CHAPTER 5

FUTURE SOCIO-ECONOMIC FRAMEWORK

CHAPTER 5

FUTURE SOCIO-ECONOMIC FRAMEWORK

5.1 Methodology

The socio-economic framework was established by envisaging the future features of the Study Area, the results of which were used as vital input data for future traffic demand forecast.

The National and Regional levels of the framework were firstly established, which were broken down to Provincial and Municipal levels, then finally to the traffic zone level.

5.1.1 Future population frame

Population projection made by the Technical Advisory Group and NSO Population Projections Unit (NSO Population Projection) is the authorized one in the country and was adopted by the Study. NSO Population Projection was made based on the 1995 Census and National and Regional population was projected.

Utilizing Regional population as a control total, provincial population was projected based on the past population growth rate of respective province. The same procedure was adopted to estimate municipal and traffic zone population.

5.1.2 Estimation of the Future Employed Population

Availability of employment population statistics is limited. The employed population was estimated as follows:

- Data 1. The labor characteristic values for the region were established base on NEDA's labor force statistical data percent of the labor force, labor force employment rate, agricultural share of employment for each region).
- Data 2. The proportion of agricultural and urban population for the municipality was determined based on the 1980 Census data. By adapting this proportion to the 1995-based municipality population, future agricultural and urban populations were calculated.
- Data 3. Population composition by age in the future was estimated based on the 1995-based population statistics.
- Data 4. 1995-based population 15 years old and over for the province, based on the 1995 Census.
- From a comparison of Data 3 and 4, the share of projected population 15 years old and over was calculated to estimate future

labor force in the Provinces.

- Total employment was estimated by adopting the value set in above, and the percent in the labor force and percent of labor force employment rate of the region was broken down to the provincial and municipal level.
- For the agricultural employment rate in the agricultural population, the provincial data in 1998 is available. Agricultural employment in the province was calculated using this data.
- Employment was classified into agricultural and non-agriculture employment.

5.1.3 GRDP

GRDP of Region III

The GRDP achievements of the Region were divided into agricultural and other sectors, and the productivity per agricultural and other employees was calculated. Using the productivity trends contained in the past data (1988 - 1997), the future GRDP was estimated. For the low assumption, values approximately equal to past productivity trends were used. For the medium assumption, the value approximately equal to the lower growth scenario of the medium-term Philippine National Development Plan was used.

Breakdown of GRDP of Region III into Province

Gross income earnings can be calculated from the number of families and average income in the province in 1994 (NSCB PROVINCES data). Assuming that GRDP and gross income are in a linear relationship, GRDP of Region III was divided by the gross income ratio of each province. The resultant value was used as GRDP for the province.

Breakdown of GRDP of Province into Municipality

Productivity per capita employed was estimated using the productivity rates of ordinary and agricultural employees, provincial employment figure, and provincial GRDP. Municipality GRDP was estimated based on productivity per capita employed and employment.

Breakdown of Municipality GRDP into cluster zones of barangay

The GRDP of the small cluster zones was calculated by multiply the municipality GRDP by the ratio of the cluster zone population to the total population of the municipality.

5.2 Philippine Development Plan

Plan 21 (The Philippine National Development Plan - Direction for the 21st Century) was established by the Ramos Administration as a long-term plan. It was made public in 1998. This plan assumes high economic growth rate up to 2025. Economic indices of the plan are shown in Table 5.2-1.

TABLE 5.2-1 MAIN SOCIO-ECONOMIC INDEX PLAN 21

Index	1999	2004	1999-2004	2005-2025
GRDP growth rate (%)	5.0-6.0	5.0-6.0	4.9-6.1	8.0-10.0
GDP growth rate (%)	4.5-5.5	4.5-5.5	5.5-6.5	8.0-10.0
Per capita GNP ($US)	981-1,051	1,356-1,520	1,356-1,520	8,416-13,970
Per capita GDP ($US)	928-995	1,252-1,405	1,253-1,405	7,833-12,912
Inflation (%)	6.0-7.0	4.0	5.2	3.0
Growth rate by Industry (%)				
Primary	2.0-3.0	3.0-4.5	2.8-7.1	
Secondary & Tertiary	5.1-6.0	6.9-7.7	6.1-7.1	
Unemployment ratio (%)	8.71-9.5	4.95-6.64	6.92-8.29	
Employment (thousand)	979-1,075	1,392-1,443	1,198-1,278	

Source: NEDA The Philippine National Development Plan for the 21st century

The long-term concept sets forth a policy of developing the entire Manila Metropolitan Area and CALABARZON (Region IV), including the area covered by this Study, as a Metropolitan Manila Growth Network.

The road improvement policy proposes five tasks to ensure positive road improvements. These will be the improvement policy for the future.

- For the national road of 26,700 km, 20,000 km of important routes are selected for upgrade to all-weather roads. A remaining 6,700 km will be transferred to the management of local authorities.

- Construction of expressways using private investment will be promoted.

- The beneficiary-payment principle will be applied to road users. To promote this principle application, an Autonomous Highway Management Authority, Better Road Fund will be established.

- The general hierarchy for investment in national roads will be: (1) maintenance of the existing assets, (2) rehabilitation of sections in bad condition, (3) improvement and widening, and (4) construction of new roads with developmental roads receiving priority over missing links in the road network.

- The road improvement indices of long-term highway development plan (1999-2025) in DPWH are shown in Table 5.2-3. According to this plan, a total of 161,000 km of national, provincial, city, municipal existing road will be improved to all weather road with concrete pavement. In addition, 140,000 km of Barangay roads will be newly built. On the other hand, all of roads other than Barangay roads will be paved to turn them into all-weather roads. The average pavement ratio including the Barangaiy roads will be increased from 19% to 53%, and the ratio of all-weather roads will be increased from 61% to 85%.

- Also in the long-term higway development plan, construction of 814km expressways including 111 km expressways in Central Luzon is proposed. Moreover, 900 km expressways are proposed as candidate projects for BOT. The candidate expressway in the BOT project in Central Luzon includes 418 km of the North Luzon Expressway (NLE) extension plan and 82 km of NLE rehabilitation/improvement.

TABLE 5.2-2 EXISTING ROAD (1997)

Road Classification	Pavement					% paved	% All-whether
	Concrete	Asphalt	Gravel	Earth	Total		
National	10,004	6,918	10,198	249	27,369	62	80
- Arterial	6,171	4,998	4,691	155	16,015	70	90
- Secondary	3,833	1,920	5,507	94	11,354	51	70
Provincial	803	2,553	20,383	5,024	28,763	12	56
City	658	2,000	1,143	148	3,949	67	96
Municipal	1,820	1,503	6,417	3,080	12,820	26	78
Barangay	2,856	676	67,865	16,966	88,363	4	52
Total	16,141	13,650	106,006	25,467	161,264	19	61

Source: DPWH Long-term highway development plan 1999-2025

TABLE 5.2-3 ROAD IMPROVEMENT PLAN (To be end of 2025)

Road Classification	Pavement					% paved	% All-whether
	Concrete	Asphalt	Gravel	Earth	Total		
National	27,369				27,369	100	100
- Arterial	16,015				16,015	100	100
- Secondary	11,354				11,354	100	100
Provincial	13,506	15,257			28,763	100	100
City	3,949				3,949	100	100
Municipal	12,820				12,820	100	100
Barangay	45,270	42,376	94,951	44,766	227,363	39	80
Total	130,283	57,633	94,951	44,766	327,633	53	85

Source: DPWH Long-term highway development plan 1999-2025

5.3 DEMOGRAPHIC FRAMEWORK

5.3.1 Population Projection

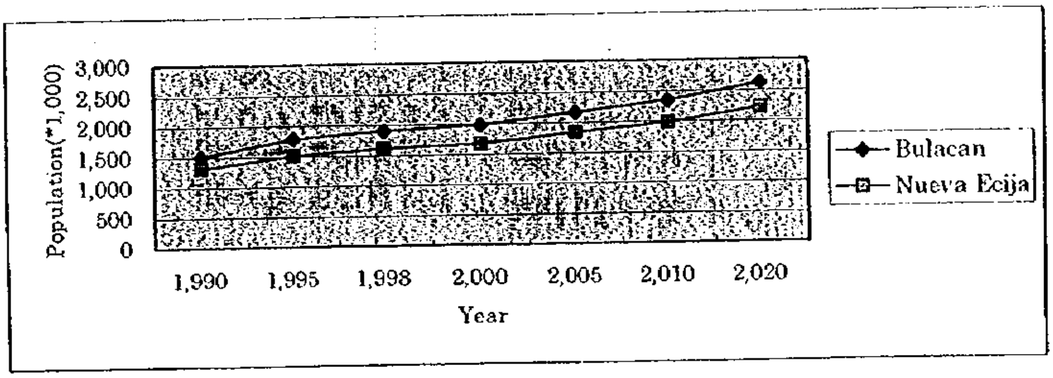
The 1995-based national and regional population projection was approved by the Government in 1997 as the official figures to be used for planning and programming purposes.

Table 5.3-1 and Figure 5.3-1 show the future population projection of the Study Area provinces. The Region III population will increase by 1.47 times from 6.9 million in 1995 to 10.2 million in 2020. Generally, the population growth rates will decrease as time goes on in future. The growth rates of Region III were projected to be less than the national average.

TABLE 5.3-1 FUTURE POPULATION PROJECTION ('000)

	1,990	1,995	1,998	2,000	2,005	2,010	2,020
Philippines	60,703	68,617	73,131	76,320	84,215	91,851	105,503
Annual Growth Rate (%)		2.48	2.15	2.33	1.99	1.75	1.40
Central Luzon (Region III)	6,199	6,933	7,375	7,687	8,427	9,101	10,194
Annual Growth Rate (%)		2.26	2.08	2.16	1.88	1.60	1.14
Bulacan Province	1,505	1,784	1.892	1,975	2,166	2,340	2,620
Nueva Ecija Province	1,313	1,506	1,605	1,673	1,834	1,981	2,219

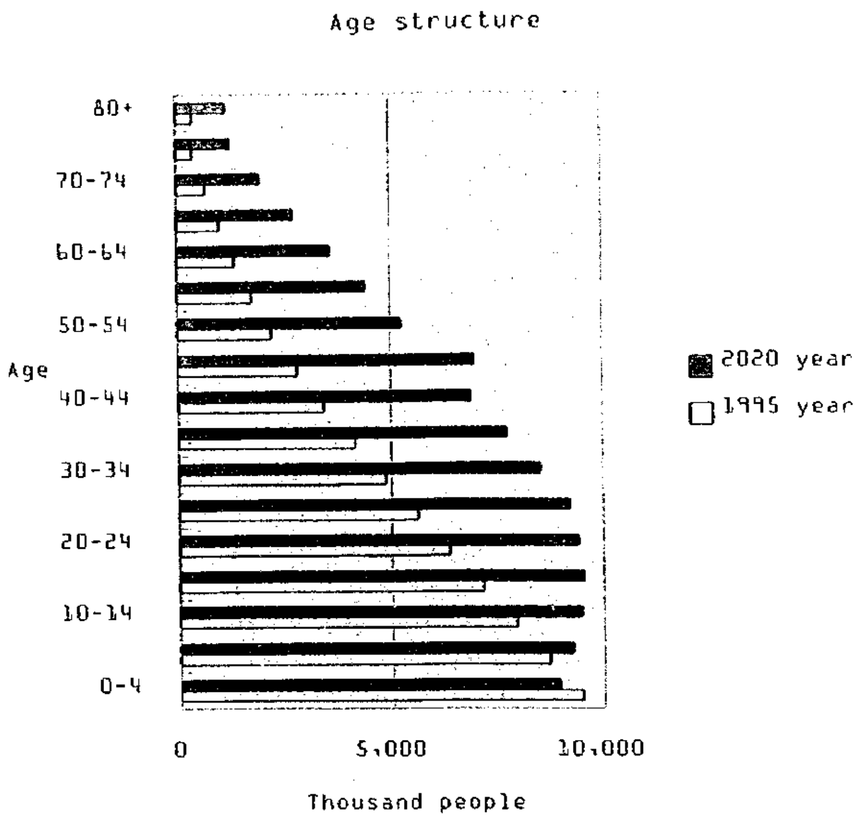
Source : NSO



Source: NSO

FIGURE 5.3-1 POPULATION PROJECTION OF STUDY AREA PROVINCE

Figure 5.3-2 illustrates the age structure of 1995 and 2020 populations in the Philippines based on1995 NSO estimation. Because of the declining trend of fatality rate and birthrate, the age structure pattern is expected to be changed significantly from a pyramid pattern to a vase-pattern. By this, the dependent population rate to productive age (15-64) population is estimated to decrease from 48% in 1995 to 26% in 2020 which will affect the labor force rate.



Source: NSO

FIGURE 5.3-2 AGE STRUCTURE IN THE PHILIPPINES

TABLE 5.3-2 PRODUCTIVE AGE RATE

Year	Philippine	Bulacan	Nueva Ecija	Pampanga
1,995	0.617	0.622	0.634	0.638
2,000	0.638	0.646	0.654	0.658
2,005	0.662	0.670	0.678	0.682
2,010	0.689	0.697	0.705	0.709
2,015	0.714	0.722	0.730	0.734
2,020	0.738	0.746	0.750	0.758

Source; Based on NSO data

5.3.2 Employment

Employment for the Study Area has been projected based on the population projection by estimating productive age population rate, labor force rate and employment rate. Based on the past trends, assumptions of employment in the provinces are made as follows.

(1) Productive age (Table 5.3-2): This is expected to increase by 2.6% annually due to decrease in fatality rate and the entry of the youthful population into the workforce.

(2) Labor force rate (Table 5.3-3): This is estimated to remain constant at around 60% through to the year 2020.

(3) Employment rate : This is estimated to remain constant according to the past value by province.

(4) Agricultural employment is estimated to decrease in proportion to a decrease of the rural population projection due to urbanization (Table 5.3-4).

TABLE 5.3-3 LABOR FORCE AND EMPLOYMENT RATE

	Philippines	Bulacan	Nueva Ecija	Pampanga
Labor force rate	0.59	0.61	0.56	0.59
Employment rate	0.90	0.95	0.96	0.90

Source: JICA Study Team set up based on NSO data

TABLE 5.3-4 FUTURE EMPLOYMENT Unit: Thousand

		2005	2010	2020
Region III	Agriculture	771	760	712
	Non- Agri	2,353	2,756	3,614
	Total	3134	3516	4326
Bulacan	Agriculture	101	88	61
	Non- Agri	717	828	1044
	Total	818	917	1,106
Nueva Ecija	Agriculture	274	280	276
	Non- Agri	389	465	612
	Total	664	746	888
Pampanga	Agriculture	66	55	35
	Non- Agri	651	751	929
	Total	717	806	964

Source: Based on NSO data

5.4 ECONOMIC FRAMEWORK

5.4.1 GRDP

During the period of the Study, the official future economic framework was not available. The Study Team made economic growth estimate based on the recently completed studies in the Philippines, past per capita productivity by agriculture and non-agriculture sectors, etc., and presented the three scenarios as follows:

TABLE 5.4-1 ECONOMIC GROWTH SCENARIOS

	Growth Rate Per Annum		
GDP / GRDP	Low	Medium	High
GDP	3.6%	4.6%	5.6%
GRDP , Region III	3.8%	5.3%	6.8%

The Technical Working Group and the Steering Committee agreed to adopt the medium assumption for this Study. GDP, GRDP of Region III, Bulacan and Nueva Ecija Provinces and major cities / municipalities were estimated as shown in Table 5.4-2.

TABLE 5.4-2 GDP AND GRDP

Unit: Billion Pesos at 1998 Prices

	GDP and GRDP				2020 / 1998
	1998	2005	2010	2020	
Philippines	2,737.9	3,750.9	4,696.8	7,364.0	2.69
Region III	230.5	330.9	428.4	718.0	3.11
Bulacan Province	26.1	36.0	46.6	81.0	3.10
Nueva Ecija Province	16.3	22.5	29.1	48.9	3.00
Plaridel	1.0	1.4	1.8	3.1	3.10
Baliuag	1.6	2.2	2.8	4.7	2.94
Gapan	0.9	1.3	1.6	2.7	3.00
Cabanatuan City	2.4	3.2	4.1	6.9	2.88
San Jose City	1.0	1.4	1.9	3.2	3.20

Table 5.4-3 shows future population and GRDP by municipality. Figure 5.4-1 graphically shows GRDP by municipality.

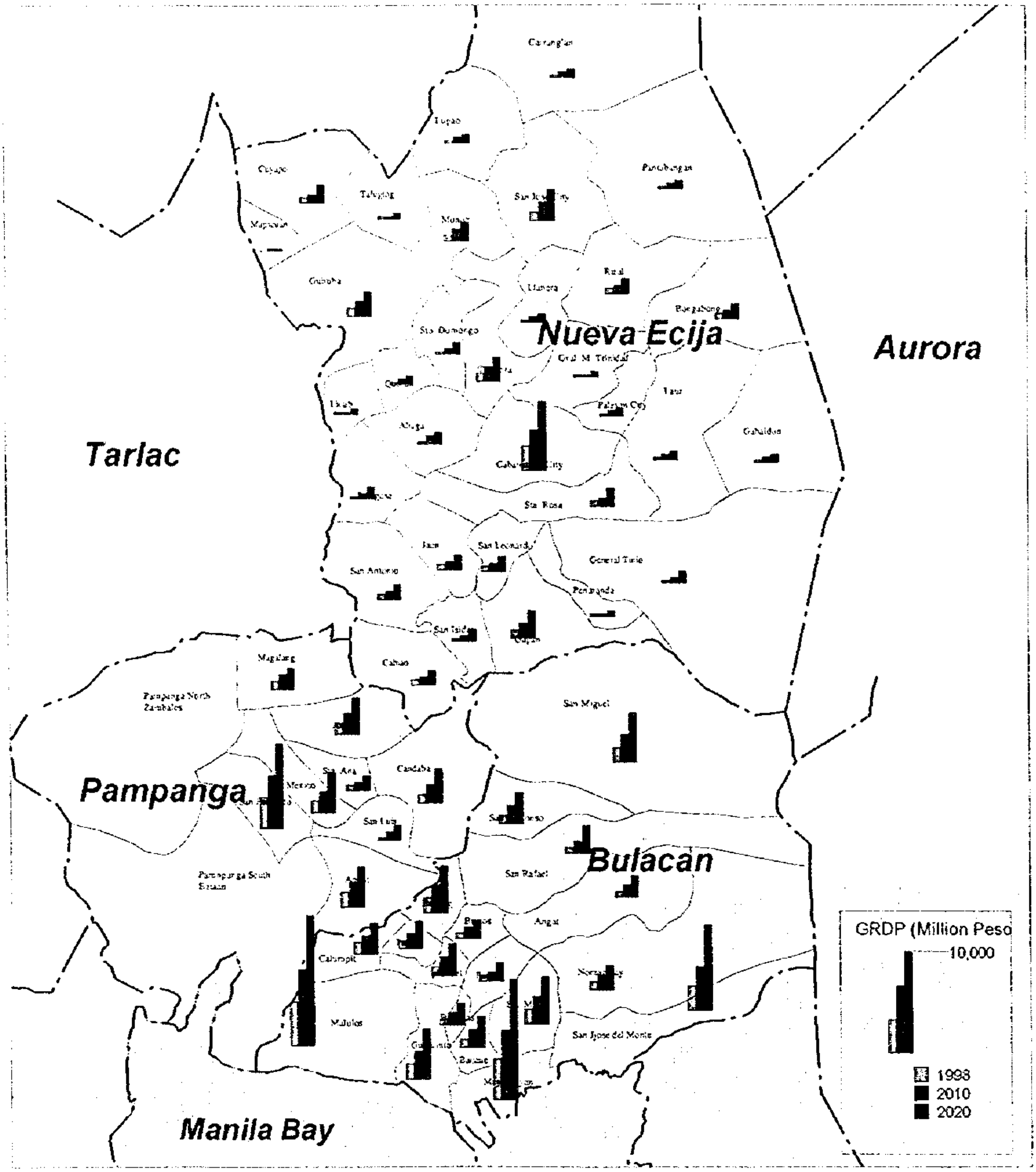
5.4.2 Car Ownership

The number of registered vehicles nationwide was 3.194 million units (2.242 million units when motorcycles are excluded) in 1997. The annual growth rate for the most recent ten-year period remains high at 9.6% (8.5% when motorcycles are excluded).

TABLE 5.4-3 FUTURE POPULATION AND GRDP BY MUNICIPALITY

ID	Municipality \ Year	GRDP (million pesos at 1998 price)					Population (person)				
		1998	2000	2005	2010	2020	1998	2000	2005	2010	2020
	Bulacan	26,057	27,790	35,982	46,646	81,039	1,892,233	1,974,840	2,165,968	2,339,511	2,620,259
1	Angat	738	781	995	1,275	2,190	53,498	55,779	61,162	66,062	73,989
2	Balagtas	773	815	1,035	1,323	2,261	52,504	54,720	59,996	64,801	72,577
3	Baliuag	1,618	1,706	2,167	2,770	4,732	109,920	114,540	125,578	135,636	151,912
4	Bocaue	1,088	1,143	1,450	1,854	3,167	73,914	76,733	84,054	90,781	101,674
5	Guiguinto	1,488	1,585	2,110	2,845	4,886	131,638	137,353	150,637	162,706	182,231
6	Bustos	590	645	873	1,116	1,906	44,219	46,130	50,590	54,643	61,200
7	Calumpit	1,115	1,178	1,497	1,913	3,269	44,219	46,130	50,590	54,643	61,200
8	Malolos *1	4,251	4,489	5,732	7,376	12,805	305,522	318,440	349,148	377,114	422,368
9	Meycauayan *2	4,034	4,253	5,400	6,904	11,795	163,403	170,232	186,628	201,575	225,764
10	Norzagaray	818	873	1,112	1,422	2,429	145,871	151,784	166,356	179,675	201,236
11	Pandi	573	626	850	1,087	1,857	55,580	58,623	64,460	69,638	77,996
12	Plaridel	962	1,054	1,407	1,799	3,073	71,092	74,331	81,559	88,097	98,669
13	Pulilan	942	996	1,266	1,619	2,766	64,003	66,892	73,389	79,271	88,784
14	San Ildefonso	846	912	1,278	1,821	3,186	73,971	77,116	84,557	91,330	102,289
15	San Jose Del Monte	2,375	2,567	3,407	4,523	8,438	217,703	228,835	251,409	271,587	304,181
16	San Miguel	1,601	1,756	2,279	2,913	4,977	115,440	120,438	132,082	142,664	159,784
17	San Rafael	691	743	1,008	1,383	2,681	62,207	64,879	71,147	76,846	86,068
18	Santa Maria	1,556	1,667	2,116	2,704	4,621	107,529	111,885	122,625	132,443	148,336
	Nueva Ecija	16,329	17,399	22,468	29,083	48,886	1,605,221	1,673,070	1,834,417	1,981,430	2,219,210
19	Aliaga	462	493	636	822	1,371	48,872	50,914	55,817	60,288	67,522
20	Bongabon	523	556	719	932	1,565	47,810	49,804	54,600	58,973	66,050
21	Cabanatuan City	2,363	2,510	3,170	4,100	6,865	213,192	222,248	238,355	257,030	287,844
22	Cabiao	549	587	757	978	1,628	59,671	62,187	68,182	73,643	82,480
23	Carranglan	308	329	425	550	919	31,960	33,312	36,525	39,451	44,185
24	Cuyapo	517	552	713	923	1,840	53,176	55,437	60,787	65,656	73,535
25	Gabaldon	277	295	382	496	832	27,478	28,671	31,444	33,964	38,040
26	Gapan	931	986	1,270	1,643	2,744	82,776	86,146	94,421	101,981	114,219
27	General M. Trinidad	258	276	357	462	770	27,973	29,195	32,021	34,587	38,738
28	General Tinio	404	429	556	724	1,212	35,078	36,523	40,035	43,241	48,430
29	Guimba	799	851	1,098	1,422	2,377	82,795	86,049	94,284	101,831	114,051
30	Jaen	535	572	738	955	1,593	57,110	59,491	65,220	70,443	78,896
31	Laur	294	314	408	532	901	26,881	28,039	30,749	33,213	37,198
32	Licab	225	241	311	403	676	23,144	24,206	26,563	28,692	32,135
33	Llanera	304	324	418	541	902	30,132	31,468	34,519	37,286	41,760
34	Lupao	303	323	417	539	901	31,922	33,209	36,396	39,310	44,027
35	Munoz	633	676	874	1,133	1,896	64,249	67,064	73,557	79,451	88,985
36	Nampicuan	100	107	139	179	298	11,505	12,040	13,214	14,273	15,986
37	Palayan City	318	337	502	653	1,077	28,341	29,679	37,914	41,452	46,462
38	Pantabangan	295	318	403	511	824	23,766	24,822	27,228	29,410	32,940
39	Penaranda	251	267	346	449	755	24,132	25,117	27,530	29,734	33,302
40	Queson	287	306	395	511	853	31,134	32,443	35,570	38,419	43,029
41	Rizal	493	527	681	884	1,482	49,010	51,130	56,074	60,566	67,834
42	San Antonio	534	570	735	950	1,582	59,712	62,103	68,058	73,506	82,327
43	San Isidro	374	398	514	666	1,112	38,539	40,046	43,877	47,389	53,076
44	San Jose City	1,046	1,117	1,447	1,879	3,158	103,486	107,936	118,365	127,847	143,189
45	San Leonardo	488	521	673	871	1,454	49,743	51,886	56,901	61,459	68,834
46	Santa Rosa	593	630	815	1,057	1,760	50,810	53,007	58,131	62,788	70,323
47	Santo Domingo	385	412	532	687	1,144	43,752	45,595	49,990	53,994	60,473
48	Talavera	880	937	1,207	1,559	2,594	91,414	95,161	104,309	112,661	126,180
49	Talugtog	205	219	283	367	616	19,487	20,402	22,393	24,189	27,091
50	Zaragosa	396	421	545	707	1,187	36,173	37,738	41,387	44,703	50,067
	Pampanga	9,620	10,304	13,418	17,467	29,319	721,823	752,626	825,234	891,335	998,296
51	Apalit *3	1,420	1,509	1,937	2,499	4,176	107,516	111,730	122,413	132,211	148,075
52	Arayat	1,202	1,301	1,743	2,312	3,809	91,741	95,609	104,820	113,215	126,800
53	Candaba	1,059	1,145	1,531	2,029	3,425	82,606	85,984	94,241	101,786	114,001
54	Magalang	814	867	1,103	1,412	2,327	56,006	58,403	64,039	69,168	77,468
55	Mexico	1,179	1,282	1,706	2,252	3,938	98,632	103,279	113,357	122,446	137,140
56	San Fernando	3,022	3,200	4,072	5,214	8,592	206,495	215,544	236,399	255,339	285,980
57	San Luis	453	490	650	858	1,498	38,336	39,891	43,718	47,218	52,884
58	Santa Ana	471	510	676	891	1,553	40,491	42,187	46,249	49,952	55,947
	TOTAL	52,007	55,494	71,868	93,196	159,244	4,219,278	4,400,537	4,825,619	5,212,277	5,837,765

*1 Malolos includes Paombong, Hagonoy
*2 Meycauayan includes Obando, Marilao
*3 Apalit includes San Simon



FUGURE 5.4-1 GRDP BY MUNICIPALITY

TABLE 5.4-4 VEHICLE REGISTRATION IN 1997

	All Philippines	(%)	NCR	(%)	Region III	(%)
Car	743,299	23.3	513,254	40.9	46,503	13.4
Utility Vehicle	1,191,392	37.3	487,733	38.9	156,226	44.9
Truck	242,842	7.6	78,839	6.3	26,113	7.5
Bus	31,950	1.0	9,815	0.8	3,517	1.0
Trailer	32,022	1.0	19,074	1.5	3,492	1.0
Motorcycle	952,044	29.8	144,953	11.6	111,751	32.1
Total	3,193,549	100.0	1,253,668	100.0	347,602	100.0
Vehicle Ownership Per 1000 inhabitants		45	147		48	

Source: Land Transportation office

Figure 5.4-2 shows the past trend of vehicle registration by type in Region III. The number of registered vehicles in Region III is 348 thousand units (236 thousand units when motorcycles are excluded), with an annual growth rate for the last ten-year period remaining high at 8.0% (6.8% when motorcycles are excluded). The growth rate leveled off by 1.5 - 1.9% when compared with the national average.

As regards the national share, cars are relatively low at 6 - 7% while utility vehicles and buses/trucks are high at 13 - 14% and 10 - 12% respectively.

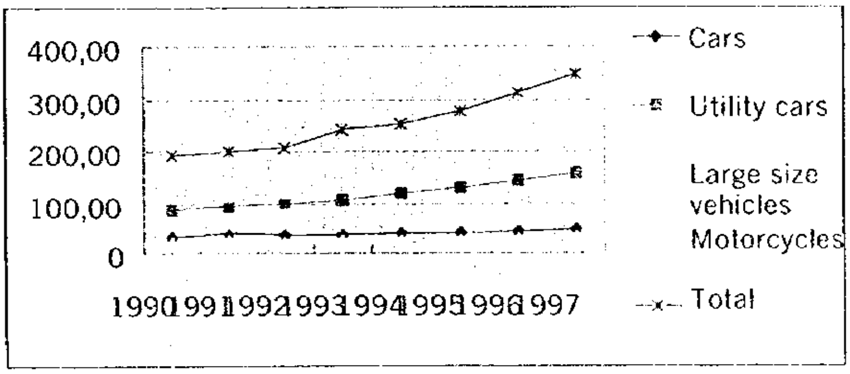


FIGURE 5.4-2 VEHICLE REGISTRATION BY YEAR

The coefficient of correlation in the linear regression analysis between the number of registered motor vehicles and GRDP in Region III is slightly smaller at 0.715 for trailers and 0.851 for buses, but higher at 0.904 for cars, 0.992 for utility vehicles, and 0.972 for all vehicles.

Table 5.4-5 and 5.4-6 shows the estimate from lower and medium assumptions of GRDP in Region III, which was calculated using the linear correlation formula.

A linear regression analysis, gives the following relation;

$$V = a \times GRDP + b$$

where, *V*; Vehicle Ownership (Vehicles)
GRDP;(Per Capita GRDP in M.Rp.)
a=slope
b=constant
(r^2=0.72-0.99)

It is expected that the number of registered motor vehicles will increase by factors of 1.5 (1.7), 2.0 (2.5), and 3.4 (4.8) from present level in the years 2005, 2010, and 2020, respectively. Numerical values in parentheses apply to the case of GRDP medium assumption. For Region III, the rate of 3.4 * the 1997 figure for the year 2020 is about the same level as the 1997 NCR car-ownership.

TABLE 5.4-5 VEHICLE REGISTRATION FORECAST (LOWER CASE)

	2005	2010	2020
Car	58,207	70,335	103,708
Utility	251,137	333,313	559,432
Truck	34,451	43,598	68,769
Bus	4,157	4,751	6,386
Trailers	3,881	4,206	5,100
Motorcycle	185,086	251,978	436,042
Total	536,918	708,182	1,179,438
Growth Rate for 1997	1.54	2.04	3.39

TABLE 5.4-6VEHICLE REGISTRATION FORCAST (MEDIUM CASE)

	2005	2010	2020
Car	62,238	80,848	135,743
Utility	278,453	404,546	776,481
Truck	37,492	51,528	92,930
Bus	4,354	5,266	7,956
Trailers	3,989	4,487	5,958
Motorcycle	207,321	309,963	612,724
Total	593,848	856,639	1,631,792
Growth Rate for 1997	1.7	2.5	4.7

CHAPTER 6

FUTURE TRAFFIC DEMAND FORECAST

CHAPTER 6

FUTURE TRAFFIC DEMAND FORECAST

6.1 METHODOLOGY

6.1.1 Demand Forecast Process

FIGURE 6.1-1 shows the demand forecast process. The process is divided mainly into two parts; Model Building and Demand Forecast. In model building vehicle trip generation/attraction (G/A) is developed based on the present trip generation/attraction. Applying the future socio-economic indicators to the trip G/A model, the future vehicle trip G/A is estimated, and applying the present pattern method, the future OD matrix is estimated, following the pattern of the present OD matrix. The future traffic on each link is estimated by assigning the future OD demand on the future road network.

6.1.2 Trip Generation / Attraction Model

The trip generation/attraction model was developed based on the present generating/attracting traffic, and the population and GRDP in terms of 1985 constant price as the socio-economic indicators

The vehicle trips generation/attraction models by vehicle type were developed by linear regression analysis;

$$G = A = a_1 \times P + a_2 \times GDP + a_3$$

where, *G:* Generated Trip (Veh./day)
A: Attracted Trip
P: Population (person)
GDP: GRDP (1,000 peso)

The coefficients of variables mentioned above were estimated shown in Table 6.1-1;

TABLE 6.1-1 RESULTS OF ESTIMATES OF COEFFICIENTS

Vehicle Type	Items	a_1	a_2	a_3	R^2
Passenger Car	Coefficient	0.004823	1.945771	530.13316	0.8451
	Standard Error	0.006206	0.461346	1,062.347	
Bus	Coefficient	0.000763	0.033549	32.287534	0.8505
	Standard Error	0.000258	0.017735	43.758538	
Tricycle	Coefficient	0.027575	0.055286	4,574.2638	0.71283
	Standard Error	0.068252	5.929768	1,861.1997	
Truck	Coefficient	0.002249	0.335300	107.81807	0.87132
	Standard Error	0.001339	0.092623	230.76079	

Note: "R^2" stands for coefficient of determination.

The statistically significant coefficients for jeepney couldn't be derived by regression analysis. Then, generation/attraction traffic volume of jeepney was assumed to increase proportionately with the ones of bus.

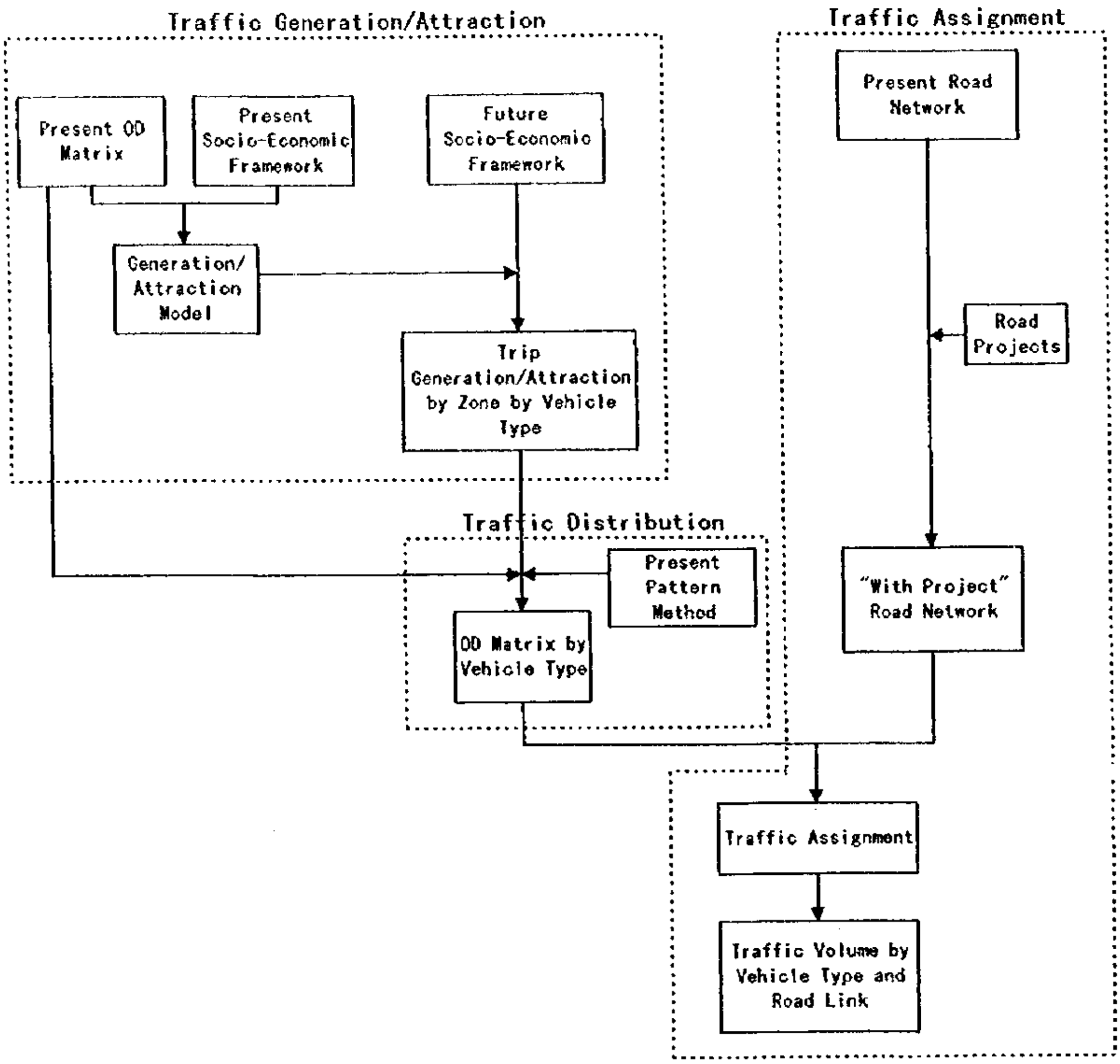


FIGURE 6.1-1 PROCEDURE OF FUTURE TRAFFIC DEMAND FORECAST

6.1.3 Present Pattern Method

The future OD matrices by vehicle type are forecasted by applying Fratar method. The Fratar method is a kind of method of iteration on the assumption that the present OD pattern will continue to the future without drastic change of socio-economic structure for each zone. By using the present OD matrix and future generation/attraction traffic volume, iteration is continued until calculated generation/attraction traffic volume derived by Fratar method is coincided with the forecasted generation/attraction traffic volume mentioned above.

6.1.4 Assignment Model

1) Network Development

The road network in the study area was developed based on the road inventory data of DPWH. The roads, which are classified into national, provincial and municipal roads, are divided into links, and they are subdivided into sub-links and sections according to road conditions such as carriage way width, surface type, and shoulder type and width.

The sections were further sub-divided into flat and mountainous area by topographic features. The total section number in the network was 380.

2) Free Flow Speed

The free flow speed was calculated following the multilane rural and suburban highways in Highway Capacity Manual;

$$FFS = FFS1 - FM - FIW - FIC - FA$$

where:

FFS	=	estimated free-flow speed (mph)
FFS1	=	Estimated free-flow speed (mph) for ideal condition
FM	=	adjustment free-flow speed (mph) for median type
FIW	=	adjustment free-flow speed (mph) for lane width
FIC	=	adjustment free-flow speed (mph) for lateral clearance
FA	=	adjustment free-flow speed (mph) for access points

3) Q-V

Q-V formula of each links were calculated and classified by condition of road side land use, numbers of lanes, lane width, directional split, heavy vehicles in the traffic flow, peak hour traffic ratio.
Using Q-V pattern is shown FIGURE 6.1-2. In the calculation of traffic volumes, passenger car equivalent (PCU) will be applied to large sized vehicles as truck and small sized vehicles.
When the traffic volumes on existing road located in built up area are almost capacity or beyond capacity the traffic speed is low. Then, the PCU as shown TABLE 6.1-2 is based in occupancy of road area by vehicles of different size.

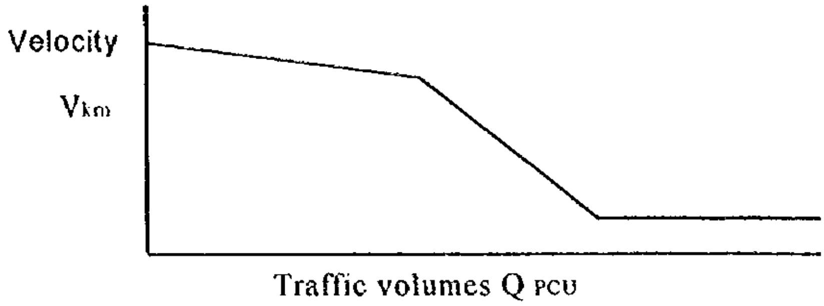


FIGURE 6.1-2 Q-V PATTERN

TABLE 6.1-2 PASSENGER CAR UNIT

Car	1.0
Jeepney	1.3
Bus	2.0
Truck	2.0
Triyscle	0.6

4) Assignment Method

OD Traffic was assigned on the road network following the incremental assigning method with link capacity constraint. Each OD traffic volume was equally divided into ten volumes and assigned on the shortest path. Computer application system called "JICA-STRADA" was used for this simulation.

6.2 GENERATED AND ATTRACTED TRAFFIC

6.2-1 Total Trip Passing the Project Road

Currently, total demand for the Study Road was estimated at about 310,000 vehicle trips per day excluding zone-internal trips. Out of them, 47% are trips made by tricycles which are serving for short distance trips. Cars have a share of 34%, jeepneys of 10% and large vehicles of 9%. The trips will grow to 400,000 in 2005 and 760,000 in 2020, 2.4 times of the present. Cars will show the highest growth rate of 3.1 times during the coming 22 years while other vehicles will show slightly higher than twice.

TABLE 6.2-1 TOTAL VEHICLE TRIPS IN THE FUTURE

(Unit: 1000 Vehicle/Day)

Vehicle Type	1998	2005	2010	2020
Passenger Car	106	149	192	329
Jeepney	31	40	48	70
Bus	5	6	7	11
Tricycle	21	25	29	44
Truck	149	183	215	306
Total	312	403	491	760
Growth Rate	1.00	1.29	1.57	2.43

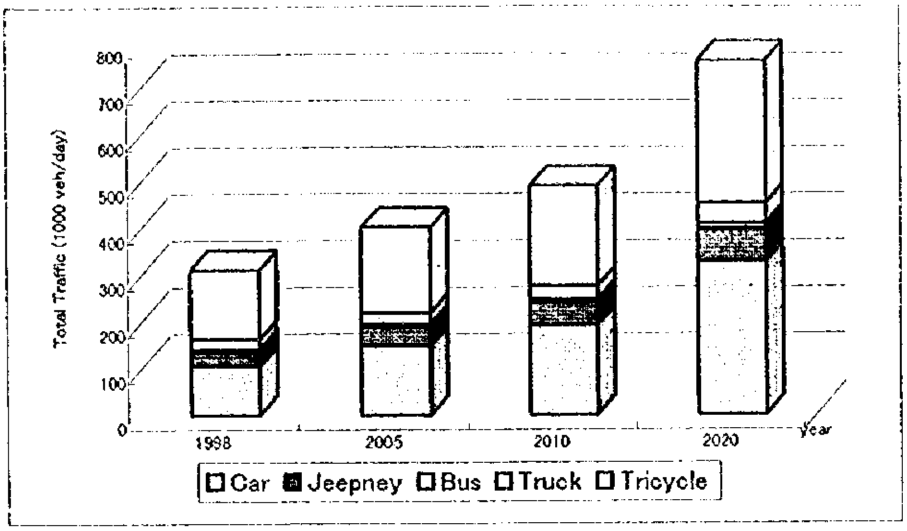


FIGURE 6.2-1 INCREASE OF VEHICLE TRIPS

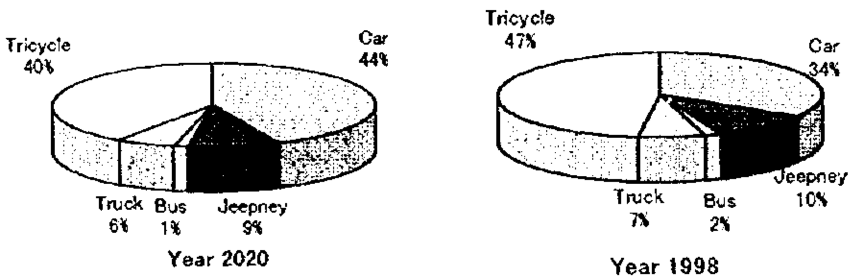


FIGURE 6.2-2 COMPOSITION OF VEHICLE TYPE

6.2.2 Trip Generation by Zone

In the Study Road Corridor, the largest vehicle trip generation or attraction is observed in Cabanatuan City in the future as well as at present; its inter-zonal trips are17,000 in 1998 and 61,000 in 2020 excluding tricycle trips, followed by Gapan City (6,200 trips in 1998 and 19,000 in 2020) and Santa Rosa City and San Jose City (both cities has almost same trips of about 5,000 in 1998 and 9,000 in 2020). Present trips in other cities are less than 3,000. The highest growth rate is 6.0 times in General M. Trinidad, followed by 5.6 times of Norzagaray. Others show the rate between 2.0 to 4.5.

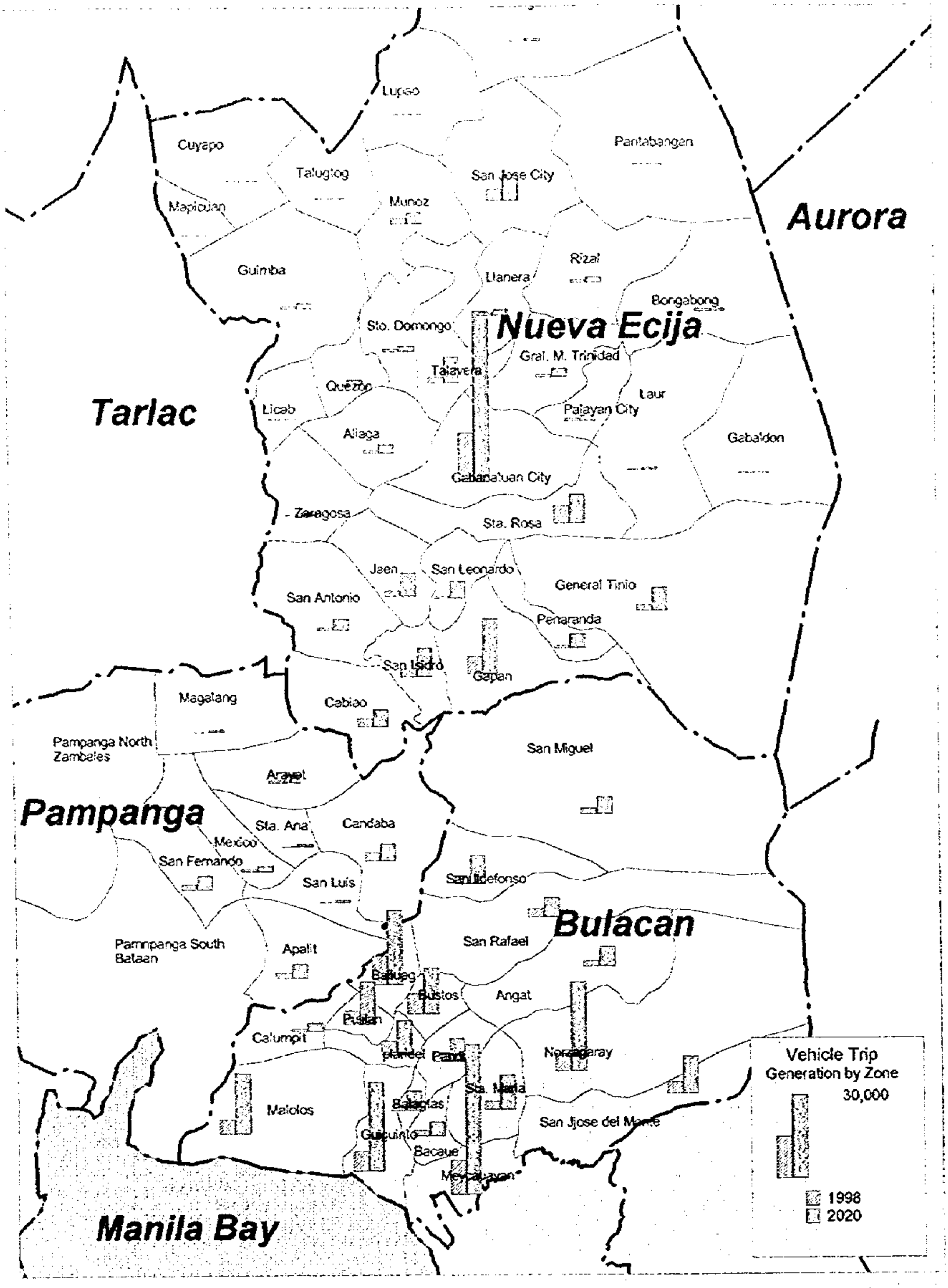


FIGURE 6.2-3 VEHICLE TRIPS GENERATED BY ZONE

6.3 FUTURE VEHICLE OD MATRIX

6.3.1 Structure of OD Trips

FIGURE 6.3-1 shows OD traffic volume in the Study Area in the form of desire lines. More than half of the total traffic is observed between NCR and the southern part of Bulacan Province which does not give any burden on the Study Road. Urbanization of the Capital will reach south Bulacan in the future.

Cities of Cabanatuan, Gapan and San Jose will grow larger and their characteristics as a regional center will become clearer. Long-distance trips passing through the whole Study Area are not outstanding while local trips are the majority of the total demand.

6.3.2 Average Trip Length

Average trip length is not so long because the most trips are local ones. To estimate the average at present of inter-zonal trips, cars move 21 Km in average for each one trip, buses 27Km, trucks 31Km. Jeepneys and tricycle serve mainly inside a city and their trip lengths are rather shorter as 16 Km of jeepney and 4 Km of tricycle, excluding intra-zonal trips. In the future, these trip lengths tend to be longer than at present by 10 to 20 %(Table 6.3-1).

TABLE 6.3-1 AVERAGE TRIP LENGTH (KM)

	1998	2020
Car	21.2	24.5
Jeepney	16.0	18.3
Bus	27.2	28.8
Truck	30.6	35.6
Tricycle	3.9	3.9

6.3.3 Generated / Attracted Trips

As an urban bypass is a main planning issue of this Study, future traffic passing through main cities is analyzed based on the OD matrices to see the potential demand for a bypass. The results are shown in FIGURE 6.3-2. Plaridel /Baliuag and San Jose will have through traffic more than trips with either of origin or destination inside the city in the future as well as at present. Especially in Plaridel/Baliuag located at the origin of the Study Road Corridor, through traffic will be more than three times of traffic to/from the cities. The largest city of the Study Area, Cabanatuan will also have through traffic more than a half of traffic to/ from the city. These through traffic will increase more than three times of the present by year 2020. From this viewpoint, the importance of bypass construction is apparent.

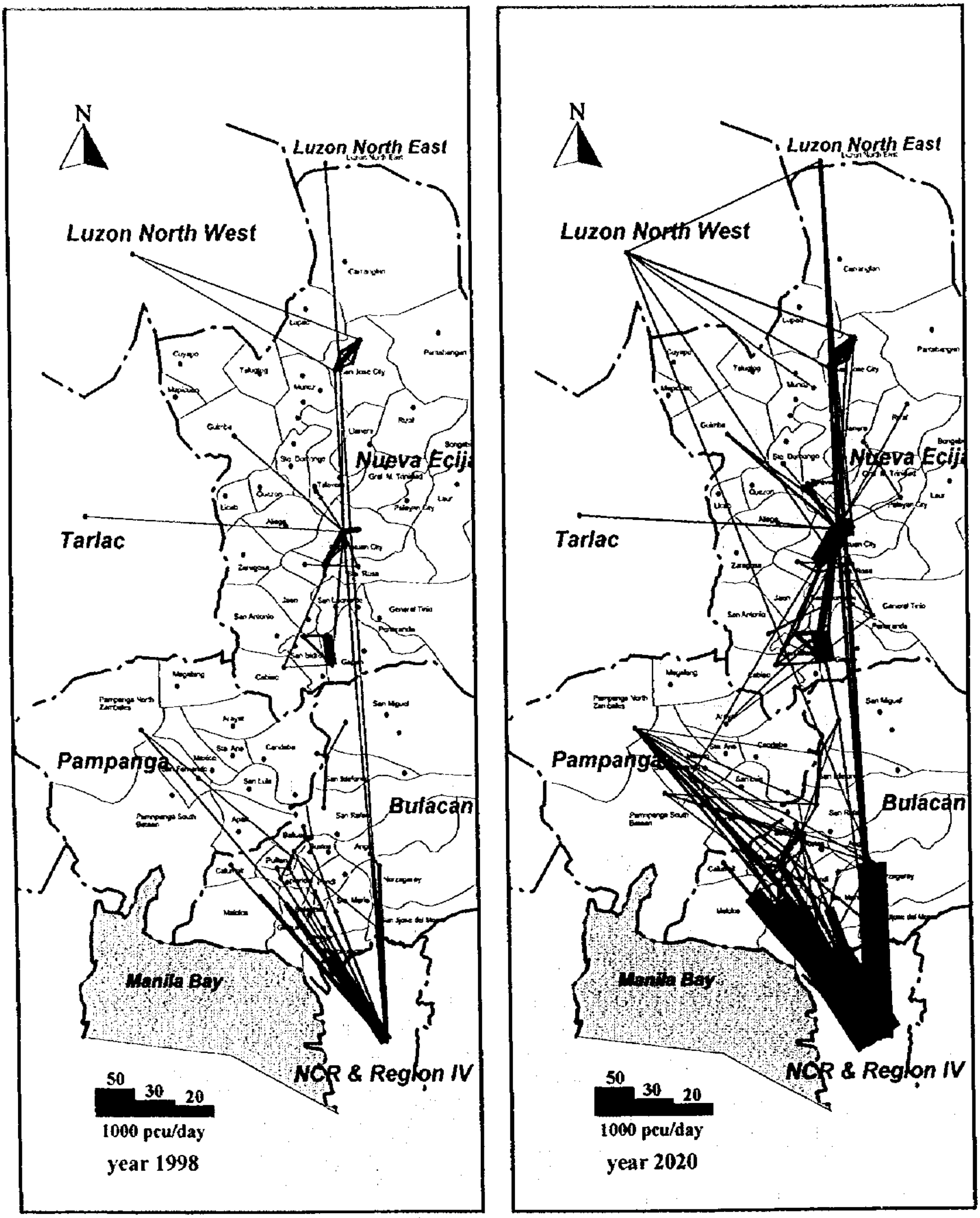


FIGURE 6.3-1 PRESENT AND FUTURE DESIRE LINE

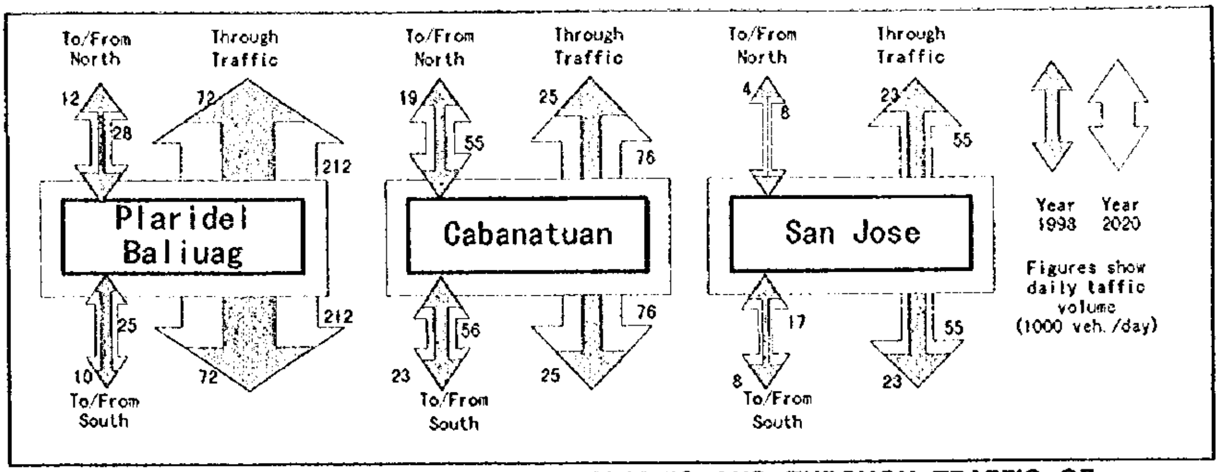


FIGURE 6.3-2 GENERATED/ATTRACTED TRAFFIC AND THROUGH TRAFFIC OF MAIN CITIES

6.4 FUTURE TRAFFIC IN "WITHOUT PROJECT" CASE

6.4.1 Cases for Traffic Assignment

To estimated the traffic on each road section in the network, following four networks are set up for the planning purpose:

1. Existing road network
2. Existing road network + Expressway
3. Existing road network + Bypass
4. Existing road network + Bypass + Expressway

Forecasted OD matrices of the vehicle trips, for the future years of 2005, 2010 and 2020 in case of without project, are assigned on the do nothing case to produce the daily traffic volumes. There are two do nothing cases which are 1and 2 road network. Road network pattern 1 is applied to calculate in "do nothing" case in 2005 and 2010. Network pattern 2 is applied to "do nothing" case in 2010 and 2020. On the other hand, OD matrices for with project are assigned on road network pattern 3 and 4. The former one is applied to "with project" in 2005 and 2010. The last one is applied to with project in 2010 and 2020. These cases for traffic assignment are shown in TABLE6.3-1.

TABLE 6.3-1 CULCULATION CASE ON TARGET YEAR

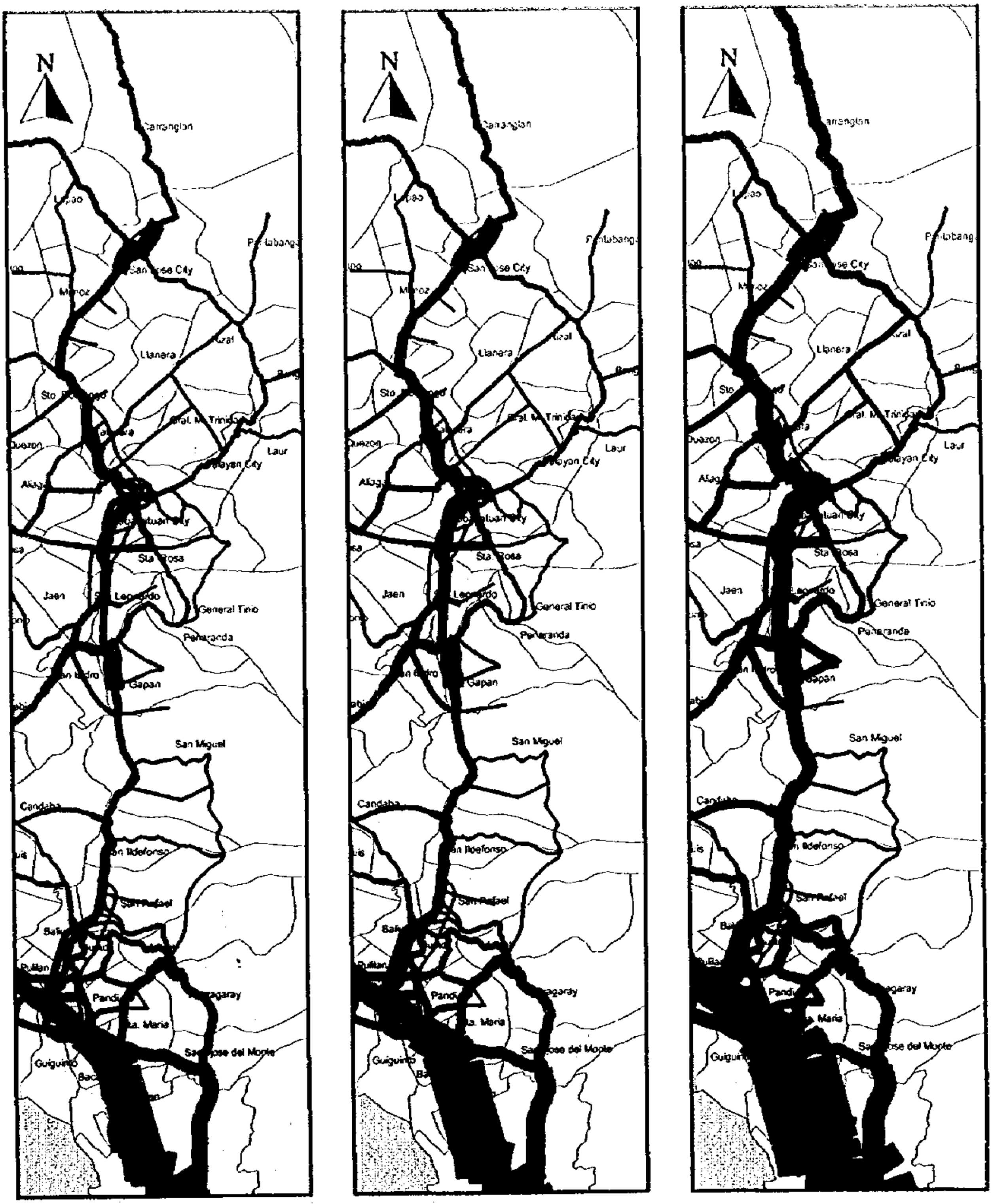
Road network	Pattern 1	Pattern 2	Pattern3	Pattern4
2005	×		O	
2010(1)	×		O	
2010(2)		×		O
2020		×		O

× "Do nothing" case
O "With project" case

6.4.2 Future Traffic in "Do Nothing" Case

Forecasted traffic volumes on the road network in the case of "Do nothing" are shown graphically in the flow map of FIGURE 6.4-1, for the three future years of 2005, 2010 and 2020. From FIGURE 6.4-2 to 6.4-4 show traffic volume on each road link in Plaridel, Cabanatuan and San Jose area comparing the present one with traffic in 2020.

Most sections of the study road are presently two lane roads of which daily capacities are 18,000 pcu to 24,000 pcu and even at wider sections, 27,000 pcu at most. Present traffic volumes are mostly less than thee capacity. On the other hand, future traffic will exceed the capacity in most sections. Especially, at the urban sections, future traffic will be more than double of the present capacity.



year 2005 year 2010 year 2020

100000
50000
Legend (pcu/day)

TABLE 6.4-1 TRAFFIC FORECAST IN "WITHOUT PROJECT" CASE

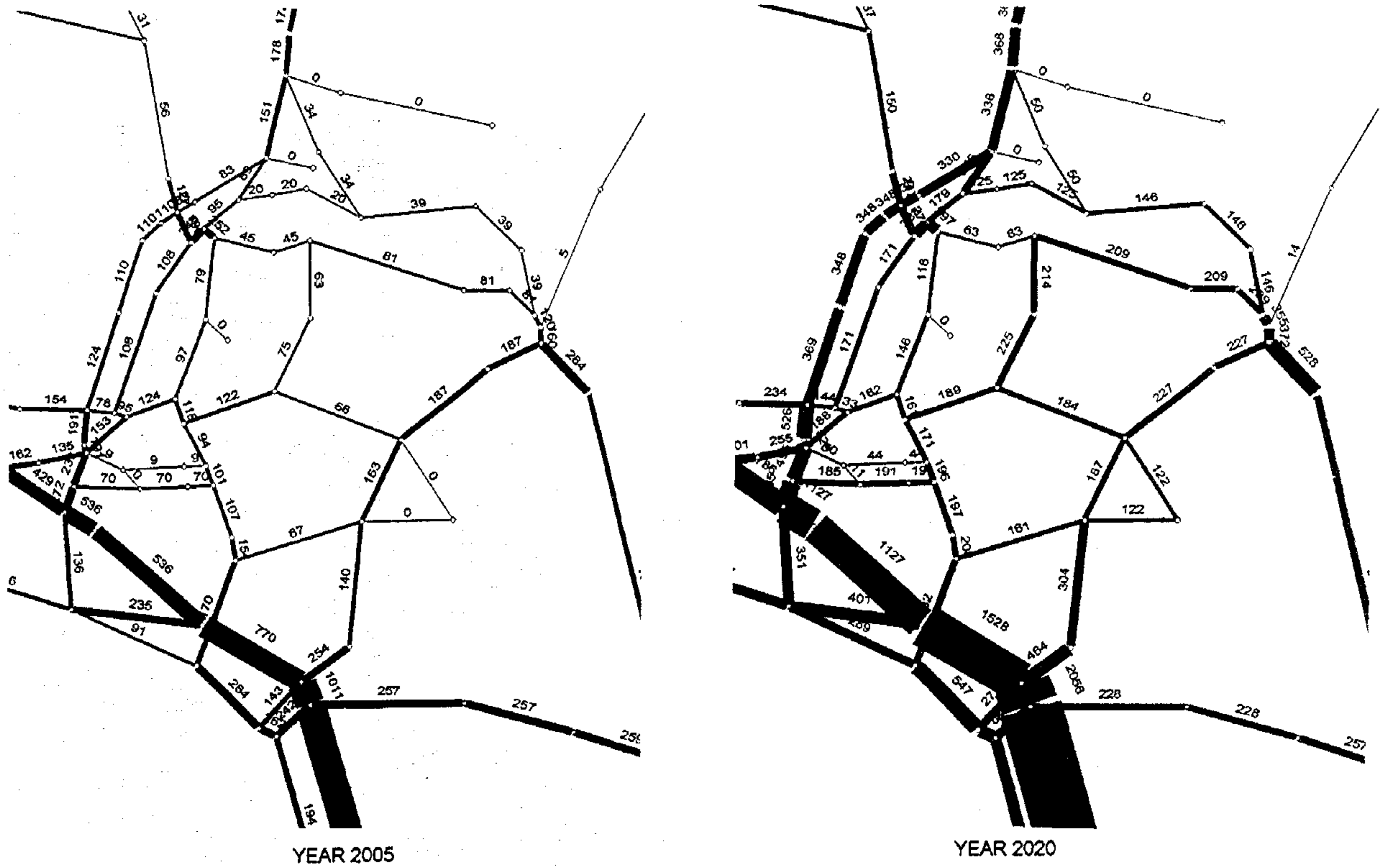
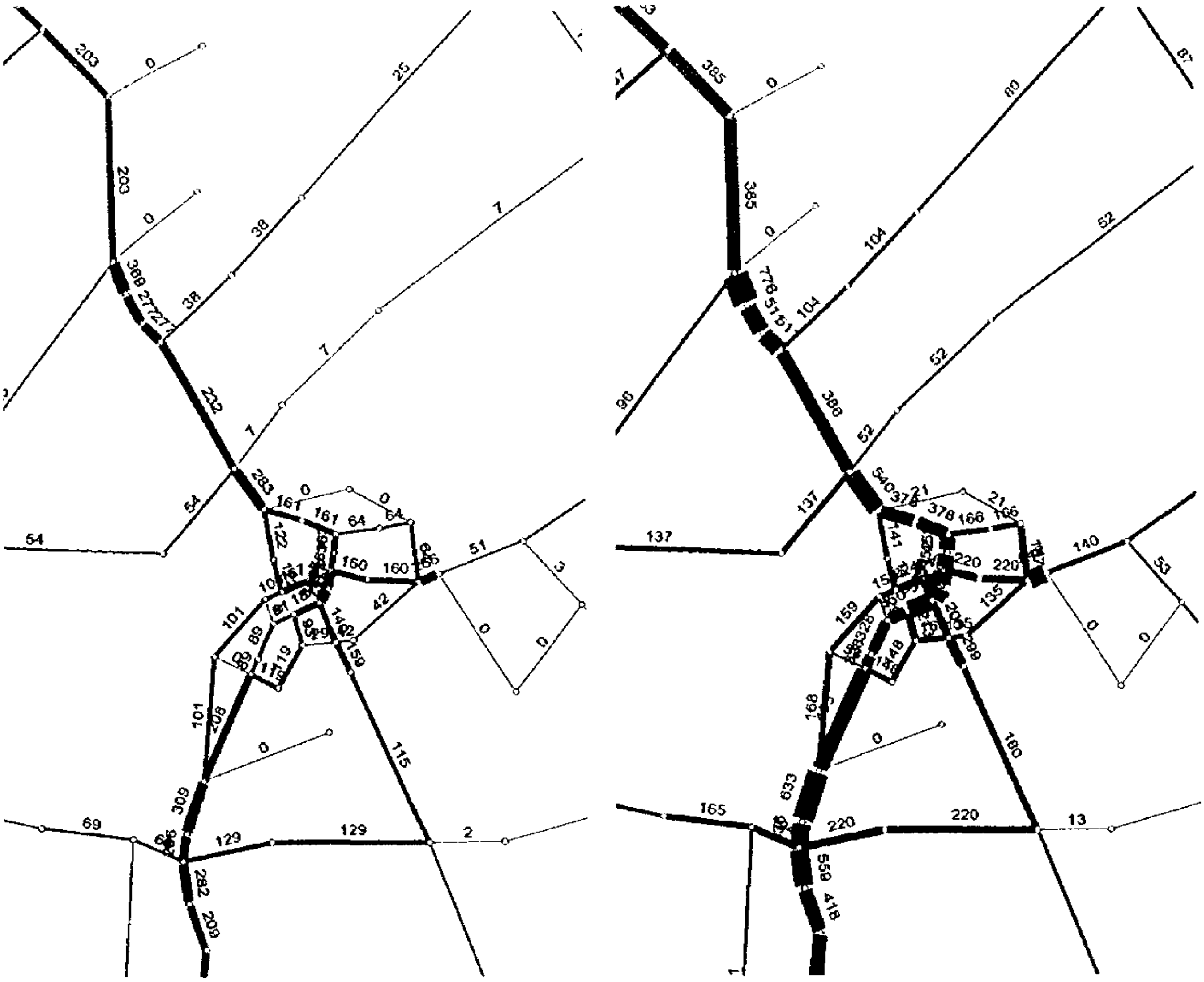


FIGURE 6.4-2 FORECASTED TRAFFIC IN PLARIDEL-BALIUAG AREA

(UNIT: 100 PCU/DAY)

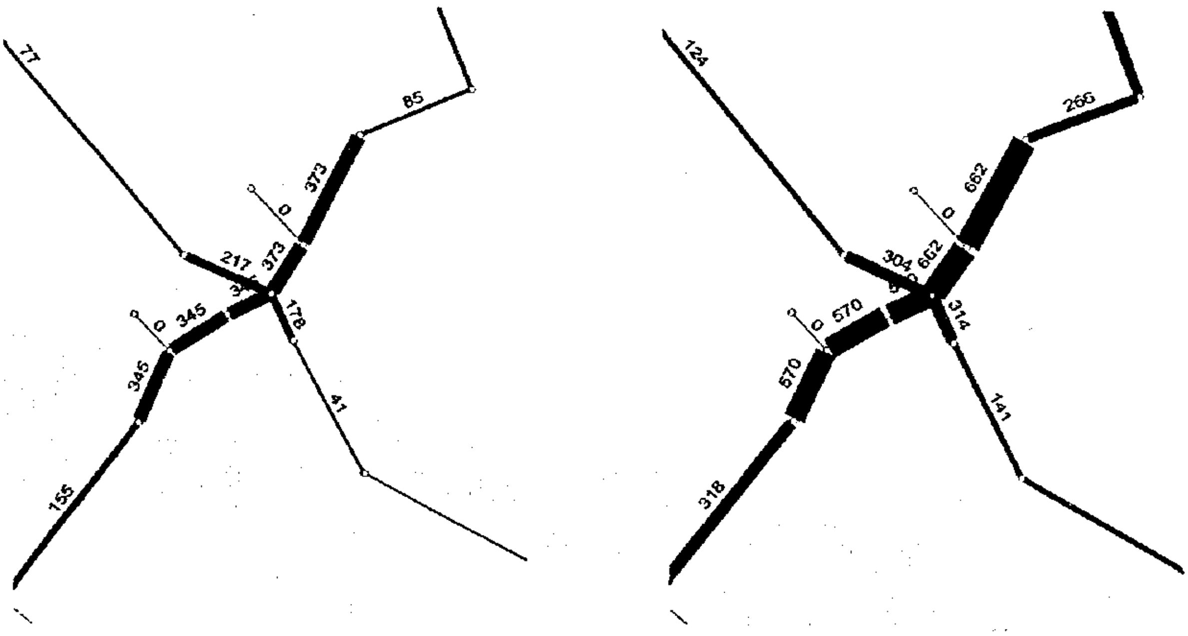


YEAR 2005

YEAR 2020

FIGURE 6.4-3 FORECASTED TRAFFIC IN CABANATUAN AREA

(UNIT: 100 PCU/DAY)



YEAR 2005

YEAR 2020

FIGURE 6.4-4 FORECASTED TRAFFIC IN SAN JOSE AREA

(UNIT: 100 PCU/DAY)

PART III

DEVELOPMENT OF UPGRADING MEASURES

CHAPTER 7

BASIC ROAD DEVELOPMENT PLAN

CHAPTER 7

BASIC ROAD DEVELOPMENT PLAN

7.1 HIGHWAY FUNCTIONS AND CLASSIFICATION

In comprehensive highway planning, highway are classified according to the operational system, functional classes or geometric types. The AASHTO standards 1994 introduces the concept of functional classification, i.e. the grouping of highways by the character of service they provide. The Republic Acts and Presidential Decrees of the Philippines have established an administrative and functional road classification, as discussed hereunder.

7.1.1 Concept of Functional Classification

(1) Hierarchy of Movement

Functional design recognizes that individual elements of a travel circulation system are not independent. Travel involves movements through a network of public and private roadways. Thus, a functionally designed circulation system provides for the distinct stages of service that are involved in making a trip. As illustrated in Figure 7.1-1, these are; primary movement, transition, collection, distribution, access and termination.

The hierarchy circulation system provides for the gradation in function from access to primary movement. Efficient and safe operation of the system requires that specific facilities be designed to serve a specific purpose within this spectrum.

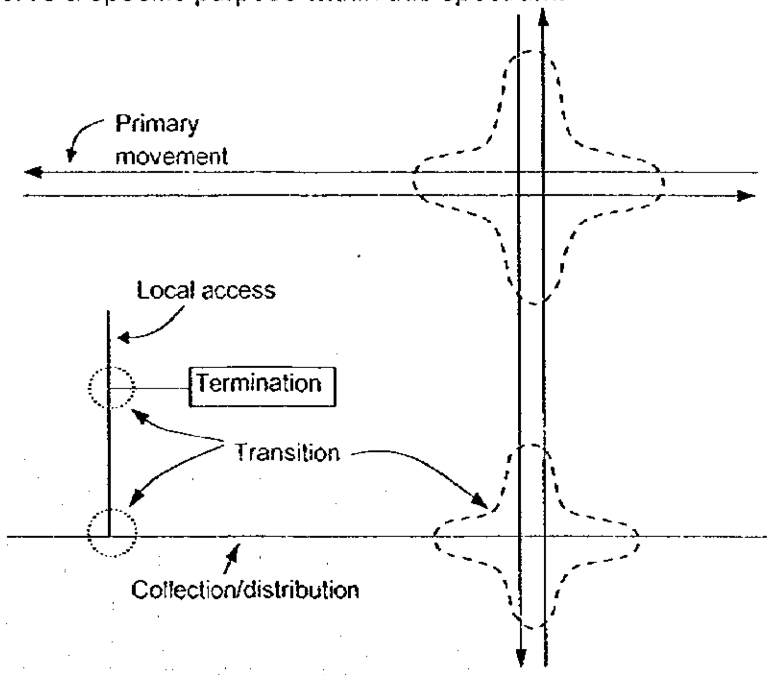


FIGURE 7.1-1 HIERARCHY OF MOVEMENT IN A FUNCTIONAL CIRCULATION SYSTEM

(2) Functional Classification

A functional system of highways must provide for a gradation of traffic flow from the movement function to the access function. Figure 7.1-2 schematically shows the relationship between mobility and access.

As indicated, three general classes of facilities are recognized (arterial, collector, and local). Regulated limitation of access is necessary on arterials to enhance the primary function of mobility. Conversely, the primary function of local roads is to provide access which causes a limitation of mobility.

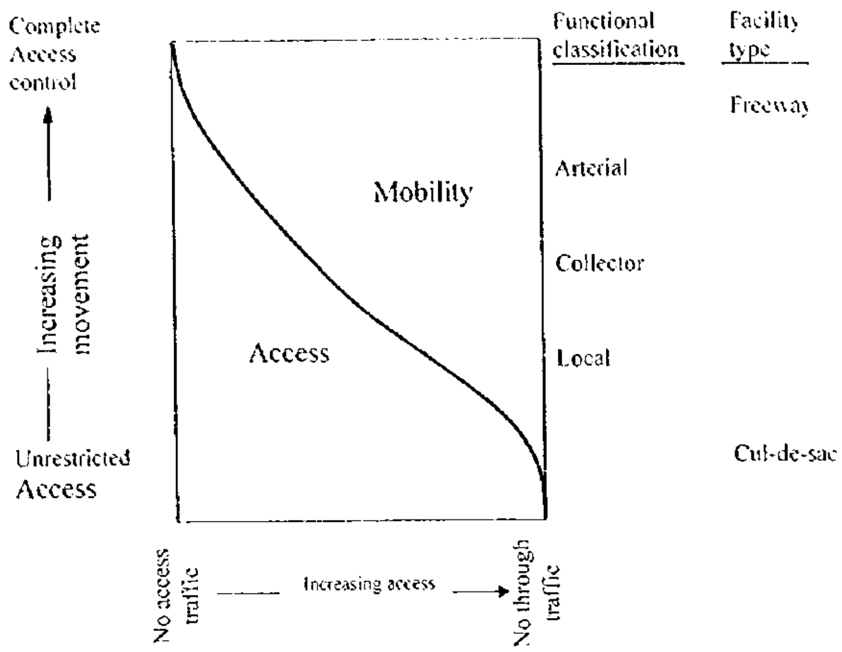


FIGURE 7.1-2 FUNCTIONAL CLASSIFICATION

(3) Characteristics of Highways.

The extent and degree of access control as well as continuity of facilities are the significant factors in defining the functional category of a highway.

The general types of facilities and their characteristics are summarized in Table 7.1-1.

Table 7.1-1 CHARACTERISTICS OF HIGHWAYS

	Function	Continuity	Spacing (km)	Direct Land Access	Minimum Roadway Intersectio Spacing (km)	Speed Limit (kph)	Parking	Comments
Expressway	Traffic movement	Continuous	6 ~ 7	None	1.6	70 - 90	Prohibited	Supplements capacity of arterial street system and provides high speed mobility
Primary Arterial	Intercommunity and intrametro area Primary-traffic movement Secondary-land access	Continuous	1.5 ~ 3	Limited- major generators only	0.8	55-70 in fully developed areas	Prohibited	
Secondary Arterial	Primary-intercommunity, intrametro area, traffic movement Secondary-land access	Continuous	0.8 ~ 1.6	Restricted-some movements may be prohibited; number and spacing of driveways controlled	0.4	45-55	Generally Prohibited	Backbone of Street System
Collector	Primary-collect/ distribute traffic between local streets and arterial system Secondary-land access Tertiary-interneighbourhood traffic movement	Not necessarily continuous; should not extend across arterials	0.8 or less	Safety controls; limited regulation	0.1	40-45	Limited	Through traffic should be discouraged
Local	Land access	None	As needed	Safety controls only	300 feet	25	Permitted	Through traffic should be discouraged.

SOURCE : Transporation and Land Development, Institute of Transportation Engineers.

7.1.2 Road Classification of DPWH

There are two kinds of road classification in the Philippines; the administrative road classification and the functional road classification.

(1) Administrative Road Classification

Administrative road classification in the Philippines has been established by a series of Executive Orders, Republic Acts and Presidential Decrees. At present, there are five classes of roads as follows:

- National Road
  - Primary National Road
  - Secondary National Road
- Provincial Road
- City Road
- Municipal Road
- Barangay Road

National Roads – are 1) all roads that form part of the main trunkline system continuous in extent; and 2) all roads leading to national ports, national parks or coast-to-coast roads.

Provincial Roads – are 1) those roads connecting one municipality with another municipality, the termini are public plazas; 2) all roads extending from a municipality or from a provincial or national road to a public wharf or railway station; and 3) any other roads to be designated as such by the Sangguniang Panglalawigan.

City Roads – are those roads or streets within the urban area of the city to be designated as such by the Sangguniang Panglungsod.

Municipal Roads – are those roads or streets within the poblacion area of a municipality to be designated as such by the Sangguniang Bayan.

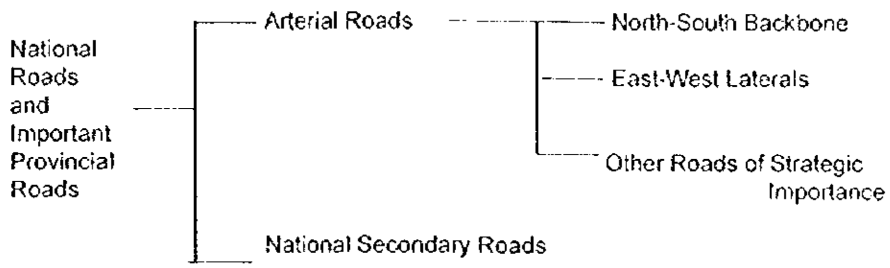
Barangay Roads – are 1) rural roads located either outside the urban area of a city or outside industrial, commercial or residential subdivision which act as feeder roads such as farm-to-market roads, and which are not otherwise classified as a national, provincial, city or municipal roads; 2) roads located outside the poblacion area of a municipality; and, 3) those roads located outside the urban area of a city to be designated as such by the Barangay Council concerned.

The responsibility for planning, construction and maintenance of national roads is with the Department of Public Works and Highways (DPWH). Under the general supervision of the Department of Interior and Local Government (DILG), the Provincial, City and Municipal Engineers Offices, a behalf of their government units are responsible for the roads in their areas. Barangay roads, which were the responsibility of DPWH, are now being transferred to the jurisdiction of Local Government Units (LGUs).

(2) Functional Road Classification

DPWH have classified roads into arterial and national secondary roads based on the functions to be played by each road. Arterial roads were further classified into North-South Backbone, East-West Laterals and Other Roads of Strategic Importance.

DPWH's Functional Road Classification



Arterial roads are mostly national roads, however, some important provincial roads are included in the Other Roads of Strategic Importance. National Secondary Roads are all national roads not classified as Arterial Roads.

7.1.3 Highway Classification of AASHTO

AASHTO Standards 1994 presents highway functions and functional classifications. Categories are defined separately in urban and rural areas as follows.

(1) Definition of Urban and Rural Areas

For design purposes, urban and rural areas are defined according to the population forecast in the target year.

- Urban Area :
  Urbanized areas - Population of 50,000 and over
  Small urban areas - Population between 5,000 & 50,000

- Rural Areas :
  Areas outside the boundaries of urban areas

(2) Functional Road System for Rural Areas

Rural road systems consist of five classes, i.e. principal arterial, minor arterial, major and minor collectors and local roads. These are defined as follows:

- Rural Principal Arterial :

  Movement between all, or virtually all, urban areas with population over 50,000 and a large majority of those with populations over 25,000.

- Rural Minor Arterial :

  Linkage of cities, large towns and other traffic generators (such as major resort areas) that are capable of attracting travel over relatively long distances.

- Rural Major Collector Roads :

  Linkage of places with nearby larger towns or cities, or with routes of higher classifications.

- Rural Minor Collector Roads :

  Linkage of locally important traffic generators with their rural hinterland.

- Rural Local Roads :

  Access to land adjacent to the collector network and services travel over relatively short distances.

(3) Functional Road System for Urban Areas

The four functional highway systems for urbanized areas are classified as principal arterial, minor arterial, collectors, and local streets. These are defined as follows :

- Urban Principal Arterial :

  Carry most of the trips entering and leaving the urban area, as well as most of the through movements bypassing the central cities.

- Urban Minor Arterial :

  Serve for trips of moderate length at a lower level of travel mobility, including urban connections to rural collector roads.

- Urban Collector Street :

  Provide both land access, services and traffic circulation within residential neighborhoods and commercial and industrial areas.

- Urban Local Streets :

  Provide direct access to abutting lands and connection to the higher order systems.

(4) Special Purpose Roads

Some types of roads do not fit into the functional classification system. They are provided for special purposes. This type of road is referred to as a special purpose road for example:

- Recreational Roads
- Resource Development Roads
- Local Service Roads

7.2 HIGHWAY SYSTEM AND FACILITIES

The transportation system is the basic infrastructure element which influences the pattern of regional and urban development. Throughout history, transportation and land development have been closely bound. Therefore, the development of the future highway system should be planned in such a way that it will support both the specific objectives of the transport sector as well as the general development objectives. The general objectives include the regional development and land use development in the influence area.

7.2.1 Access Control

(1) Access Control Types

The regulated limitation of access is called access control. Access control is achieved through the regulation of the right of public access to and from properties abutting highway facilities. Generally these regulations, are categorized as full control of access, partial control of access, access management, and driveway and approach regulations, as illustrated in Figure 7.2-1.

Partial control of access is highly desirable on an arterial facility. Such a provision will not only enhance its initial service capability but will also preserve the original level of service. Where service is required to abutting property, it should be carefully regulated to limit the number of access points and their locations.

(2) Access Control Methods

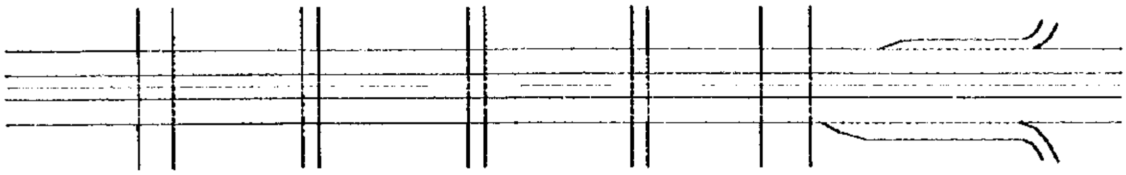
Access control may be exercised by statute, zoning ordinances, driveway controls, turning and parking regulation and geometric design acceptable to the community and property owner.

- Access Control by Statute

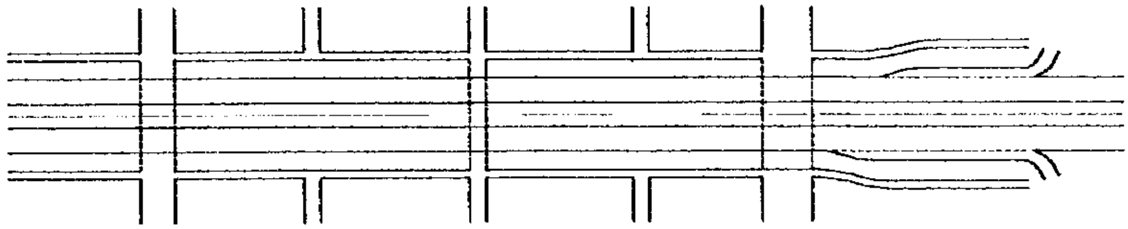
  Where a high degree of access control is desired, it is usually accomplished by statute. When statutory control is applied to an arterial street, access is usually limited to the cross streets or to other major traffic generators.

- Access Control by Zoning

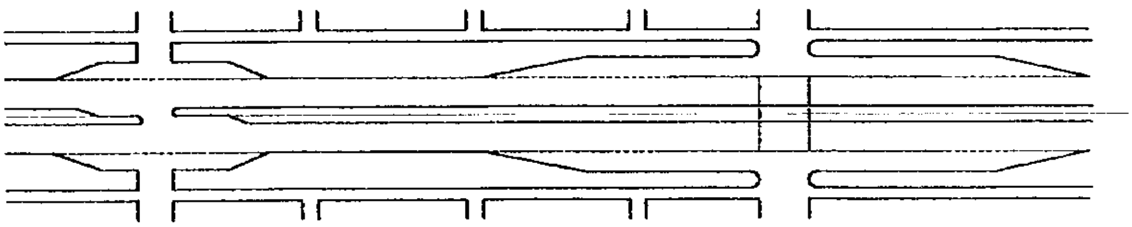
  Zoning can effectively control the property development along an arterial road and thereby influence the type and volume of traffic generated. Subdivision or zoning ordinances usually require that the developer of a major traffic generator should provide a suitable connection to the arterial street.



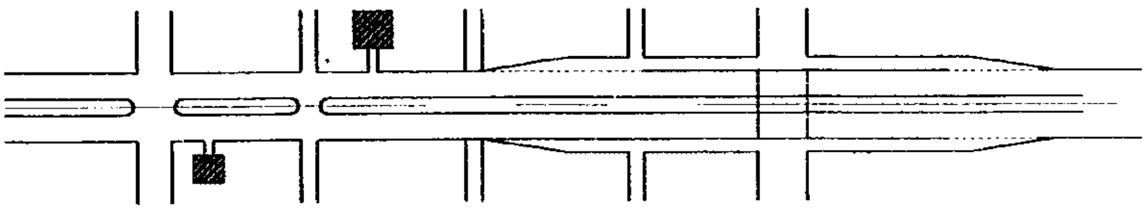
a) FULL CONTROL OF ACCESS



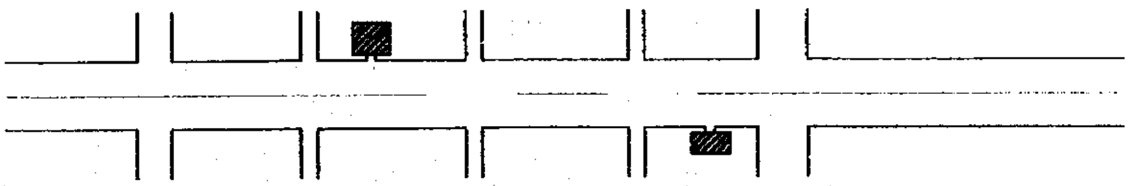
b) FULL CONTROL OF ACCESS WITH FRONTAGE ROAD



c) PARTIAL CONTROL OF ACCESS WITH FRONTAGE ROAD



d) NO CONTROL OF ACCESS WITH GRADE SEPARATION



e) NO CONTROL OF ACCESS

FIG. 7.2-1 ACCESS CONTROL

- Access Control through Driveway Regulations

  Driveway controls can be effective in preserving the functional character of arterial streets. The control of permits for curb use can be adopted to minimize marginal interference with the free flow of traffic.

- Access Control Through Geometric Design

  Frontage roads and grade separations afford the ultimate in access control. Fully developed frontage roads effectively control access to the through lanes on an arterial street, provide access to adjoining property, separate local from through traffic, and permit circulation of traffic on each side of the arterial.

7.2.2 Frontage Road

(1) Services of Frontage Road

It is highly recommended that frontage roads should be provided wherever possible to prevent the so called ribbon type development. Ribbon type development occurs when the free urbanization and building of establishments is allowed alongside the road, as illustrated in Figure 7.2.2-1.

Depending on the type of arterial they serve and the character of the surrounding area frontage roads serve numerous functions including the following,

- To control access to the arterial
- To function as a local street facility serving adjoining property.
- To segregate local traffic from the higher speed through traffic
- To maintain circulation of traffic on each side of the arterial.
- To intercept driveways of residences and commercial establishments along the arterial.

Frontage roads are used on all types of highways and are desirable in the following circumstances.

- On expressways where their primary function is to distribute and collect traffic between local streets and the interchanges.
- On expressways in rural areas to serve as access connections between crossroads and adjacent farms or other development.
- On arterial streets both in downtown and suburban areas to provide more favorable access for commercial and residential development and to preserve the safety and capacity of the arterial street.

(2) Arrangements of Frontage Roads

Frontage roads generally are, but need not be, parallel to the arterial for through traffic, they may or may not be continuous, and they may be provided on one or both sides of the arterial.

The most common arrangement and pattern of frontage roads is two frontage roads running parallel and approximately equidistant from the arterial. Where the arterial crosses a grid street system on a diagonal course, or where the street pattern is irregular, the frontage roads may be a variable distance from the through-traffic roadway as shown in Figure 7.2-2.

From an operational and safety standpoint, one-way frontage roads are much preferred to two-way roads. One-way operation inconveniences local traffic to some degree, but the advantages in reduction of vehicular and pedestrian conflicts at intersecting streets often compensates for this inconvenience. In addition, there is some saving in roadway and right-of-way width. Two-way frontage roads may be considered for partially developed urban areas where the adjoining street system is so irregular or so disconnected that one-way operation would introduce considerable added travel distance and cause undue inconvenience. In suburban or rural areas, two-way frontage roads may also be necessary where points of access to the through facility are infrequent, where only one frontage road is provided, where roads or streets connecting with the frontage roads are widely spaced, or in urban areas, where no parallel street within reasonable distance of the frontage roads is likely to be developed.

7.2.3 Intersecting Roads

(1) Arrangement of Intersecting Roads

When developing a route as an arterial or expressway, it must be determined whether each intersecting road should be terminated, rerouted or provided with an at-grade intersection, a grade separation or interchange. The chief concern is the continuous flow on the major road. For those cross roads that can not be terminated, some crossing facilities should be provided. Crossing facilities are important parts of a highway, to a great extent, the efficiency, safety, speed, cost of operation and capacity of the road depend on their location and design.

The following lists some of the alternative arrangements for intersecting roads:

- Termination of cross road
- Provision of right turn movement both from arterial and cross road
- Intersection at grade
- Grade separation without ramp
- Interchange

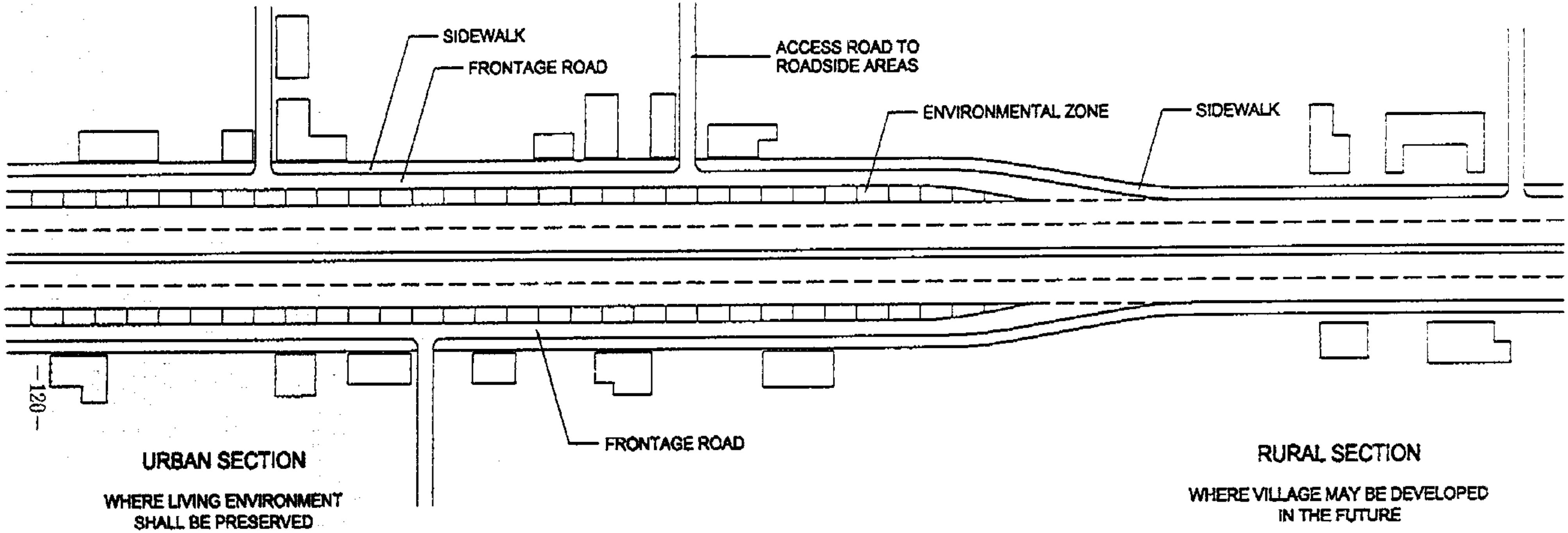


FIGURE 7.2-2   FRONTAGE ROADS

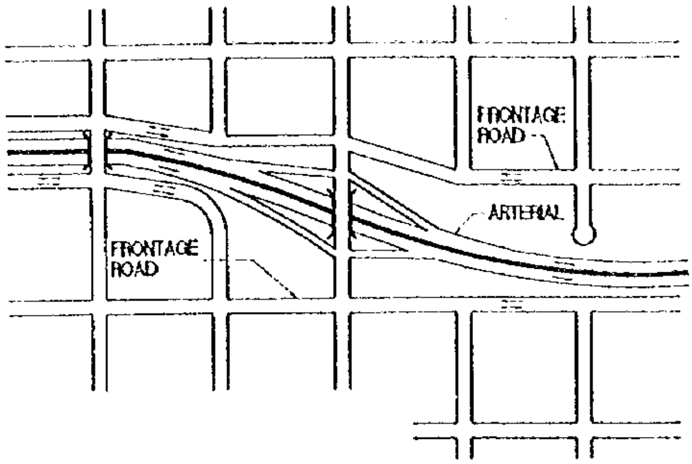


FIGURE 7.2-3 FRONTAGE ROADS, IRREGULAR PATTERN

(2) Examples of Crossings

Four-Leg Intersection (channelized type)

The typical arrangement for crossing roads is at-grade intersection. Figure 7.2-4 illustrates typical layout for a channelized intersection on a high-speed divided highway intersecting a major crossroad.

An auxiliary lane for left turn movements and a right turning lane for speed change are provided. They afford both a high degree of efficiency in operating and a high capacity, and permit through traffic on the highway to operate at reasonable speed. Proper use of signed control is required.

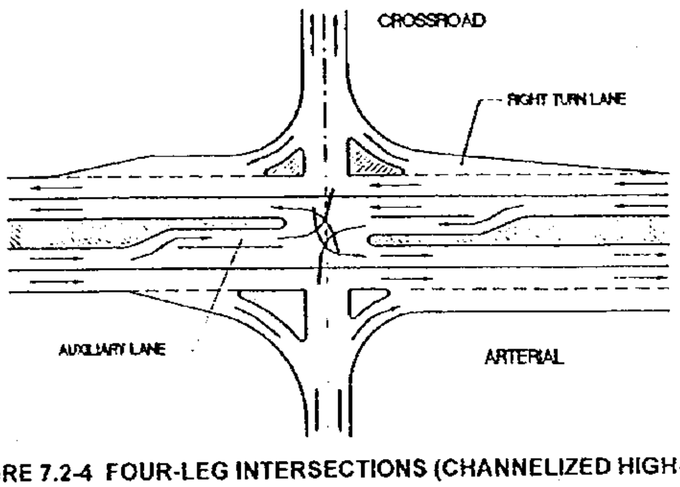


FIGURE 7.2-4 FOUR-LEG INTERSECTIONS (CHANNELIZED HIGH-TYPE)

Underpass

There are many situations where grade separation is provided without ramps. A planned arterial intersects existing highways that must be kept open for service but on which traffic is minor. In these cases, a grade separation without ramps may be provided.

A grade separation may be by overpass or underpass depending on topography, traffic condition and other factors.

Figure 7.2-5 shows an example of a simple grade separation through an underpass. An box culvert type structure can be used with a vertical clearance of 4.88m for vehicles and 2.50 m for cart, trolley or pedestrian use.

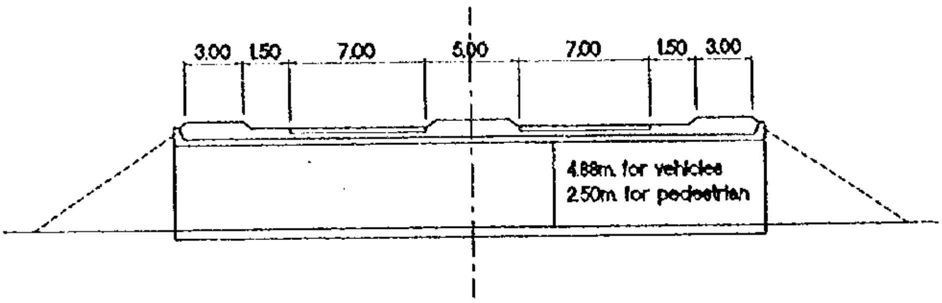


FIGURE 7.2-5 AN EXAMPLE OF UNDERPASS

7.3 DESIGN CONCEPT AND STANDARDS

7.3.1 DPWH Design Standards

The DPWH minimum design standards for highways are shown in Table 7.3-1. They are for a 2-lane road in rural areas and do not include the design standards for a multiple-lane road. As shown in the table, the design standards for a road are determined from the traffic volume in the opening year.

As an example of actual practice, the geometric design standards used for the rehabilitation of the Pan-Philippine Highway (Mindanao Section) are shown in Table 7.3-2. These are less than the DPWH minimum design standards.

7.3.2 AASHTO Design Standards

The highway should be designed so that when it is carrying the design volume, the traffic demand will not exceed the capacity of the facility even during short intervals of time. The basic design concept should be established such that the facility can provide for both the mobility and safety of road users. The following are basic elements to be considered in highway planning.

(1) Level of Service

The Highway Capacity Manual (HCM, 1994) has established the "Level of Service" concept based on the characteristics of the traffic flow. The relationship between level of service and traffic characteristics is determined from the degree of congestion. The manual recommends appropriate levels of service as summarized in Table 7.3-3.

TABLE 7.3-3 GUIDE FOR SELECTION OF DESIGN LEVEL OF SERVICE

Highway Type	Type of Area and Appropriate Level of Service			
	Rural Level	Rural Rolling	Rural Mountainous	Urban and Suburban
Freeway	B	B	C	C
Arterial	B	B	C	C
Collector	C	C	D	D
Local	D	D	D	D

Note : General operating conditions for levels of services;

- A - free flow, with low volumes and high speeds.
- B - reasonably free flow, but speeds beginning to be restricted by traffic conditions.
- C - in stable flow zone, but most drivers restricted in freedom to select their own speed
- D - approaching unstable flow, drivers have little freedom to maneuver
- E - unstable flow, may be short stoppages.
- F - forced or breakdown flow.

Source : AASHTO Standards 1994

TABLE 7.3-1 MINIMUM DESIGN STANDARD OF PHILIPPINE HIGHWAYS

ADT AVERAGE DAILY TRAFFIC ON OPENING	UNDER 200	200 - 400	400 - 1000		1000 - 2000		MORE THAN 2000	
			MINIMUM	DESIRABLE	MINIMUM	DESIRABLE	MINIMUM	DESIRABLE
DESIGN SPEED (km / h)								
FLAT TOPOGRAPHY	60	70	70	90	80	95	90	100
ROLLING "	40	50	60	80	60	80	70	90
MOUNTAINOUS "	30	40	40	50	50	60	60	70
RADIUS (metre)								
FLAT TOPOGRAPHY	120	160	160	280	220	320	260	350
ROLLING "	55	85	120	220	120	220	160	280
MOUNTAINOUS "	30	50	50	80	80	120	80	160
GRADE (PERCENT)								
FLAT TOPOGRAPHY	6.0	6.0	5.0	3.0	4.0	3.0	4.0	3.0
ROLLING "	8.0	7.0	6.0	5.0	5.0	5.0	5.0	4.0
MOUNTAINOUS "	10.0	9.0	8.0	6.0	7.0	6.0	7.0	5.0
ROAD WIDTH								
PAVEMENT WIDTH (m)	4.0	5.5 ; 6.0	6.10		6.70		6.70	7.30
SHOULDER WIDTH (m)	0.50	1.00	1.50	2.00	2.50	3.00	3.00	
RIGHT-OF-WAY WIDTH (m)	20	30	30		30	30	60	
SUPERELEVATION (m/m)	0.10 (MAX.)		0.10 (MAX.)		0.10 (MAX.)		0.10 (MAX.)	
NON-PASSING SIGHT DISTANCE (metre)								
FLAT TOPOGRAPHY	70	90	90	135	115	150	135	160
ROLLING "	40	60	70	115	70	115	90	135
MOUNTAINOUS "	40	40	40	60	60	70	70	90
PASSING SIGHT DISTANCE (metre)								
FLAT TOPOGRAPHY	420	490	490	615	560	645	615	675
ROLLING "	270	350	420	560	420	560	490	615
MOUNTAINOUS "	190	270	270	350	360	420	420	490
TYPE OF SURFACING	GRAVEL, CRUSHED GRAVEL OR CRUSHED STONE BIT. PRESERVATIVE TREATMENT SINGLE OR DOUBLE BIT. SURFACE TREATMENT, BITUMINOUS MACADAM PAVEMENT.		BITUMINUOS MACADAM PAVEMENT, DENSE OR OPEN GRADED PLAN MIX SURFACE COURSE, BITUMINOUS CONCRETE SURFACE COURSE.		BITUMINOUS CONCRETE SURFACE COURSE		BITUMINOUS CONCRETE SURFACE COURSE, PORTLAND CEMENT CONCRETE PAVEMENT	

SOURCE: Design Guidelines, Criteria and Standards, Bureau of Design, DPWH

TABLE 7.3-2 GEOMETRIC DESIGN STANDARDS FOR REHABILITATION OF PAN-PHILIPPINE HIGHWAY (MINDANAO SECTION)

Terrain	Flat			
		Rolling		
			Mountainous	
Design Speed (km/h) / Design Element	80	60	50	40
1. Lane Width (m)	3.34	3.35	3.35	3.35
2. Pavement Width (m)	6.70	6.70	6.70	6.70
3. Shoulder Width (m)	2.5	2.5	2.50 - 1.00	2.50 - 0.50
4. Minimum Horizontal Radius (m)	220	120	80	50
5. Maximum Vertical Grade (%)	4.0	5.0	7.0	8.0
6. Absolute Max. Grade (%) and It's Max. Length (m)	-	6% : 500m 7% : 400m	8% : 400m	-
7. Maximum Superelevation (%)	6	6	6	6
8. Maximum Combined Gradient Rate of Vertical Grade and Superelevation	11.5	11.5	11.5	11.5
9. Non-Passing (Stopping) Sight Distance (m)	115	70	60	40
10. Passing Sight Distance	560	420	360	270

SOURCE:
Detailed Engineering Design Study on Pan-Philippine Highway Improvement Project (Mindanao Section), Final Report, March 1997

(2) Design Speed

Table 7.3-4 summarizes the minimum design speed recommended by AASHTO Standards, 1994.

TABLE 7.3-4 MINIMUM DESIGN SPEEDS (Km/h)

Highway Classification	Terrain	Average Daily Traffic (ADT)					
		Under 50	50-250	250-400	400-1500	1500-2000	Over 2000
Rural Local Roads	Level	50	50	60	80	80	80
	Rolling	30	50	50	60	60	60
	Mountainous	30	30	30	50	50	50
Rural Collectors	Level	60	60	60	80	80	90
	Rolling	50	50	50	60	60	80
	Mountainous	30	30	30	50	50	60
Rural Arterials	Level	100 to 110 (normally used)					
	Rolling	80 to 100 (normally used)					
	Mountainous	60 to 80 (normally used)					
Urban Local Street	-	30 to 50					
Urban Collectors	-	Minimum 50					
Urban Arterials	Central Business	60 – 80					
	Outlying Business	80 – 100					

Source : AASHTO Standards 1994

(3) Roadway Width

Table 7.3-5 summarizes the minimum width of travelling lane and usable shoulder for rural arterials.

TABLE 7.3-5 MINIMUM WIDTH OF TRAVELLED WAY AND USABLE SHOULDER FOR RURAL ARTERIALS

Design Speed (km/h)	ADT Under 400	ADT 400-1500	ADT 1500-2000	DHV Over 200
	Width of Traveled Way (m) [a]			
60	6.6	6.6	6.6	7.2
70	6.6	6.6	6.6	7.2
70	6.6	6.6	6.6	7.2
80	6.6	6.6	7.2	7.2
90	7.2	7.2	7.2	7.2
100	7.2	7.2	7.2	7.2
110	7.2	7.2	7.2	7.2
120	7.2	7.2	7.2	7.2
	Width of Usable Shoulder (m) [b]			
All Speeds	1.2	1.8	1.8	2.4

[a] Width of traveled way may remain at 6.6m on reconstructed highways where Alignment and safety records are satisfactory.

[b] Usable shoulders on arterials should be paved.

7.3.3 Japan Design Standards

(1) Highway Classification of Japan Design Standards

The Highway Ordinance of Japan Road Association prescribes the highway classification as follows:

	Rural	Urban
Expressway and Motoring	Type 1	Type 2
Other Roads	Type 3	Type 4

Each type is sub-classified into 2 or 5 classes based on planned traffic volume and areas where highway unit are located as shown in Table 7.3-6.

(2) Basic Design Elements

The Japan Road Association regulates the basic design elements as shown in Table 7.3-7.

TABLE 7.3-7 DESIGN STANDARD OF JAPAN ROAD ASSOCIATION

Road Class	Expressway and Mortorway Rural Area Class-2	Expressway and Motorway Urban Area Class – 1	National Road Rural Area Grade – 1 Flat
Design Speed (km/h)	100	80	80
Radius (Min.) (m)	460	280	280
Grade (Max.) (%)	3	4	4
Road Width (Min.)			
Lane Width (m)	3.5	3.5	3.5
Shoulder (In side) (m)	1.25	0.75	0.5
Shoulder (Out side) (m)	2.5	1.25	1.25

7.3.4 Recommended Design Concept and Standards

(1) Improvement Level

Level of Service

"Level of Service" is defined by Highway Capacity Manual (HCM) as :

The concept of level of service is defined as a qualitative measure describing operational conditions within a traffic stream, and their perception by road users. The six (6) level of services were rated as; A(-the best operating condition,) B(-the good operating condition;) C(-the fair operating condition,) D(-the poor operating condition,) E(-the bad operating condition;) and F(-the worst operating condition).

TABLE 7.3-6 ROAD CLASSIFICATION OF JAPAN DESIGN STANDARDS

	AREA	TYPE	CLASS	DESIGN SPEED (km/h)		Access Control	TRAFFIC VOLUME (Vehicle/Day) 30,000>	30,000 ~20,000	20,000 ~10,000	10,000<	REMARKS
Expressway and Motorway	Rural	I	1	120	(100)	F	Expressway (Flat)	-	-	-	
			2	100	(80)	F.P.	Expressway (Mountainous) Motorway (Flat)	Expressway (Flat)			
			3	100	(80)	F.P.	- Motorway (Mountainous)	Expressway (Mountainous)		Expressway (Flat) Motorway (Flat)	
			4	60	(50)	F.P.	-	-	Motorway (Mounainous) -	Expressway (Mountainous)	Design speed for Expressway shall be 60 km/h only
	Urban	II	1	80	(60)	F	Expressay & Motorway				Motorway is not applicable to urban center
			2	60	(50) (40)	F	Motorway, Center Area of Big City				

	AREA	TYPE	CLASS	DESIGN SPEED (km/h)		Access Control	TRAFFIC VOLUME (Vehicle/Day) 20,000>	20,000 ~10,000	10,000 ~4,000	4,000 ~1,500	1,500 ~500	500<	REMARKS
Other Roads	Rural	III	1	80	(60)	P.N.	National Road (Flat)	-	-	-	-	-	
			2	60	(50) (40)	N	National Road (Mounainous) Provincial & City Road (Mountainous)	National Road (Flat)		-	-	-	
			3	60 50 40	(30)	N	- Provincial Road, City Road Mountainous	National Road (Flat)		National & Provincial Road (Flat) City Road (Flat)	-	-	
			4	50 40 30	(20)	N	-	-	-	National & Provincial Road (Mountainous) City Road (Mountainous)	City Road (Flat) (Mountainous)	-	
			5	40 30 20	-	N	-	-	-	-	-	City Road (Flat (Mountainous)	One Lane Road only
	Urban	IV	1	60	(50) (40)	P.N.	National Road Provincial & City Road						
			2	60 50 40	(30)	N	-	-	Provincial & City Road	National Road -	-	-	
			3	50 40 30	(20)	N	-	-	-	Provincial Road City Road			
			4	40 30 20	-	N	-	-	-	-	-	City Road	Onie Lande Road only

Access Control: F = Full Control, P = Partial Control, N = No Control
( ) : Reduced Design Speed due to topographic constraint.

Figure 7.3-6 shows the characteristics of each level of service and corresponding traffic volume calculated with the following assumptions These are considered a typical case for the Study Road.

- Two-lane highway segment
- Level terrain
- 0 percent of no passing zones
- Peak hour factor: 0.95
- Peak hour ratio : 7.5%
- Directional distribution : 60:40
- Traffic composition
  PC 30% Truck 10%, Bus 5%
  Jeepney 30%, Tricycles 25%

(2) Recommended Improvement Level

The minimum acceptable level required by road users would be the lowest allowable level. From the viewpoint of highway planning and if such plans are economically and financially feasible, the highway should be planned to provide a higher quality of service with faster, safer and more comfortable means of transport.

The Pan-Philippine Highway is the major trunk road serving long-distance trips and connecting major urban centers in the regions with Metro Manila. Hence mobility should be given a high priority. As much as possible land accessibility should be restricted to minimum. Therefore, it is recommended that the improvement level of the Highway is measured by level of service. Where level of service of certain sections are worse than those shown in Table 7.3-8, the section is recommended for improvement.

TABLE 7.3-8 RECOMMENDED IMPROVEMENT LEVEL

Section	Recommended Improvement Level	Level of Service at Design Stage
Rural Section	Early Stage of E	B
Urban Section	Middle Stage of E	C
Intersection	Middle Stage of E	C

(3) Geometric Design Standards

Based on the DPWH Minimum Design Standard, the geometric design standard recommended for new construction of the Pan-Philippine Highway and its bypass is shown in Table 7.3-9.

In comparison with the standard recommended for new construction, the geometric design standards adopted for the rehabilitation of the Mindanao Section of the Pan-Philippine Highway are also shown.

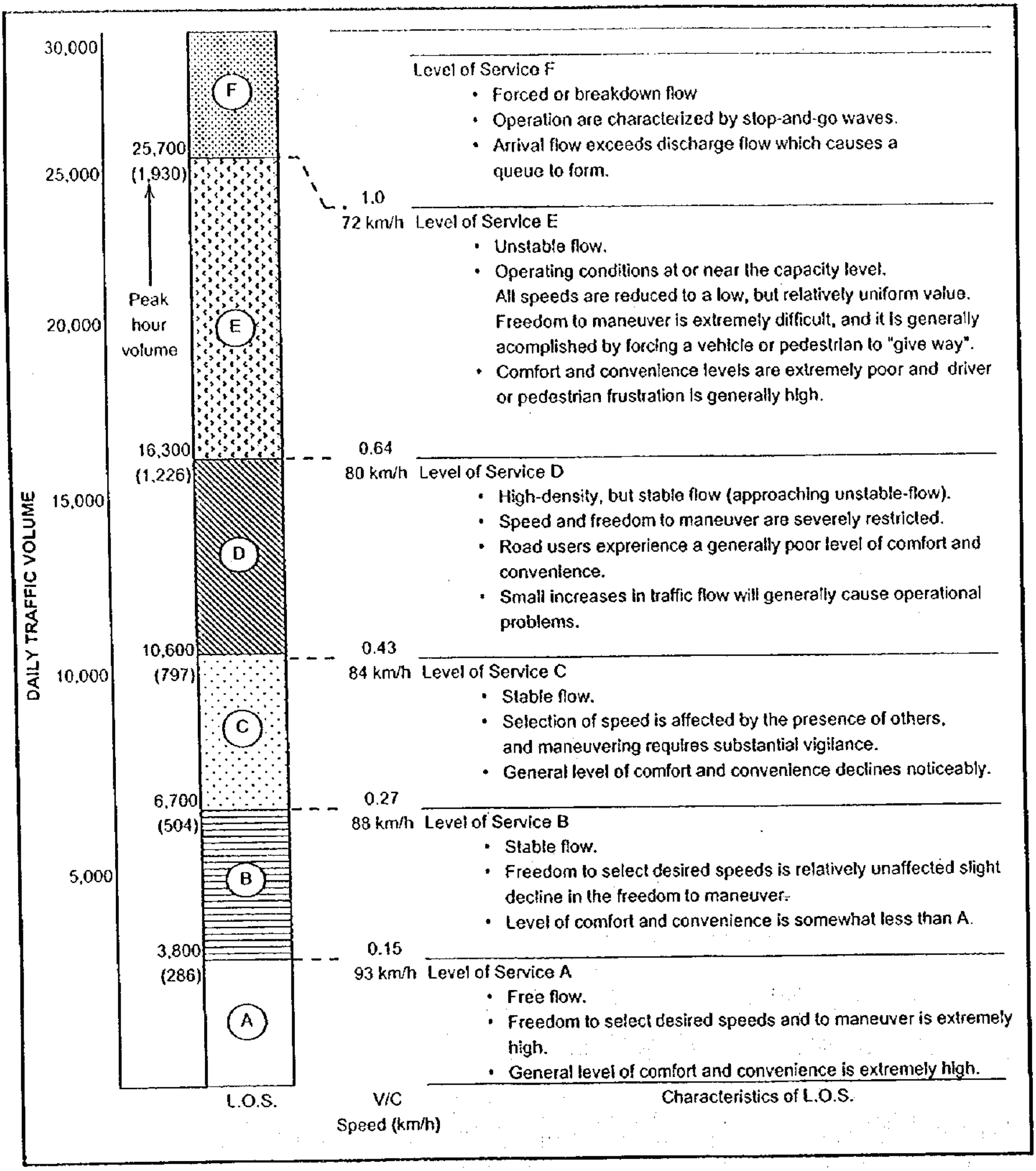


FIGURE 7.3-6 AN EXAMPLE OF TRAFFIC VOLUME UNDER EACH LEVEL OF SERVICE

TABLE 7.3-9 RECOMMENDED GEOMETRIC DESIGN STANDARDS FOR PAN-PHILIPPINE HIGHWAY

Work	Rehabilitation			New Construction		
Terrain	Flat	Rolling	Mountainous	Flat	Rolling	Mountainous
Design Speed (km/h)	60 ~ 80	50 ~ 60	40 ~ 50	80 ~ 100	70 ~ 90	60 ~ 70
Pavement Width (m)	3.35	3.35	3.35	3.35 ~ 3.65	3.35 ~ 3.35	3.35 ~ 3.65
Shoulder Width (m)	2.5	1.0 ~ 2.5	0.5 ~ 2.5	3	3	3
Right-of-Way Width (m)	-	-	-	60	60	60
Radius (m)	120 ~ 220	80 ~ 120	50 ~ 80	280 ~ 350	150 ~ 280	80 ~ 160
Grade (%)	5 ~4	7 ~ 5	8 ~ 7	4 ~ 3	5 ~ 4	7 ~ 5
Non-Passing Sight Distance (m)	70 ~ 115	60 ~ 70	40 ~ 60	115 ~ 150	90 ~ 135	80 ~ 90
Passing Sight Distance	420 ~ 550	360 ~ 420	270 ~ 360	560 ~ 675	490 ~ 165	420 ~ 490

(4) Standard Cross-Sections

Four (4) types of standard cross-section are recommended. These take into account the future environmental conditions in the areas adjacent to the bypass as well as the volume of local traffic.

- Urban Area
  - where living environment shall be preserved
  - where local traffic may be less significant

- Rural Area
  - where villages may exist along road in the future
  - where no village may exist along road in the future

Figure 7.3-7 shows the recommended standard cross-sections for the bypass to the Pan-Philippine Highway.

In planned urban areas where the living environment is to be preserved a frontage road and an environmental zone are provided. These will provide a comfortable living and environmental condition along the road, while contributing to the orderly and systematic development of the roadside area.

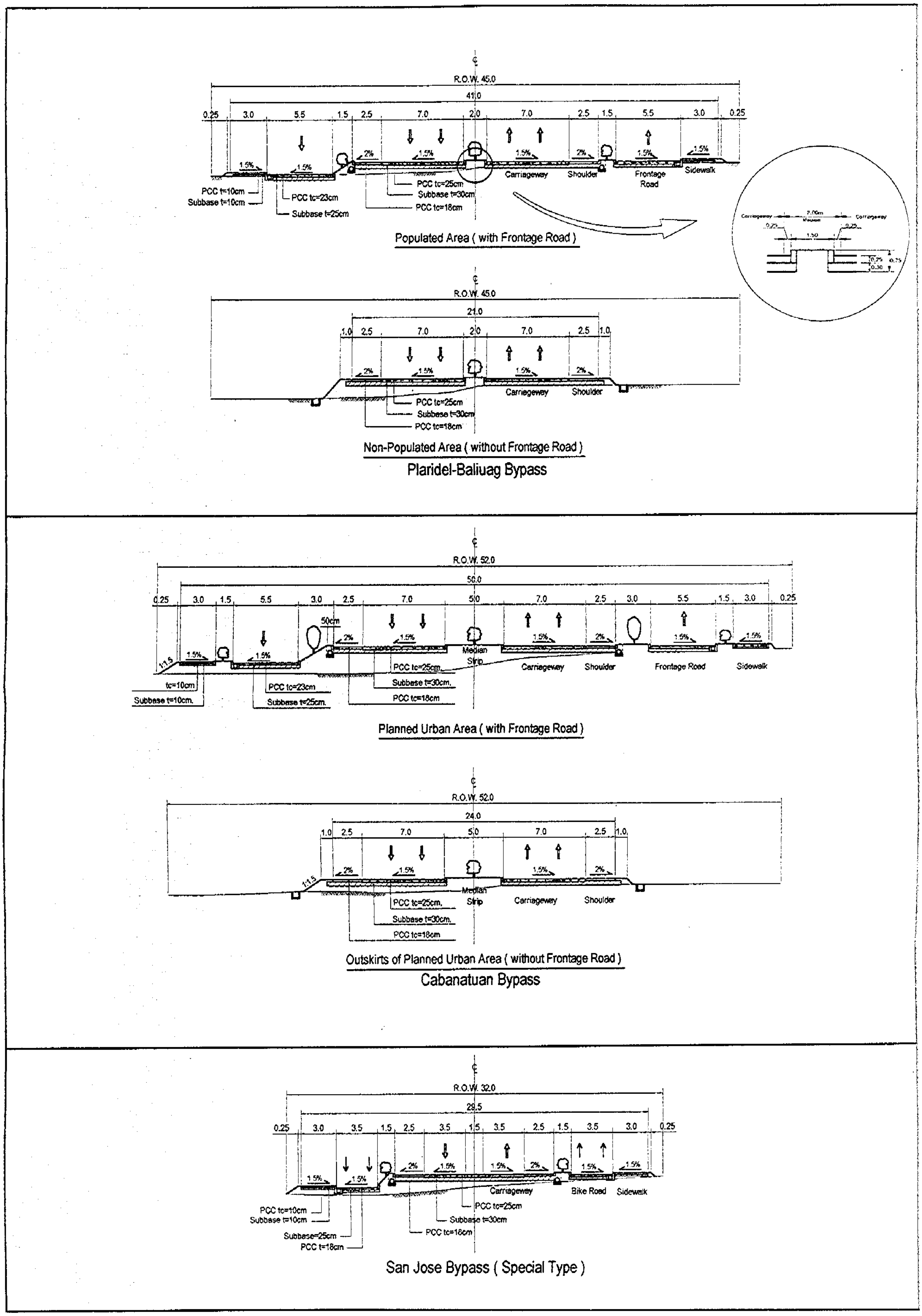


FIGURE 7.3-7 STANDARD CROSS SECTION OF EACH BYPASS

7.4 TRAFFIC SAFETY

Improving roads without applying appropriate safety measures is likely to result in an significant increase in both accident rates and accident severity. It is a fact that improved roads encourage drivers to increase their driving speeds thereby increasing the chances of a traffic accident. For upgraded highways, especially in urban areas, the need to separate people from motor traffic becomes essential.

Historically, the solution to traffic safety problems have been based on legislation, regulation, enforcement, education and engineering (L,R,3E).

In the Philippines, regulatory agencies have been created and rules have been promulgated that are intended to control the movement of vehicles in a safe manner. At various levels, rules and regulations have been enforced, and education/information programs have been carried out to improve the skill and awareness of drivers. In engineering, modern technology has been applied positively to the design and specifications of highways.

Therefore, the discussion in this section, focuses on highway facilities for traffic safety.

7.4.1 Causes and Problem Areas

In general, traffic accidents are caused by failure of one of three major elements of a transportation system; the human (drivers), the vehicle, or the guideway/environment. Identifiable problem areas in highway traffic safety include;

- Pedestrian-vehicle conflicts
- Vehicle-vehicle conflicts
- Interactions of different sized vehicles
- Inadequate or impaired driving ability
- Inadequate communication with the driver and between drivers (signs, markings, signals)
- Deterioration of physical facility (reduced maintenance on highways and bridges)
- Roadside safety hazards

Because pedestrians may decide to cross a traffic stream wherever they choose, accidents at intersections account for the major proportion of urban traffic accidents. Traffic signals adjusted for vehicles may be effective as a traffic solution, but sometimes they may not allow for children or the elderly to cross a road in safety. Pedestrian overpasses or underpasses may contribute to traffic safety, but require the pedestrian to climb stairs.

The installation of modern, well tried systems of communication (signs, markings, signals) at some locations may greatly contribute to safety. While poorly, placed and maintained signs, poorly timed signals and poorly maintained or non-existent markings may contribute to accidents.

7.4.2 Traffic Control Devices

Traffic control devices such as signs, markings and signals should be well designed and placed at proper locations.

- Design
  The combination of physical features such as size, colors and shape needed to command attention and convey a message.

- Placement
  Devices should be placed so that they are within the cones of vision of the users, and thus able to command attention and allow time for response.

- Operation
  Devices should be applied so that they meet traffic requirements in a uniform and consistent manner, fulfill a need, command respect, and allow time for response.

- Maintenance
  The upkeep of devices to retain legibility and visibility, or the removal of devices if not needed, encourages respect and attention while fulfilling the needs of users.

- Uniformity
  The uniform application of similar devices for similar situations so that they fulfill the needs of users and command their respect.

(1) Traffic Signs

Functionally, traffic signs are classified as follows:

- **Regulatory Signs**

  To give notice of traffic laws or regulations

- **Warning Signs**

  To call attention to conditions on, or adjacent to a highway or street that are potentially hazardous to traffic operations.

- **Guide Signs**

  To show route designations, destinations, directions, distances, services, point of interest, and other geographical and recreational information.

- **Regulatory Signs**

  Regulatory signs are normally erected at those locations where regulations apply. The sign message should clearly indicate the requirements imposed by the regulation and should be easily visible and legible to the vehicle operator.

Regulatory signs are classified in the following groups:

- Right of way series (STOP, YIELD)
- Speed series
- Movement series (turning, alignment, exclusion, one way)
- Parking series
- Pedestrian series
- Miscellaneous series

- **Warning Signs**

  Warning signs require caution on the part of the vehicle operator and may call for a reduction of speed or a maneuver in the interest of his own safety and that of other vehicle operators and pedestrians. Adequate warnings are of great assistance to the vehicle operator and are valuable in safe-guarding and expediting traffic. Typical locations and hazards that may warrant the use of warning signs are:

  - Changes in horizontal alignment
  - Intersections
  - Advance warning of control devices
  - Converging traffic lanes
  - Narrow roadways
  - Changes in highway design
  - Grades
  - Roadway surface conditions
  - Entrances and crossings
  - Miscellaneous

  - **Guide Signs**

    Guide signs are essential to guide vehicle operators along streets and highways, to inform them of intersecting routes, to direct them to cities, towns, villages, or other important destinations, to identify nearby rivers and streams, parks, forests, and historical sites, and generally to give such information as will help them along their way in the most simple and direct manner possible.

Figure 7.4-1 demonstrates an example of traffic signs to be used in the country.

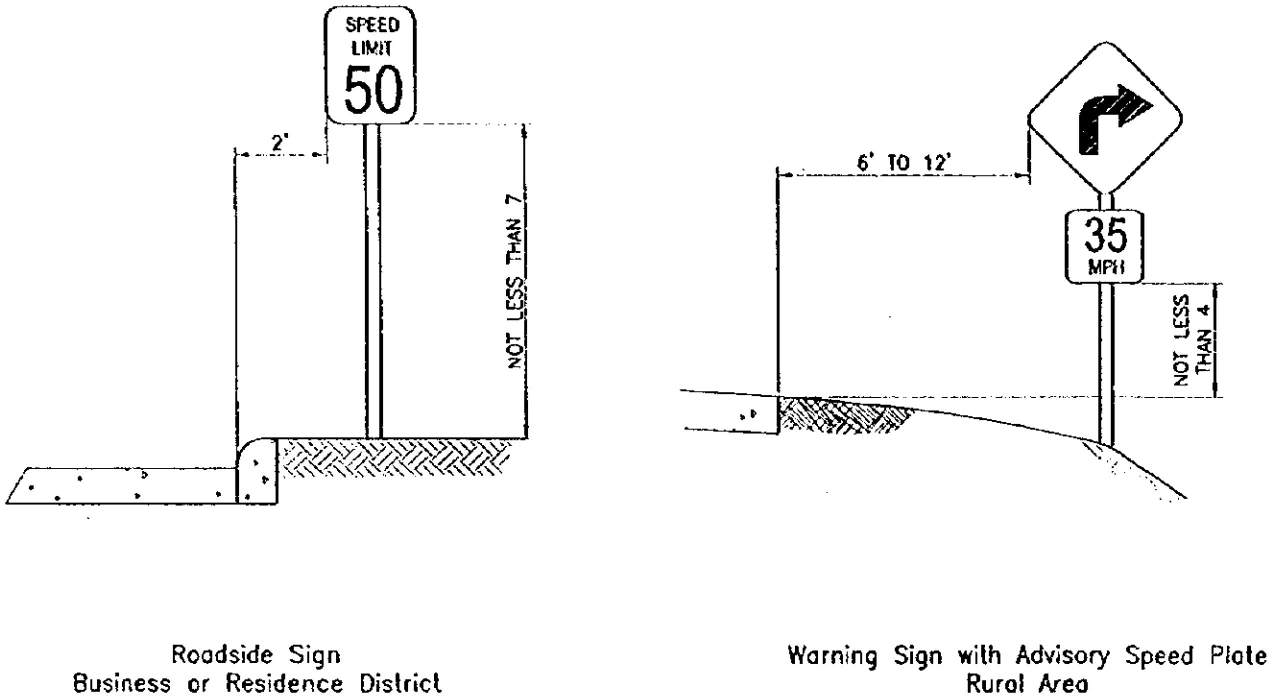


FIGURE 7.4-1 AN EXAMPLE OF TRAFFIC SIGNS

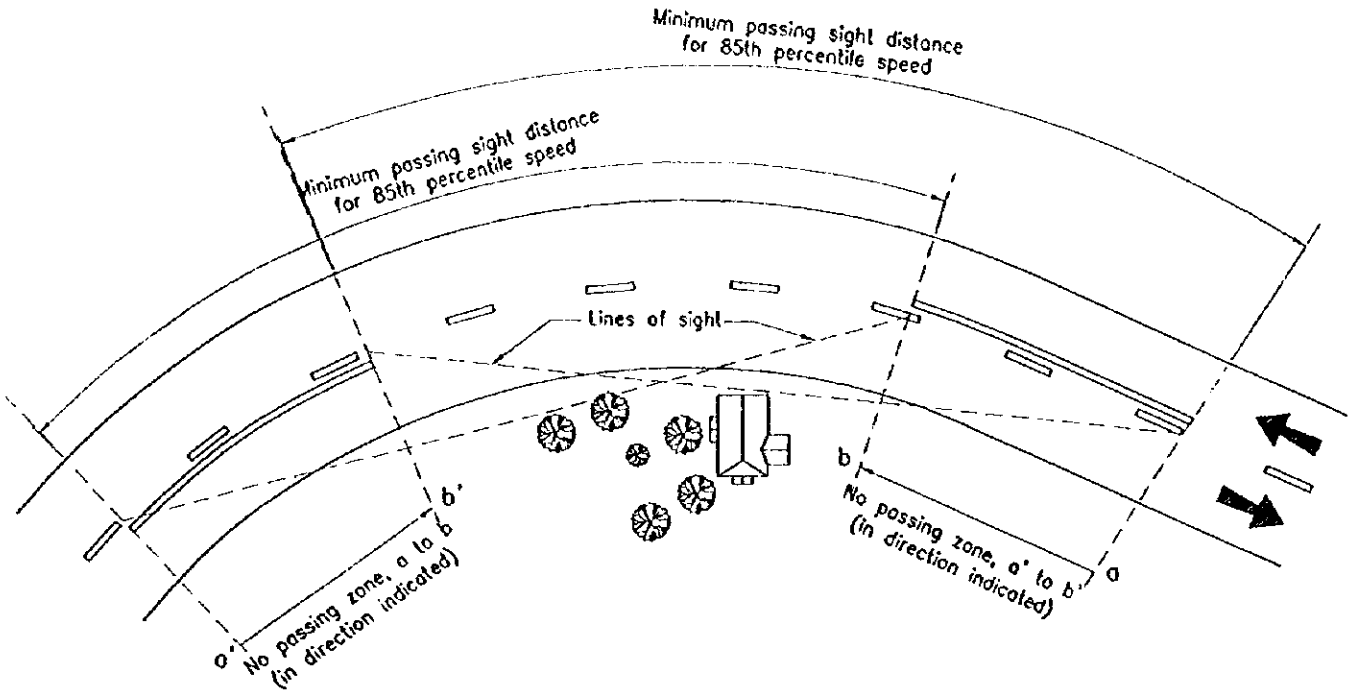
(2) Markings

In a proper scheme of traffic control, markings have definite and important functions to perform In some cases, they are used to supplement the regulations or warnings of other devices such as traffic signs or signals. In other instances, they are used alone and produce results that cannot be obtained by the use of any other device. In such cases they serve as a very effective means of conveying certain regulations and warnings that could not otherwise be made clearly understandable.

One example of an effective marking is the No-Passing Zone marking. Where center lines are installed, no-passing zones should be established at vertical and horizontal curves and elsewhere on two- and three-lane highways where an engineering study indicates passing must be prohibited because of inadequate sight distances or other special conditions. A no-passing zone should be so marked where the sight distance is equal to or less than that listed below for the prevailing off-peak 85 percentile speed or the posted speed limit, whichever is higher:

85 Percentile Speed (MPH)	Minimum Passing Sight Distance (Feet)
30	500
40	600
50	800
60	1000
70	1200

Figure 7.4-2 show an example of no-passing zone due to horizontal curve.



a, a' Begin no-passing zone

Sight distance, measured along center line (or right-hand lane line on three lane road) becomes less than minimum

b, b' End no-passing zone

Sight distance again exceeds minimum

Note: No-passing zones in opposite directions may or may not overlap, depending on alignment.

FIGURE 7.4-2 NO PASSING ZONE AT HORIZONTAL CURVE

(3) Signals

Highway Traffic Signals

In most cases, the installation of a highway traffic signal will operate either to the advantage or disadvantage of the vehicles and persons controlled. A careful analysis of traffic operations and other factors at a large number of signalized and unsignalized intersections, have provided a series of warrants that define the minimum conditions under which signal installations may be justified. Consequently the selection and use of this control device should be preceded by a through engineering study of roadway and traffic conditions.

Engineering studies should be made of operating signals to determine if the type of installation and the timing program meet the current traffic requirements.

Pedestrian Signals

Pedestrian signals shall be installed in conjunction with vehicular traffic signals (which meet one or more of the traffic signal warrants previously set forth) under any of the following conditions:

- When a traffic signal is installed under the Pedestrian Volume or School Crossing warrant.
- When an exclusive interval or phase is provided or made available for pedestrian movements in one or more directions, with all conflicting vehicular movements being stopped.
- When vehicular indications are not visible to pedestrians such as on one-way streets, at "T" intersections; or when the vehicular indications are in a position which would not adequately serve pedestrians.
- At established school crossings at intersections signalized under any warrant.

(4) Lighting

To the urban community, street lighting is a means of improving the urban environment through increased comfort, convenience, and safety of night-traffic operation and reduced crime and accidents.

Lighting provides traffic safety by illuminating hazardous objects or hazardous situations so that the driver may respond readily and safety. Further, it can significantly improve the efficiency and safety of traffic operation.

Public lighting should permit users of traffic facilities to move about at night with the greatest possible safety, comfort, and convenience. The driver must be able to see distinctly and locate with certainty details of the driving environment. The pedestrian must also be able to see distinctly the pedestrian path and its relationship to vehicles and possible obstacles. Although public lighting must satisfy the informational needs of both vehicle operators and pedestrians, in practice, the driver's requirements are the more stringent.

7.5 ENVIRONMENTAL CONSIDERATION

7.5.1 Present Practice

(1) Environmental Legislation

Philippine Environmental Laws

There are thirteen (13) laws that instituted the implementation of the Environmental Impact Statement (EIS) System for proposed projects in the Philippines. Some of these laws which embody the basic EIA guidelines are: (i) Presidential Decree 1586 (PD 1586) and (ii) Proclamation No. 2146.

PD 1586 also known as the Philippine Environmental Impact Assessment (EIA) Law in 1978 introduced the concept of Environmentally Critical Projects (ECPs) and projects within Environmentally Critical Areas (ECAs). Proclamation No. 2146, series of 1981 delineated the major categories of ECPs and projects within ECAs.

Based on these laws, a Proponent is required to submit an Environmental Impact Statement (EIS) to the DENR Environmental Management Bureau (EMB) for ECPs. A proponent of projects located within ECAs is required to submit an Initial Environmental Examination (IEE) to the concerned DENR Regional Office.

EIS and IEE documents are reviewed by the DENR/EMB designated EIA Review Committee. A recommendation to grant or deny an Environmental Compliance Certificate (ECC) is then drafted by the said Committee. The ECC is signed by the Secretary of the DENR (for EIS documents) or the Regional Executive Director (for IEE documents).

MOA between the DENR/EMB and the DPWH

To expedite the processing of environmental clearances for government infrastructure projects, a Memorandum of Agreement (MOA) between the DENR/EMB and the DPWH is currently being finalized. This MOA contains the basic provisions, rights, obligations, and procedures to be followed by both parties for projects that are covered by PD 1586.

Under the said MOA, all road projects are categorized based on the following criteria. Only those criteria which are applicable to the bypass sections under the present study are discussed below.

(i) Projects within Environmentally Critical Areas (ECAs)

Under the General Provisions of the said MOA, IEE documents shall be prepared for projects that traverse and/or are located in an ECA and with a rating of less than 5. For projects that traverse and/or are located in an ECA and with a rating equal to or greater than 5, an EIS shall be prepared. The calculation of the ECA rating is determined by getting the total of values assigned according to the following table. A rating of 0 is given if the ECA is not applicable.

TABLE 7.5-1 ENVIRONMENTALLY SENSITIVE/CRITICAL AREAS VALUES

ECA	Rating
1. National Parks / watersheds / sanctuaries	5
2. Aesthetic potential tourist spots	2
3. Endangered species	4
4. Unique historic / archaeological / scientific areas	3
5. Indigenous culture communities	5
6. High incidence of natural hazards	1
7. Critical slopes > 40%	5
8. Prime agricultural land	3
9. Recharge areas for aquifer	2
10. Protected water bodies	2
11. Mangrove areas	4
12. Coral reefs	5

Source : Draft MOA between DENR/EMB and DPWH, 1999.

(ii) Environmentally Critical Projects (ECPs)

Major Realignments

These include road projects with major realignments from the existing road as defined in Table 7.5-2 given below. The table shows the maximum permissible length (Column 3) with the corresponding shift in the horizontal realignment (Columns 1 and 2) measured horizontally from the centerline of the existing road. Projects with values exceeding those indicated in this table are considered as ECPs.

TABLE 7.5-2 CRITERIA FOR NON-ECP CLASSIFICATION OF MAJOR ROAD REALIGNMENTS

Shift in Horizontal Alignment (m) for Mountainous Roads (>200 m above sea level)	Shift in Horizontal Alignment (m) for Lowland Roads (>200 m above sea level)	Maximum Total Length (m) Permitted for Non-Critical Project
0-1	0-2	1000
1-2	2-5	500
2-5	5-10	100
5-10	10-20	50
>10	>20	1

Source : Draft MOA between DENR/EMB and DPWH, 1999.

Major Widening

Any road rehabilitation and/or widening project where the widening will be <20% measured in relation to the existing paved area, or where the widening will result in one or more additional lanes will be considered as an ECP.

Construction or improvement of any national highway/road that will significantly increase access to an area.

This criteria refers to cases wherein the access to the influence area of the road is foreseen to increase by 50% or more, as indicated by an increase in the AADT over the first five (5) year period. The term "influence area", here refers to the area in which the project will cause an impact either directly or indirectly.

For example, if the existing AADT is say, 10,000 and the projected AADT after 5 years is 16,000 or more, then the project is considered as an ECP otherwise it will be classified as non-critical.

(iii) The following table provides the type of EIA document that must be prepared and the level of environmental management activities to be carried out for the different project categories.

TABLE 7.5-3 SUMMARY OF ENVIRONMENTAL MANAGEMENT PROCEDURES FOR PROPOSED ROAD PROJECTS

Category	Principal EIA Document	Supporting Documents
ECPs and Projects in ECA (5	Scooping Report EIS	Environmental Management Plan (EMP) Contract Specifications
Projects within ECA <5	Scooping Document IEE	Mitigation and Enhancement Measures Contract Specifications
Non-Critical Projects	EMP Standard Operational Procedures	Environmental Management Guidelines Contract Specifications

7.5.2 Recommendations

The main environmental problems associated with highways are i) impairment of scenic values / environmental aesthetics, ii) pollution noise and vibrations, and iii) inadequate maintenance.

To cope with these problems, a promotion of green movement is recommended including roadside land greening movement, particularly in urban areas. The concept is to provide a environmental protection zone and develop tree/plant species which can grow successfully in smog environment, and thus be useful for aesthetic screening of the highway from the adjacent environment.

For this environment consideration, the outer space of carriageway within the road right of area is recommended to be designed as shown on Figure 7.5-1.

(1) Provision of Environmental Protection Zone

- To provide planting zone to grow tree/plant species for environmental aesthetics and purification of polluted air.
- To provide wide open-space for noise and vibration including frontage road which can serve not only for local traffic but for environmental consideration.
- To provide sidewalk for pedestrian.

(2) Provision of Road Facilities

- Wide and paved shoulder
- Complete drainage system
- Barrier or plant on median

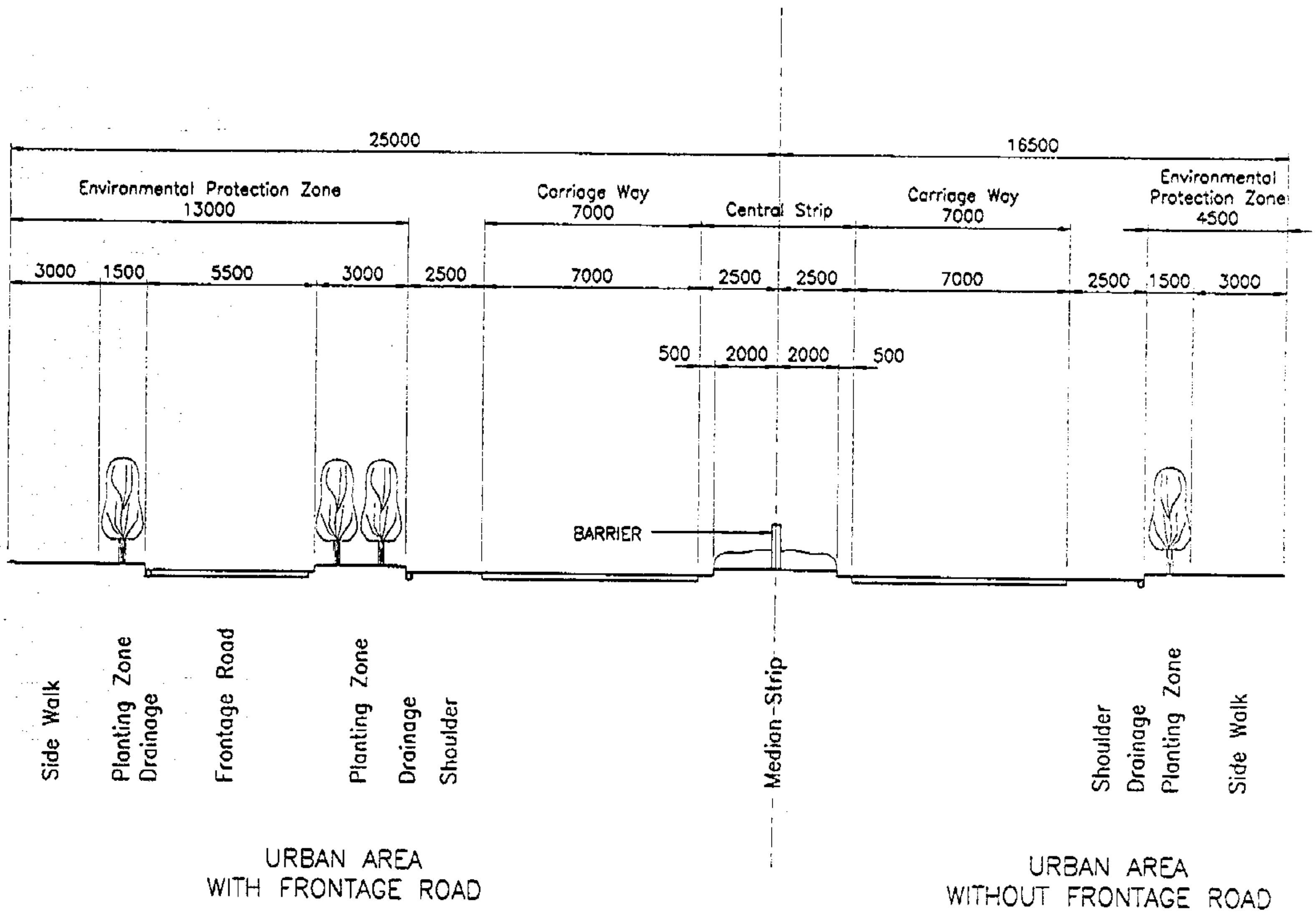


FIGURE 7.5-1 ENVIRONMENTAL CONSIDERATION FOR ROAD PLANNING

7.6 COMMUNITY RESETTLEMENT

7.6.1 Present Practice

(1) Current Conditions

1) The Law in Force : -
The Presidential Decree No. 399 is applicable to resettlement. This decree limits the use of a strip of land along existing/proposed or ongoing public road until the government has formulated a comprehensive land-use and development program.

2) Grouping of Land Acquisition and Resettlement : -
The work of land acquisition and resettlement is divided into the following groups:

   a) Legal Owner and Occupants : -
   To acquire the land by purchase with monetary compensation. In this case, the resettlement area will not be prepared.

   b) Squatters : -
   The resettlement areas will be prepared and the compensation will be determined and based on humane considerations.

   c) Illegal buildings : -
   Removal of illegal buildings from the road site without compensation.

3) Procedure for land acquisition : -
The DPWH flow chart for land acquisition in each group is shown in Figure 7.6-1.

4) Authorities and their activities for the resettlement of squatters

   a) Rural area
      - NHA (National Housing Authority)
      - LGU (Local Government Unit)

   b) Urban area
      - HUDCC (Housing and Urban Development Coordinating Council)
      - HIGCC (Housing and Insurance Guarantee Corporation)

   As a matter of fact, the authorities mentioned above are not closely connected with DPWH and their activities make slow progress. Their progress does not satisfy DPWH requirements.

Hazardous works such as compulsory removal of squatters are often carried out by Inter-agency Task Force organized in conjunction with PNP, LGU etc.

(2) Problems

Based on the consultant's experience in the Philippines, common problems related to land acquisition are summarized as follows:

1) Insufficient consideration during the planning and design stages.
   The route selection and detailed design etc. of the road construction are made without the adequate consideration of land acquisition.

2) Delay to the commencement of land acquisition procedures.
   The land acquisition procedures are started at the commencement of construction.

3) Inappropriate compensation.
   Difference between the official and actual land prices result in appropriate compensation.

4) Numerous squatters.
   It is difficult to compensate large numbers of squatters and other groups of people.

5) Responsibility of government authorities
   The rights and duties of the statutory authorities are not clear.

7.6.2 Recommendations

(1) Basic Concepts

Resettlement, and the associated problems connected with land acquisition, are one of the most important issues for the successful implementation of the Project.

The basic requirements for successful resettlement are as follows:

1) Select a resettlement area that is consistent with the inhabitant's lifestyle and economic environment.

   a) Carry out a Public Hearing for the implementation of the Project
   b) Carry out interviews of the inhabitants
   c) Request the support of the local self-governing community body.
      - Hold public meetings to explain the project.
      - Early commencement of the resettlement negotiations.

2) Prepare the inhabitant's living and economic environment for resettlement.

   a) Provide reasonable resettlement compensation
   b) Prepare the necessary infrastructure such as road, water supply, electricity, community and buildings, etc.
   c) Prepare the housing land and cultivated field area (as necessary)
   d) Provide a guidance plan for the resettlement.

3) Select a rational alignment for the Project

   a) Select an alignment for the project road that avoids densely built-up and commercial areas.

(2) Recommendations for Planning and Design

Detailed field reconnaissance will be undertaken to identify the land areas to be acquired and the number of people affected. Based on the existing laws, orders and regulations, an action plan for the resettlement will be prepared. The plan will identify the responsible agencies, and the agreements to be made between the agencies. The actions to be taken by the agencies will be specified.

The recommended stages in the planning and design are as follows:

1) Resettlement Plan for Legal Occupants
   - Flow chart of Right-of-Way (ROW) acquisition
   - Land areas to be acquired and their ownership (public or private)
   - Number of houses/buildings to be removed and compensated
   - Number of tenant farmers and their agricultural products
   - Resettlement site (if DPWH agrees to provide resettlement site for legal occupants)
   - Estimate of ROW acquisition and compensation cost
   - Action program

2) Resettlement Plan for Squatters
   - Flow chart for relocation of squatters
   - Number of squatters and distribution
   - Resettlement site development plan
   - Squatter relocation/resettlement program
   - Operation plan for resettlement site
   - Cost estimate by agency
   - Action program

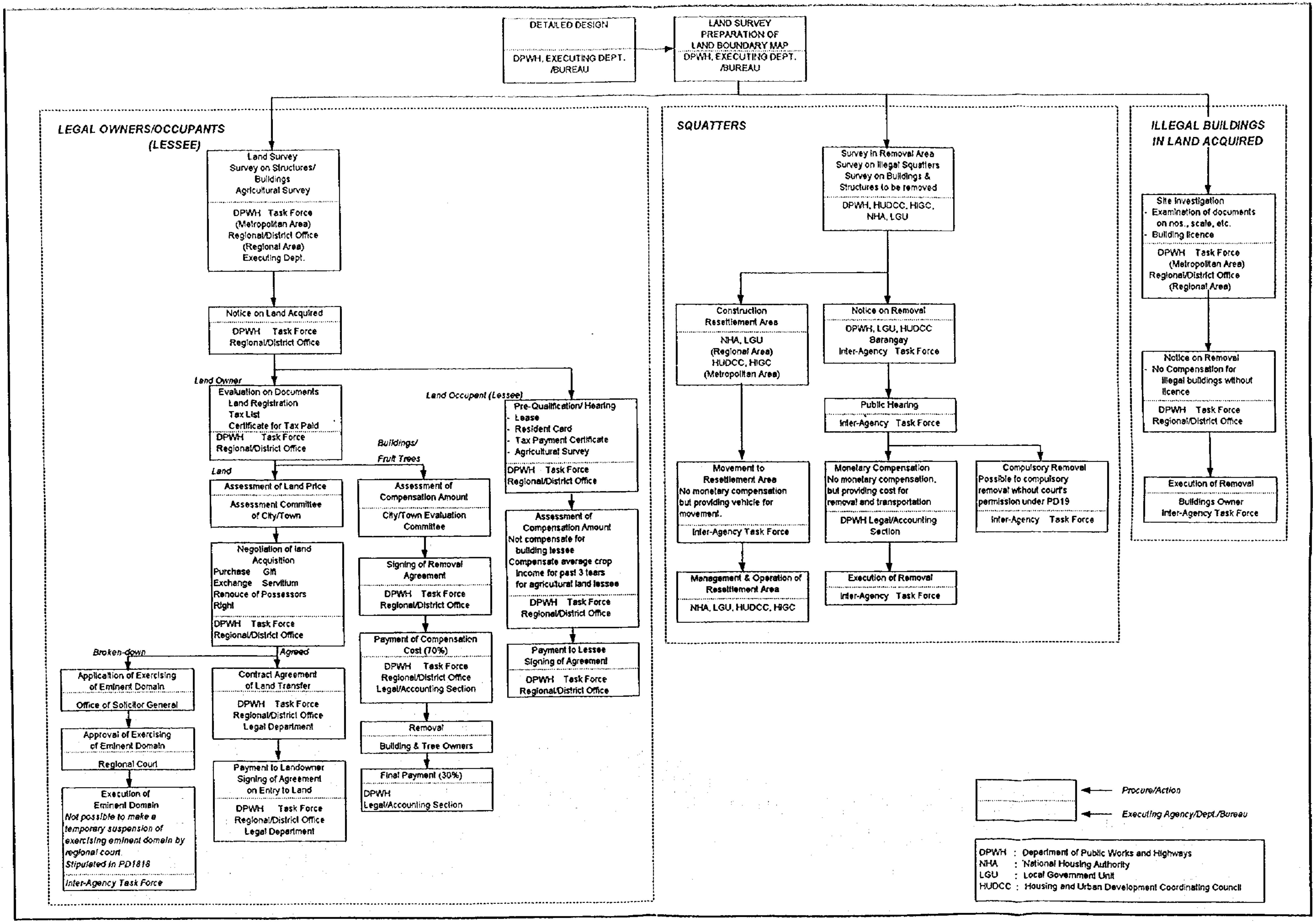


FIGURE 7.6-1 PROCEDURE OF LAND ACQUISITION AND RESETTLEMENT IN PHILIPPINES

7.7 ROAD MAINTENANCE

7.7.1 Present Practice

The present practice of road maintenance has several problems.

(1) Maintenance Budget

The maintenance budget depends on the maintenance level or target standard. The present maintenance level and budget covers 40% of pavement distresses. This is one of the main reasons for the common complaint, (about 84% of District Offices), that the maintenance budget is insufficient.

(2) EMK Budget Allocation System

The Equipment Maintenance Kilometer (EMK) system is used to determine the road maintenance allocation to Regional Offices and the Maintenance Sections of the District/City Engineering Offices (DEO/CEO).

This present EMK system considers the following factors;

- Pavement Type
- Roadway Width
- Traffic Volume

The existing road conditions are not included. Because the road conditions vary among District Offices, the existing road conditions should be one of the factors for determining the road maintenance allocation. In engineering terms, the present budget allocation is not equitable.

(3) Maintenance Level

The study "ROAD MAINTENANCE SUSTAINABILITY STUDY, March 1998, OECF" identified the following problems with PCC pavements.

- The maintenance level is not sufficient to repair the defects in the pavement because the present standards only cover between 34% and 40% of pavement distress.

- If the present level of maintenance is not upgraded, the condition of the PCC pavement will be further aggravated.

(4) Prioritization of Maintenance Activities

Because of the limitations of the maintenance budget, prioritization of maintenance works is vital. Each maintenance activity is currently specified as "unlimited (First priority)" or "limited (Second priority)".

Priority guidelines do not consider road class, traffic volume and type of pavement.

(5) Demarcation of Maintenance Activities into MBA and MBC

Under the current DPWH maintenance system, road maintenance is by "Maintenance Work by Administration" (MBA) or under the Highway Maintenance Management System (PHMMS) and "Maintenance Work by Contract" (MBC).

- MBA is intended for "bad/very bad section", and
- MBC is intended for equipment oriented activities

However, many District Offices use:
- MBA for labor oriented activities, and
- MBC for equipment oriented activities

To clearly demarcate maintenance activities into MBA and MBC is not practical because:

- Present 50:50 budgetary sharing between MBC and MBA
- Road conditions are different from the District to District, and hence maintenance needs for each activity are different.
- Number of laborers and the condition of the equipment varies from District to District.

(6) Existing Workforce

Under the present maintenance budget with 50% MBA share most District Offices have a surplus of staff, provided that the productivity of the staff and equipment is the same as specified in the Maintenance Manual. However, if the productivity is 70% of the specified standard as many District Offices assess, about 40% of District Offices suffer from a lack of staff. Thus, the key issue is how to maintain productivity of staff and equipment to the level specified in the Maintenance Manual.

7.7.2 Recommendations

(1) Effective Utilization of Maintenance Budget

In order to effectively utilize a limited maintenance budget, the following two aspects should be reassessed and new guidelines should be established.

- Setting a higher maintenance level, and
- Setting a higher priority for paved roads when compared to unpaved roads.

(2) **EMK Budget Allocation System**

A new EMK budget allocation system, that considers existing road and bridge conditions, will be needed to equitably allocate the maintenance budget to the District Offices. The IBRD-assisted Road Information and Management Support System (RIMSS) is studying a new EMK system to include road and bridge conditions.

(3) **Maintenance Level**

A higher maintenance level should be set for paved roads and that for unpaved roads could be relaxed. At present, a substantial proportion of the maintenance budget is spent on unpaved roads, that usually have light traffic, and will be improved sooner or later.

(4) **Prioritization of Maintenance Activities**

A higher priority should be set for paved roads than unpaved roads. Other important factors to be considered are traffic volume, class of road, and type of works (for example, drainage maintenance works should be given a higher priority than maintenance works for roadside features).

(5) **Strengthening of MBA and MBC Share**

Even though MBA will be gradually reduced, 30% of maintenance works are planned to be undertaken by MBA even at the ultimate stage. This allocation is required to cope with emergency cases such as road closure due to natural calamity.

Many District Offices assess that the productivity of MBA is getting lower due to inappropriate equipment and old age of staff. Productivity is estimated at about 70% of the standard productivity set in the Maintenance Manual. In order to strengthen MBA, the following are recommended:

- Purchase new sets of equipment, particularly those required for emergency works.
- Provide equipment support for old aged staff and train younger staff.

With the present workforce and equipment, MBA output (i.e. capacity) in terms of the amount and volume of work is almost fixed. Unless the workforce and equipment are increased to improve MBA productivity, the MBA share can not be increased beyond the present level.

MBC share should be gradually increased to support and promote the Government policy of privatization and active participation of a private sector in Government Projects.

(6) Workforce

The following are recommended.

- As the organization of District Offices is still that of MBA, management and supervisory staff should be strengthened.
- Maintenance contract should be more flexible to cope with immediate maintenance needs. At present, the change order is limited to 15% of a contract amount.