

(1) General

The purpose of road maintenance is to preserve roads which are an important social facility of a country, and is performed in order to prevent deterioration and to maximize the functions of the roads. Road maintenance is roughly divided into maintenance and repair works, however the division is not clearly defined. Maintenance is generally carried out to preserve the road condition, so it accordingly includes various works such as mending, patching, filling up or weeding of the road surface. These items of work are regularly carried out as routine duties. Patrolling and inspection are also included in the work. Repair work covers repairs and/or renovation of considerably damaged portions. For example replacing or overlaying of pavement and reinforcing of structures, which works are generally not possible as part of the routine duties.

In order to execute the maintenance work effectively, not only are the required personnel, materials and equipments necessary, but organization of the road management system is also important. In this respect, it is recommended that the maintenance section is organized independently from other sections. Refer to the organization chart in section 8.2.1.

(2) Execution of Maintenance Work

1) Maintenance Team

Except for large scale repair works road maintenance is generally undertaken under direct management by the government. With the aim of satisfactorily executing the routine maintenance, it is suggested that each Kabupaten forms a full-time maintenance team. This should be divided into road and bridge maintenance teams because each team will have a different objective as follows:

a. Road Maintenance Team

The duties of this team should include inspection and reporting of the road condition, planning and execution of the road repair work, cleaning of the ditches and culverts, and weeding of the shoulder and slope. Accordingly, the team undertakes thorough maintenance works of the roadway excluding bridges and other structural items.

b. Bridge Maintenance Team

This team should be engaged in special duties for the maintenance of bridges and other structures, including inspection and reporting of bridge condition, planning and execution of bridge repair work, and painting. When making engineering judgements the team needs a considerable level of technical knowledge of structures, so that at least one technician qualified in bridge engineering is required.

The road administrator in each Kabupaten is advised to organize the maintenance crew according to the outlined suggestions. The type and organisation of the personnel should be determined by each Kabupaten in accordance with its requirements.

2) Routine Maintenance

Maintenance work should be periodically carried out in order to promptly take measures and so as not to miss the opportunity for repair. A good maintenance operation can detect damage in its early stages and so treat it before the damage becomes serious. For that purpose, patrolling of the road should be performed according to a schedule which has previously been prepared by the maintenance section of each Kabupaten. Patrolling should be scheduled separately as follows:

a. Regular Patrolling

This patrolling is carried out to inspect the road surface conditions and as a rule is within visual scope from the patrol car. The frequency of patrolling, although it should be decided by each Kabupaten considering the traffic volume, route condition and existence of noteworthy damage, is suggested to be at least once or twice a month.

b. Periodic Patrolling

This patrolling is periodically carried out chiefly to maintain safety of the road structures. On this occasion the inspection is practiced mainly for structures, particularly for bridges. The frequency of patrolling should be decided considering the importance of the structures, the extent of deterioration and the affect for others when the structure is broken. However, it is advised to be performed at least once a year.

c. Emergency Patrolling

This patrolling is executed on special occasions when the road is feared to be obstructed such as in concentrated rainfall, earthquake or other emergency situations. It is performed to obtain information required about accident or disaster.

3) Report and Record of Road Information

The road information obtained through the patrolling or maintenance work should be reported and recorded as a routine duty, and suitably filed for possible future use. It will thus be useful for future maintenance work. It is suggested that a standard format is used for the report which records the items listed below as a minimum requirement:

- Date, weather and inspector's name;
- Route and location;
- Judgement of road surface condition;
- Damaged portion when detected;
- Outline of repair work when executed; and
- Sketch or picture if necessary.

In addition, if circumstances of the Kabupatens permit, it is suggested that a rating system of the road condition is practiced by using the above mentioned maintenance records. That is, the rating of the road condition is defined in several grades from good to bad condition according to the extent of the deterioration, and this is applied to the actual road inspection. After totaling the rating results for each route, the road maintenance will be more effectively managed by the systematic evaluation.

5.7 Quantity Estimation

The quantities of road improvement works are estimated using the computer based on the inventory data.
The matters considered in the quantity estimation of each work are as follows:

5.7.1 Earth and Pavement Works

(1) Site Clearing in Light Bush

If the required road bed width is wider than the effective width of the existing road, this work is necessary.

(2) Subgrade Preparation

This work is necessary in following cases :

a. Existing earth road

b. All roads in the flood area

(3) Normal Fill

The volumes of the normal fill from the inventory data are used for the estimation.
The materials provided by the normal excavation are generaly used for the normal fill.
If the volume of the normal fill is large than that of the normal excavation, the required materials are carried from a borrow pit.
However, due to the lack of data, detailed study of the quantity of materials and schedule of works is impossible and therefore based on study of previous similar projects it is assumed that 40% of the normal fill materials is carried from a borrow pit.

(4) Fill in Swamp

Taking into consideration the road width of each road link, the quantity is estimated using data of length and depth of flood from the inventory.

(5) Normal Excavation to Spoil

This work is necessary in following cases :

a. Normal excavation required from the inventory data

b. Widening of existing asphalt paved or gravel roads

c. Existing earth roads

The excavation depth from the earth road surface is assumed as follows:

Surface Condition	Depth (cm)
Fair	2
Bad	4
Very bad	5

(6) Subbase Course

The material of the subbase course is gravel and the thickness is decided following the road classification of each road link. However, the additional thickness to existing subbase course is assumed as follows depending on the existing surface types and conditions :

Surface Condition	Additional Thickness (cm)
Asphalt	0
Gravel	
Good	0
Fair	1
Poor	2
Very bad	3
Earth	Full thickness as shown in Fig. 5-2-1

(7) Base Course

The material of the base course is crusher run and the thickness is decided following the road classification of each road link as shown in Fig. 5-2-1.

(8) Shoulder

The shoulder width is calculated as follows :

a. Road bed width required > Existing road bed width:
Shoulder width = Road bed width required - Pavement width required

b. Road bed width required < Existing road bed width
Shoulder width = Existing road bed width - Pavement width required

(9) Asphalt Patching

In case of the existing asphalt surface, this work is necessary. The unit quantity of this work is assumed as follows :

Existing Surface Condition	Quantity (m^2/km)
Good	10
Fair	50
Poor	200
Very bad	500

(10) Earth Drain

The quantity of the earth drain is calculated for following cases :

a. Earth drain required but none existing

b. Reconstruction of earth drain because of widening of road bed.

(11) Drain in Swamp

In the case of a flooded road link the existing road surface should be elevated. Since the existing embankment is widened, widening of the existing drains is necessary.

5.7.2 Bridge

The quantities of the superstructure of bridges to be constructed are calculated as follows :

Design bridge width x Required bridge length of the inventory

The quantities of the substructures are estimated counting the number of abutments and piers based on the number of design bridge spans.

In the case of re-construction of bridges, the quantities for the demolition of existing bridges are estimated as areas of existing bridges surface.

5.7.3 Other Structures

(1) Culvert

The lengths of culverts to be improved are stored in the inventory and are used for the estimation.

(2) Inlet and Outlet

Since there is no datum of the number of culverts to be improved in the inventory, the number of inlets and outlets of culverts is estimated based on the assumption that the standard culvert is 8 m long.

The volume of the inlet and outlet is as follows :

Culvert Type	Inlet + Outlet (m^3)
Pipe	3.2
Stone masonry	1.2

(3) Retaining Wall

The quantities of the required retaining walls are stored in the inventory and are used for the estimation.

(4) Gabion Protection

The quantities stored in the inventory are used.

Chapter 6 CONSTRUCTION AND MAINTENANCE COST ESTIMATIONS

Chapter 6 CONSTRUCTION AND MAINTENANCE COST ESTIMATIONS

6.1 Standard for Estimation of Construction Cost

6.1.1 General

With regard to the unit prices of materials and labor, the data were collected from each Kabupaten through Bina Marga as already mentioned in sub-clause 4.1.3. The collected data were compared with those of Jakarta using BAHAN BANGUNAN DKI-JAKARTA MAY & JUNE 1985 compiled by PUSAT INFORMASI TEKNIK PEMBANGUNAN, and then finalized. The finalized data were used for the estimation of the construction and maintenance costs and also for the economic evaluation assuming the following conditions.

6.1.2 Conditions

Conditions assumed in the estimations were as follows :

(1) Costs are shown in Rupiah (RP).

(2) US $ 1.00 is equivalent to Rp. 1,110.

(3) Unit prices of Equipment, material and labour are values at July 1985.

(4) Inflation factor is ignored in the economic evaluation.

(5) Foreign currency components are :

a. Costs of imported construction equipment, spare parts, equipment for workshop, laboratory testing and survey (CIF price) ;
b. Costs of materials for asphalts, cements, reinforcing steel and paints;
c. A portion of the consulting service; and
d. A portion of the contingency.

(6) Local currency components are :

a. Materials cost except for foreign components;
b. Labour cost ;
c. Transportation cost;
d. Ownership cost for existing equipment;
e. A portion of cost of spare parts and repair for equipment;
f. A portion of the contingency; and
g. A portion of the consulting service.

6.2 Unit Price

6.2.1 Unit Price of Labour

Table 6-2-1 shows the average unit price of labour in each province for Kabupatens concerned with the Study.

Table 6-2-1 UNIT LABOUR PRICE

Wage per Day

PROVINCE	NO OF KABS.	MANDOR	SKILLED LABOUR	CARPENTER	MASON	LABOUR	DRIVER	OPERATOR
RIAU	3	3,800	3,185	4,135	4,135	2,667	3,935	5,000
SUMATERA SELATAN	4	2,813	2,250	3,838	3,525	2,025	3,250	3,625
LAMPUNG	1	1,750	1,750	2,250	2,250	1,500	1,600	1,500
KALIMANTAN TENGAH	4	2,925	2,713	2,625	2,750	2,038	2,875	4,263
KALIMANTAN TIMUR	4	2,875	2,250	2,875	2,875	1,750	2,875	4,125
KALIMANTAN SELATAN	9	2,333	2,078	2,556	2,444	1,667	2,417	3,039
NUSA TENGGARA TIMUR	3	2,000	1,300	1,917	1,917	1,233	2,333	2,750
SULAWESI UTARA	1	3,500	2,500	4,500	4,500	2,750	4,000	5,000
SULAWESI SELATAN	7	2,464	2,171	3,000	3,000	1,671	3,179	4,393
SULAWESI TENGGARA	2	2,900	2,625	3,250	3,250	1,975	2,500	3,250

6.2.2 Unit Price of Materials

The unit price of materials was reconsidered based on the price in IJ-KAB Table 6-2-2 shows the average unit price of materials in each province for Kabupatens concerned with the Study.

Table 6-2-2 UNIT PRICE OF MATERIALS

MATERIAL	UNIT	RIAU (3)	SUMATERA SELATAN (4)	LAMPUNG (1)	KALIMANTAN TENGAH (4)	KALIMANTAN TIMUR (4)	KALIMANTAN SELATAN (9)	NUSA TENGGARA TIMUR (3)	SULAWESI UTARA (1)	SULAWESI SELATAN (7)	SULAWESI TENGGARA (2)
Bitumen	L	500	330	300	600	375	320	433	350	295	350
Asphalt	L	1,500	700	800	800	600	725	1,500	800	1,000	825
Gasoline	L	250	250	250	250	250	250	267	250	250	250
Sand	M^3	3,667	5,625	5,000	8,000	6,500	6,833	7,333	3,500	5,250	5,750
Cement	bag	5,100	4,200	4,000	5,000	5,000	4,795	5,833	4,000	4,070	4,875
River Stone	M^3	30,000	11,625	7,500	18,750	13,875	9,250	6,000	5,000	5,393	4,250
Steel moulds	Set	8,000	7,000	7,000	8,500	8,000	8,000	8,500	8,000	7,143	8,500
Timber	M^3	125,000	128,750	120,000	73,750	125,000	83,000	200,000	170,000	184,285	117,500
Point	L	2,333	3,125	2,500	2,750	2,250	2,705	2,750	1,500	2,820	3,000
Reinforcing Steel	Kg	817	875	1,000	1,000	950	917	1,350	900	828	775
Tying Wire	Kg	1,133	1,225	7,500	1,500	1,125	1,167	1,667	1,100	1,357	1,200

The price of stone varies greatly between the Kabupatens. There is a tendency that the price is considerably higher in Kabupatens not producing stone than in the other Kabupatens. This can be explained because the price in the non-producing Kabupaten includes the shipping cost from the producing Kabupaten.

Sand is produced in most of the Kabupatens so that the price is relatively constant.

Accordingly in Kabupatens which do not produce stone cement stabilization method is recommended for sub-base and base courses.

6.2.3 Hourly Equipment Cost

The calculation method was simplified before adoption since the operator's wage is considered in the labour cost and is not included in the equipment cost.

The hourly equipment cost is estimated using the following formulae and the results of the estimation for each type of equipment are shown in Table 6-2-3 (1) and Table 6-2-3 (2).

Hourly Equipment Cost = Ownership Cost + Operation Cost + Indirect Cost

$$\text{Ownership Cost} = \frac{\text{Net Depreciation Value}}{\text{Economic Life in Hours}}$$

Net Depreciation Value = Delivery Price - Salvage Value

Economic Life in Hours = Annual Use Hours x Depreciation Period

Operation Cost = Fuel Cost + Lubrication Cost + Repair & Spare Parts Cost

Fuel Cost = A x B x C

Where :

A : Hourly fuel consumption per Engine HP (ltr/HP)

B : Engine HP

C : Unit Price (for each Kabupaten)

Lubrication Cost = D x B x C

Where :

D : Hourly lub. consumption per Engine HP (ltr/HP)

Repair & Spare parts Cost = f1 x Ownership Cost

Where :

f1 : Repair Factor

Indirect Cost = f2 x (Ownership Cost + Operation Cost)

Where :

f2 : Indirect Cost Factor.

A detailed explanation of the formulae is as follows :

Table 6-2-3 (1) HOURLY EQUIPMENT COSTS

(Rp 10^3)

EQUIPMENT	CLASS	RIAU			SUMATERA SELATAN			LAMPUNG			KALIMANTAN TENGAH			KALIMANTAN TIMUR		
		L.C	F.C	TOTAL	L.C	F.C	TOTAL	L.C	F.C	TOTAL	L.C	F.C	TOTAL	L.C	F.C	TOTAL
Bulldozer	120 HP	16,842	8,788	25,630	12,843	8,783	21,626	12,480	8,773	21,253	14,155	8,798	22,953	16,847	8,798	25,645
Bulldozer/Ripper	120 HP	17,865	10,067	27,932	13,858	10,060	23,918	13,478	10,045	23,523	15,196	10,082	25,278	17,888	10,082	27,970
Swamp Bulldozer	120 HP	18,116	10,518	28,634	14,105	10,509	24,614	13,720	10,493	24,213	15,453	10,533	25,986	18,145	10,533	28,678
Bulldozer	90 HP	11,561	5,558	17,119	8,690	5,555	14,245	8,497	5,549	14,046	9,581	5,564	15,145	11,574	5,564	17,138
Bulldozer/Ripper	90 HP	12,159	6,276	18,435	9,281	6,273	15,554	9,079	6,263	15,342	10,186	6,286	16,472	12,179	6,286	18,465
Bulldozer	65 HP	8,417	3,957	12,374	6,312	3,956	10,268	6,171	3,952	10,123	6,962	3,962	10,924	8,423	3,962	12,385
Bulldozer/Ripper	65 HP	8,872	4,523	13,395	6,763	4,520	11,283	6,615	4,513	11,128	7,425	4,530	11,955	8,886	4,530	13,416
Swamp Bulldozer	90 HP	12,150	6,258	18,408	9,271	6,254	15,525	9,069	6,244	15,313	10,175	6,268	16,443	12,168	6,268	18,436
Swamp Bulldozer	65 HP	8,603	4,796	13,399	6,664	4,793	11,457	6,483	4,785	11,268	7,310	4,803	12,113	8,613	4,803	13,416
Motor Grader	110 HP	14,382	8,196	22,578	11,125	8,189	19,314	10,871	8,176	19,047	12,177	8,208	20,385	14,418	8,208	22,626
Motor Grader	75 HP	9,847	5,660	15,507	7,625	5,656	13,281	7,451	5,647	13,098	8,345	5,669	14,014	9,872	5,669	15,541
Motor Grader	65 HP	8,638	5,092	13,730	6,711	5,089	11,800	6,557	5,081	11,638	7,338	5,100	12,438	8,662	5,100	13,762
Road Stabilizer	W=1850 mm	3,580	9,016	12,596	3,520	9,014	12,534	3,402	9,010	12,412	3,699	9,020	12,719	3,699	9,020	12,719
Vibratory Roller	4 ton	4,382	3,279	7,661	3,352	3,278	6,630	3,269	3,274	6,543	3,690	3,283	6,973	4,400	3,283	7,683
Hand-guide Vib. Roller	1000 Kg	801	878	1,679	627	878	1,504	583	876	1,459	718	878	1,596	831	878	1,709
Tire Roller	8-15 ton	10,297	3,207	13,504	7,364	3,207	10,571	7,192	3,206	10,398	8,234	3,208	11,442	10,271	3,208	13,479
Vibratory Roller (D&T)	4 ton	4,382	3,279	7,661	3,352	3,278	6,630	3,269	3,274	6,543	3,690	3,283	6,973	4,400	3,283	7,683
Hand-guide Vib. Roller	600 Kg	546	620	1,166	428	620	1,048	398	619	1,017	491	620	1,111	566	620	1,186
Rough Terrain Crane	10 ton	16,869	10,780	27,649	13,010	10,776	23,786	12,693	10,769	23,462	14,279	10,787	25,066	16,927	10,787	27,714
Hydraulic Excavator; Wheel	0.3 m3	10,456	4,647	15,103	7,805	4,645	12,450	7,625	4,640	12,265	8,623	4,653	13,276	10,456	4,653	15,109
Wheel Loader	1.2 m3	10,660	7,939	18,599	8,479	7,935	16,414	8,276	7,926	16,202	9,230	7,948	17,178	10,717	7,948	18,665
Wheel Loader	0.3 m3	3,766	2,566	6,332	2,957	2,565	5,522	2,886	2,562	5,448	3,228	2,569	5,797	3,783	2,569	6,352
Water Tank Truck	4000 ltr.	4,030	985	5,015	2,839	985	3,824	2,747	980	3,727	3,217	988	4,205	4,038	988	5,026
Fuel Tank Truck	4000 ltr.	4,036	1,001	5,037	2,846	1,000	3,846	2,753	996	3,749	3,224	1,004	4,228	4,046	1,004	5,050
Dump Truck	3.0 ton	4,874	1,668	6,542	3,563	1,666	5,228	3,432	1,659	5,091	4,014	1,673	5,687	4,911	1,673	6,584
Flat Bed Truck with Crane	3.0 ton	4,271	1,843	6,114	3,084	1,842	4,926	3,009	1,840	4,849	3,445	1,843	5,288	4,267	1,843	6,110
Dump Loader Truck	12 ton	27,394	3,963	31,357	18,831	3,963	22,794	18,403	3,962	22,365	21,263	3,964	25,227	27,238	3,964	31,202
Dump Truck	5.0 ton	8,103	2,485	10,588	5,877	2,482	8,359	5,669	2,473	8,142	6,625	2,494	9,119	8,152	2,494	10,646
Flat Bed Truck	3.0 ton	3,819	603	4,422	2,640	604	3,244	2,580	603	3,183	2,976	604	3,580	3,798	604	4,402
Portable Crusher/Screening	30-40 t/h	28,334	21,266	49,600	21,795	21,254	43,049	21,139	21,230	42,369	24,036	21,290	45,326	28,413	21,290	49,703
Concrete Mixer	0.5 m3	2,825	5,812	8,637	2,588	5,807	8,395	2,341	5,794	8,135	2,941	5,823	8,764	3,040	5,823	8,863
Water Pump	200 l/min	367	194	561	267	194	461	253	194	447	307	194	501	373	194	567
Concrete Vibrator	3.3 HP	324	75	399	228	75	303	219	75	294	260	75	335	326	75	401
Asphalt Sprayer	850 ltr.	959	1,157	2,116	796	1,155	1,951	741	1,151	1,892	898	1,161	2,059	997	1,161	2,158

Note : L.C : Local Currency

F.C : Foreign Currency

Table 6-2-3 (2)

HOURLY EQUIPMENT COSTS

(Rp 10^3)

EQUIPMENT	CLASS	KALIMANTAN SELATAN			NUSA TENGGARA TIMUR			SULAWESI UTARA			SULAWESI SELATAN			SULAWESI TENGGARA		
		L.C	F.C	TOTAL	L.C	F.C	TOTAL	L.C	F.C	TOTAL	L.C	F.C	TOTAL	L.C	F.C	TOTAL
Bulldozer	120 HP	14,258	8,793	23,051	13,533	8,806	22,340	14,317	8,808	23,125	13,483	8,803	22,286	13,125	8,817	21,942
Bulldozer/Ripper	120 HP	15,290	10,075	25,365	14,589	10,096	24,685	15,376	10,097	25,473	14,533	10,091	24,624	14,200	10,112	24,312
Swamp Bulldozer	120 HP	15,544	10,525	26,069	14,851	10,547	25,398	15,638	10,549	26,187	14,793	10,541	25,334	14,470	10,565	25,035
Bulldozer	90 HP	9,694	5,561	15,255	9,166	5,570	14,736	9,753	5,571	15,324	9,142	5,568	14,710	8,889	5,577	14,466
Bulldozer/Ripper	90 HP	10,295	6,282	16,577	9,781	6,295	16,076	10,369	6,295	16,664	9,753	6,292	16,045	9,514	6,305	15,819
Bulldozer	65 HP	7,046	3,961	11,007	6,658	3,967	10,625	7,087	3,966	11,053	6,641	3,965	10,606	6,451	3,971	10,422
Bulldozer/Ripper	65 HP	7,505	4,527	12,032	7,127	4,536	11,663	7,556	4,537	12,093	7,107	4,533	11,640	6,931	4,544	11,475
Swamp Bulldozer	90 HP	10,285	6,263	16,548	9,771	6,276	16,047	10,358	6,277	16,635	9,743	6,273	16,016	9,503	6,287	15,790
Swamp Bulldozer	65 HP	7,356	4,799	12,155	7,016	4,810	11,826	7,397	4,810	12,207	6,989	4,808	11,797	6,827	4,817	11,644
Motor Grader	110 HP	12,286	8,201	20,487	11,724	8,218	19,942	12,385	8,220	20,605	11,685	8,214	19,899	11,434	8,233	19,667
Motor Grader	75 HP	8,418	5,664	14,082	8,036	5,676	13,712	8,487	5,677	14,164	8,011	5,673	13,684	7,840	5,686	13,526
Motor Grader	65 HP	7,400	5,097	12,497	7,073	5,107	12,180	7,464	5,107	12,571	7,050	5,104	12,154	6,906	5,115	12,021
Road Stabilizer	W=1850 mm	3,639	9,018	12,657	3,798	9,024	12,821	3,817	9,025	12,842	3,758	9,022	12,780	3,936	9,029	12,965
Vibratory Roller	4 ton	3,723	3,282	7,005	3,555	3,286	6,841	3,766	3,286	7,052	3,542	3,285	6,827	3,471	3,290	6,761
Hand-guide Vib. Roller	1000 Kg	715	879	1,594	723	879	1,602	750	879	1,629	723	880	1,603	735	880	1,615
Tire Roller	8-15 ton	8,363	3,208	11,571	7,773	3,209	10,983	8,365	3,209	11,574	7,758	3,209	10,967	7,442	3,210	10,652
Vibratory Roller (D&T)	4 ton	3,723	3,282	7,005	3,555	3,286	6,841	3,766	3,286	7,052	3,542	3,285	6,827	3,471	3,290	6,761
Hand-guide Vib. Roller	600 Kg	489	620	1,109	496	621	1,117	514	621	1,135	496	621	1,117	505	622	1,127
Rough Terrain Crane	10 ton	14,399	10,783	25,182	13,757	10,793	24,550	14,541	10,794	25,335	13,707	10,790	24,497	13,436	10,801	24,237
Hydraulic Excavator; Wheel	0.3 m3	8,727	4,650	13,377	8,230	4,657	12,887	8,765	4,658	13,423	8,208	4,655	12,863	7,961	4,663	12,624
Wheel Loader	1.2 m3	9,284	7,944	17,228	8,957	7,956	16,913	9,402	7,957	17,359	8,920	7,953	16,873	8,806	7,966	16,772
Wheel Loader	0.3 m3	3,252	2,568	5,820	3,122	2,572	5,694	3,287	2,572	5,859	3,110	2,571	5,681	3,059	2,575	5,634
Water Tank Truck	4000 ltr.	3,264	988	4,252	3,052	992	4,044	3,282	992	4,274	3,052	992	4,044	2,935	995	3,930
Fuel Tank Truck	4000 ltr.	3,272	1,003	4,275	3,061	1,008	4,069	3,290	1,007	4,297	3,060	1,008	4,068	2,944	1,011	3,955
Dump Truck	3.0 ton	4,057	1,671	5,728	3,864	1,679	5,543	4,110	1,678	5,788	3,864	1,679	5,543	3,764	1,685	5,449
Flat Bed Truck with Crane	3.0 ton	3,492	1,844	5,336	3,262	1,845	5,107	3,503	1,845	5,348	3,254	1,845	5,099	3,136	1,846	4,982
Dump Loader Truck	12 ton	21,678	3,963	25,641	19,847	3,965	23,812	21,568	3,966	25,534	19,829	3,965	23,794	18,784	3,966	22,750
Dump Truck	5.0 ton	6,704	2,491	9,195	6,353	2,503	8,855	6,773	2,501	9,274	6,353	2,502	8,855	6,169	2,511	8,680
Flat Bed Truck	3.0 ton	3,033	604	3,637	2,781	605	3,386	3,019	605	3,624	2,778	605	3,383	2,636	605	3,241
Portable Crusher/Screening	30-40 t/h	24,165	21,278	45,443	23,081	21,310	44,391	24,367	21,314	45,681	22,976	21,302	44,278	22,497	21,338	43,835
Concrete Mixer	0.5 m3	2,874	5,819	8,693	3,135	5,835	8,970	3,126	5,833	8,959	3,135	5,835	8,970	3,334	5,847	9,181
Water Pump	200 l/min	307	194	501	295	194	489	314	194	508	295	194	489	290	194	484
Concrete Vibrator	3.3 HP	261	75	336	245	75	320	263	75	338	244	75	319	236	75	311
Asphalt Sprayer	850 ltr.	890	1,159	2,049	915	1,164	2,079	935	1,164	2,099	915	1,164	2,079	937	1,170	2,107

Note : L.C : Local Currency
F.C : Foreign Currency

(1) Foreign and Local Currency Components of Hourly Equipment Cost

The hourly equipment cost estimated using the above formulae is divided into foreign and local currencies using the following formulae.

Local Currency = Transportation Cost + Fuel Cost + Lubrication Cost + 0.2 x Spare Parts Cost + Repair Cost + Indirect Cost.

Foreign Currency = (Ownership Cost - Transportation Cost) + 0.8 x Spare Parts Cost.

(2) Adjustment of Equipment Price

As the Project Area is far from the major ports such as Jakarta, Surabaya, Medan, etc., the proportion of the transportation cost in the CIF will become large. To adjust the equipment price, the delivery price to each Kabupaten is estimated using the following formula :

Delivery Price = CIF Jakarta x Delivery Price Ratio

While the delivery price ratios were considered basically for each province, the ratio for isolated Kabupatens far from the main island was modified taking account the transportation cost. Also since the proportion of the transportation cost in the CIF price is highly variable with the size and weight of the equipment, such an allowance was considered.

The delivery price ratio is as follows:

Province (Kabupaten)	Small Equipment	Large Equipment
1. RIAU	1.060	1.025
2. SUMATERA SELATAN		
i) MUSI RAWAS	1.040	1.020
ii) MUSI BANYUASIN	1.040	1.020
iii) BANGKA	1.055	1.020
iv) BELITUNG	1.055	1.020

Continued

3.	LAMPUNG	1.015	1.010
4.	KALIMANTAN TENGAH	1.090	1.035
5.	KALIMANTAN TIMUR	1.090	1.035
6.	KALIMANTAN SELATAN	1.080	1.030
7.	NUSA TENGGARA TIMUR		
	i) SUMBA BARAT	1.140	1.050
	ii) ENDE	1.110	1.040
	iii) NGADA	1.110	1.040
8.	SULAWESI UTARA	1.115	1.045
9.	SULAWESI SELATAN	1.120	1.040
10.	SULAWESI TENGGARA	1.150	1.055

Note : Small equipment includes ;

- Hand-Guided Vibratory Roller 1000 kg;
- Water Tank Truck 4,000 Ltr;
- Service Car 3.0 Ton;
- Dump Truck 3.0 Ton;
- Flat Bed Truck 3.0 Ton;
- Flat Bed Truck/2 Ton Crane 3.0 Ton;
- Asphalt Sprayer 850 Ltr;
- Water Pump 200 Ltr/Min;
- Concrete Vibrator 3.3 HP; and
- Concrete Mixer 0.5 m^3

(3) Local Procurement

Fuel and lubricating oil for the equipment are available in the Project Area. The prices are different for each Kabupaten. Use of the IJ-KAB data was adopted for the Project.

(4) Cost of Spare Parts and Repair

It is necessary to obtain and deliver spare parts which will be used in normal operation of the equipment for 3 to 5 years. The cost of repairing and procurement of the spare parts can be obtained by formulation of a ratio of the delivery price of the equipment. The ratio was decided taking into consideration the importance, work volume and frequency of use of each type of equipment. Guide lines for selection of the ratio are as follows:

- Heavy duty work equipment	50 %	(45 %)
- Medium duty work equipment	40 %	(40 %)
- Medium light work equipment	30 %	(30 %)
- Light duty work equipment	20 %	(20 %)

In the above, the values in parentheses show the ratio for the selection of spare parts only.

The ratio for each equipment type was decided as follows:

EQUIPMENT	RATIO (%)
Bulldozer	40
Bulldozer/Ripper	50
Swamp Bulldozer	50
Motor Grader	50
Road Stabilizer	30
Vibratory Roller	40
Vibratory Roller (D&T)	40
Hand-Guided Vib. Roller	20
Tire Roller	20
Rough Terrain Crane	30
Hydraulic Excavator	40
Wheel Loader	40
Water Tank Truck	40
Dump Truck	40
Flat Bed Truck with Crane	30
Flat Bed Truck	30
Equipment Transporter (Dump loader type	20
Portable Crusher/Screening	40
Concrete Mixer	30
Water Pump	20
Concrete Vibrator	20
Asphalt sprayer (Hand Type)	40