4.4 EXPRESSWAY ROUTE R-3 (ALONG SSH AND SLE)

4.4.1 Features of the Corridor

Expressway Route R-3 is also called as "Manila South Tollway (MST)" and located along South Super Highway (SSH) and South Luzon Expressway (SLE). It starts at the intersection between Quirino Avenue and SSH, then runs towards the south up to Alabang Interchange of SLE, extending for about 21 kms.

The corridor serves traffic from the southern area where urbanization is rapidly progressing to Manila CBD, Makati CBD and other urban centers along EDSA. At present, SLE carries about 100,000 veh/day at the section near EDSA and is suffering serious traffic congestion daily. In view of rapid urbanization in the southern area, traffic condition of SLE will be further worsened.

Both SSH and SLE has a wide road ROW of 38 and 50.5 meters, respectively. PNR runs just beside SSH and SLE from Quirino Ave. to Bicutan Interchange at the ground level. ROW of PNR is 30 meters from Quirino Ave. to EDSA and 19 meters from EDSA to Bicutan Interchange.

Physical constraints along this corridor are as follows:

- Existing MSDR Interchange (EDSA/SSH)
- Committed interchange project between the at-grade C-5 and South Luzon Exp.
- Existing overpass bridge at SSH/Buendia intersection
- Air navigational clearance at Ninoy Aquino International Airport

4.4.2 Division of the Route into Sections for an Alternative Alignment Study

The route can be divided into five (5) sections depending upon availability of alternative alignments as follows (see Figure 4.4.1):

Section - 1	:	From Quirino Ave. to EDSA (C-4)
Section - 2	:	From EDSA (C-4) to C-5
Section - 3	:	From C-5 to Bicutan Interchange
Section - 4	:	From Bicutan Interchange to Alabang Interchange
Section - 5	:	At Alabang Interchange

Alternative alignments for Sections -1, 3 and 5 have been identified, whereas competitive alternative alignments for Sections -2 and 4 were not found due to the following reasons:

<u>Section - 2</u>

Section - 2 passes near Ninoy Aquino International Airport (NAIA) where air navigational clearance must be secured, thus the alignment of the route must be at-grade. This requires that the alignment must be at the east side of PNR (see Figure 4.4.2). Another physical constraint in this section is the proposed interchange between C-5 and South Luzon Expressway. The route must go under C-5 through-lane viaduct at this point due also to NAIA air navigational clearance. Accordingly, minor amendment of the detailed design of the interchange is required to accommodate Expressway Route R-3.

<u>Section - 4</u>

Along this section, no competitive alternative alignment was found, but to utilize existing space of South Luzon Expressway.

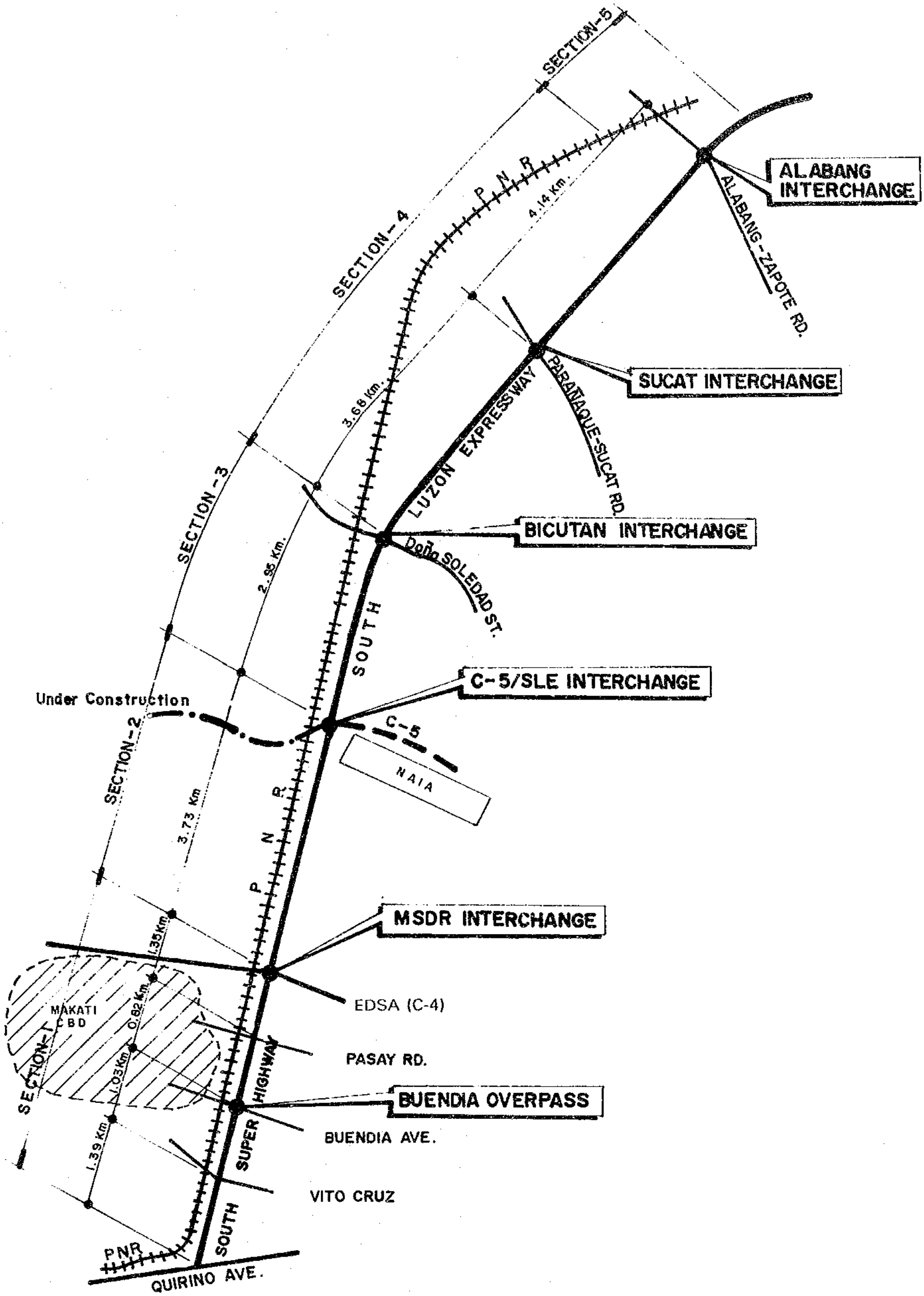


FIGURE 4.4.1 CORRIDOR OF EXPRESSWAY ROUTE R – 3 AND DIVISION OF SECTIONS FOR ALIGNMENT STUDY.

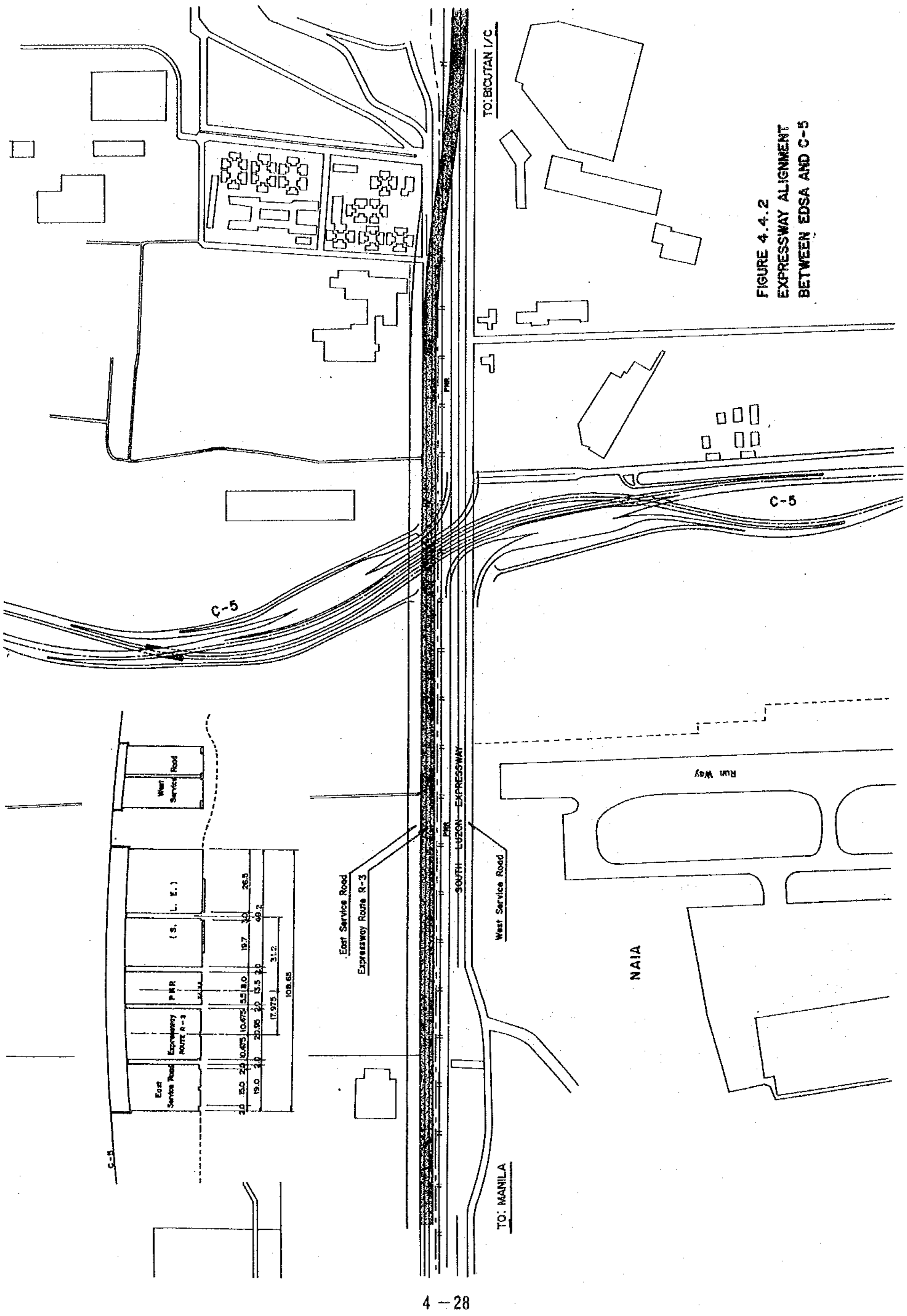


FIGURE 4.4.2
EXPRESSWAY ALIGNMENT
BETWEEN EDSA AND C-5

4.4.3 Alignment of Section - 1 (From Quirino Ave. to EDSA)

1) Alternatives

There are two public spaces which can accommodate an expressway, one is South Super Highway (SSH) and the other is PNR ROW. Two (2) alternatives were prepared as follows:

Alternative - 1 : to utilize South Super Highway (see Figure 4.4.3)

Alternative - 2 : to utilize PNR ROW (see Figure 4.4.4)

Special issues along this section are as follows:

Existing MSDR Interchange

EDSA through lanes of MSDR Interchange pass through at 3rd level, therefore, the expressway has to be at 4th level. Possibility for the expressway to pass under the interchange at surface level was studied, however, it was concluded that the expressway at surface level was not feasible due to ROW acquisition requirement and obstructions of existing substructures of the interchange.

Existing Buendia Overpass

The overpass viaduct along South Super Highway at the SSH/Buendia intersection is the major physical constraint for Alternative - 1. It was planned that an expressway alignment of Alternative - 1 utilizes the 3rd level of PNR ROW at this portion to avoid affecting the existing overpass viaduct.

PNR

PNR runs at surface level in this section. Major roads such as Vito Cruz Road, Buendia Ave. and Pasay Road cross PNR. These crossings are major obstructions for road traffic as well as rail traffic. If PNR rail services become more frequent, PNR may have to be elevated, thus possibility for PNR to be elevated in future should be maintained. An expressway for Alternative - 2 was planned to be constructed at the 3rd level and the 2nd level is reserved for PNR.

On-/Off-Ramps

On-/off-ramps for Alternative - 1 were planned to be a center ramp type. Ramp traffic is directly connected with South Super Highway without additional intersections.

For Alternative - 2, all ramps were also planned to be connected with South Super Highway avoiding an additional intersection.

2) Evaluation of Alternatives

Evaluation results of two alternatives are shown in Table 4.4.1.

Alternative - 1 is superior over Alternative - 2 in the following aspects:

- Initial investment requirement (construction cost is cheaper by about 15% (or about 320 million pesos) and squatter relocation cost by about 75% or about 13 million pesos).

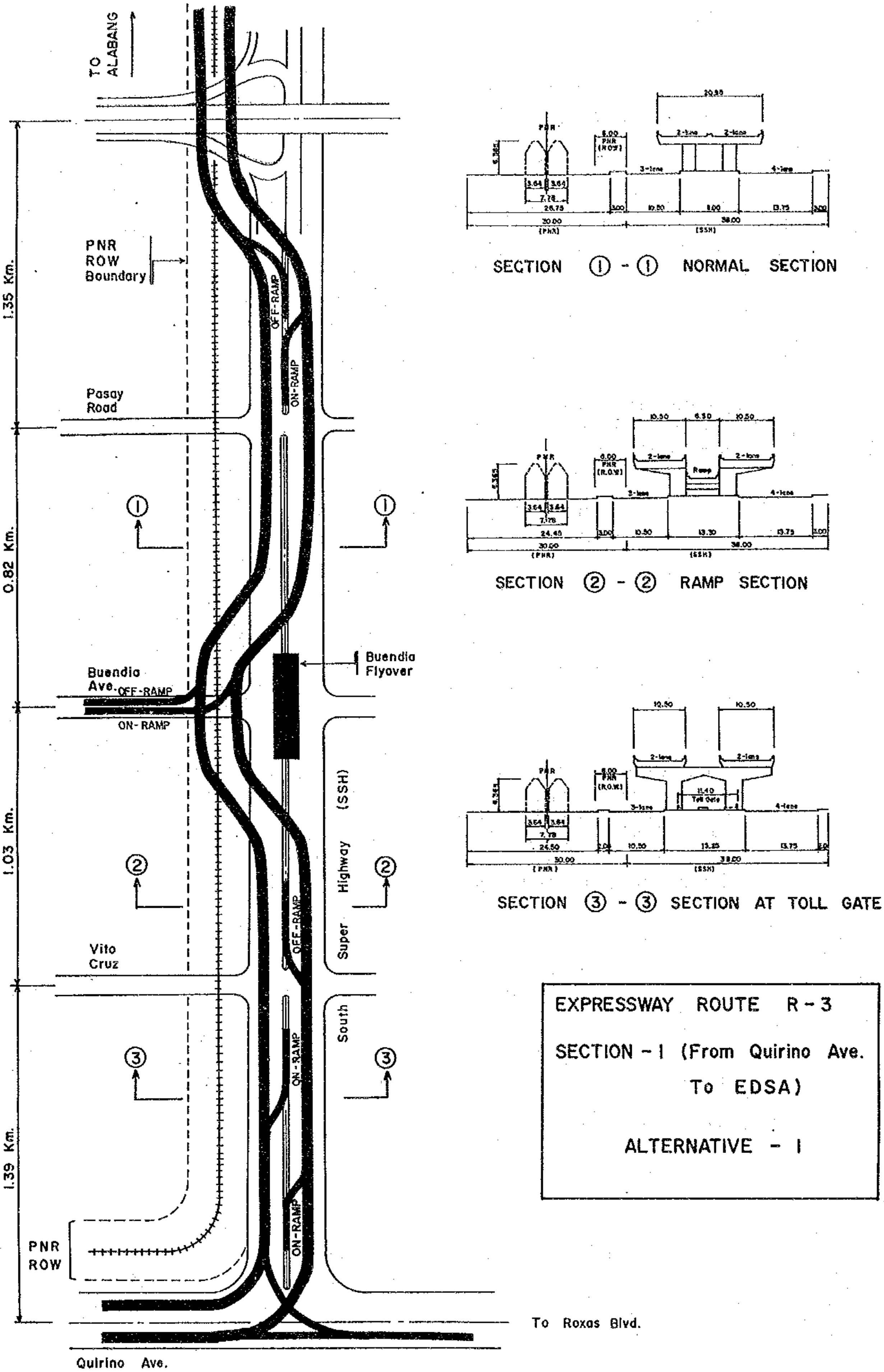


FIGURE 4.4.3 ALTERNATIVE - I FOR SECTION - I

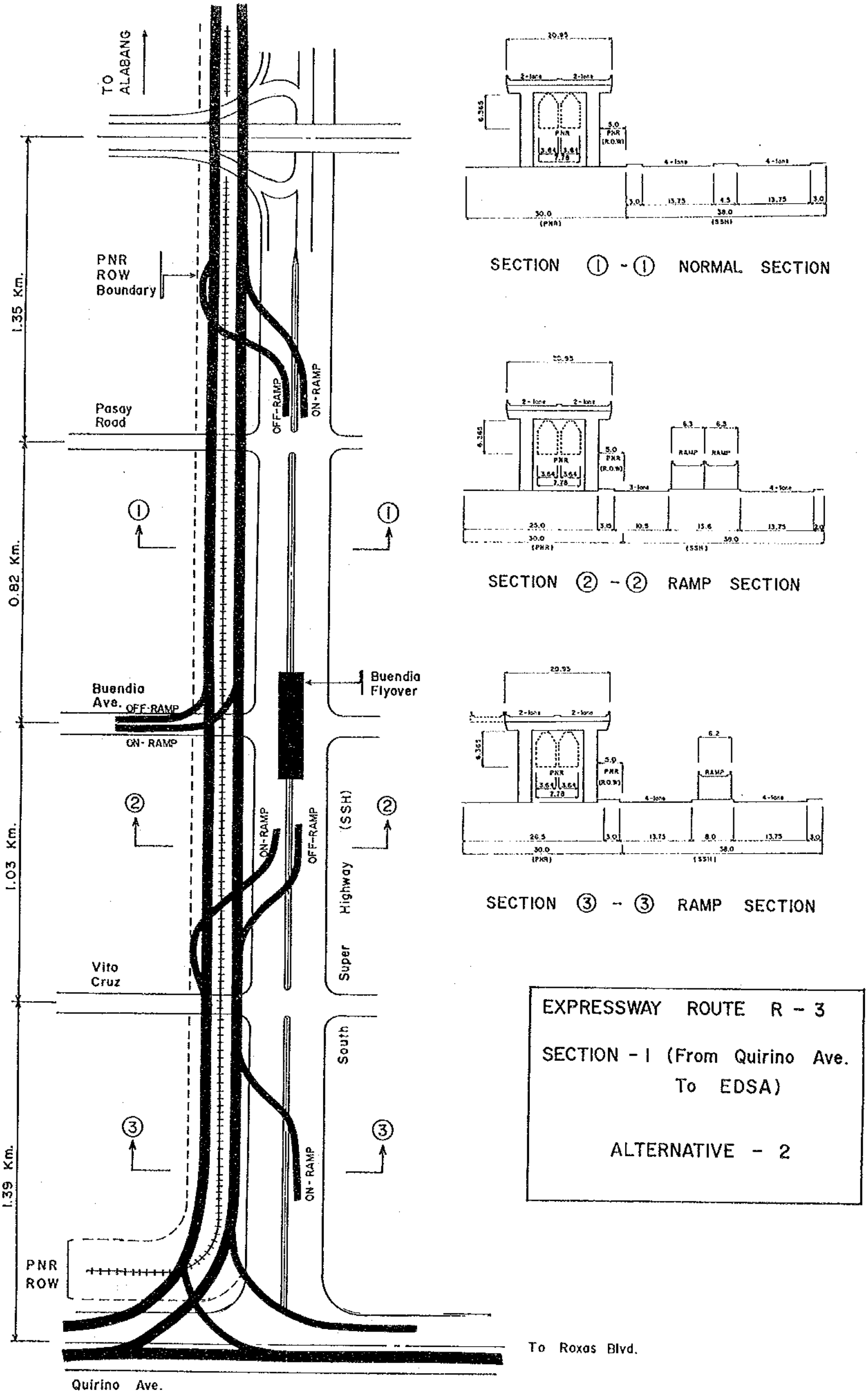


FIGURE 4.4.4 ALTERNATIVE - 2 FOR SECTION - I

TABLE 4.4.1 EVALUATION OF ALTERNATIVES: ROUTE R-3, SECTION-1

EVALUATION ASPECT	EVALUATION INDEX	WEIGHT		ALTERNATIVE ALIGNMENTS			
				Alternative-1	Score	Alternative-2	Score
a) Expressway Network Efficiency	a-1. Linkage with related expressways and appropriateness of an alignment as a part of network	10	4	–	4	–	4
	a-2. No. of on-/off-ramps		6	On-3, Off-3 Total 6	4	On-4, Off-3 Total 7	6
b) Harmony with at-grade road	b-1. Lane reduction rate and its length	10	5	7/8, L=4.59 km	0.5	7/8, L=0.55 km	5
	b-2. No. of new intersection needed due to construction of a ramp		3	0	3	0	3
	b-3. No. of potential intersections which may be grade separated		2	2 (Vito Cruz, Pasay)	0	0	2
c) Initial Investment Requirement	c-1. Construction cost	25	15	₱ 2.10 B	15	₱ 2.42 B	9.5
	c-2. ROW acquisition and compensation cost		10	₱ 4.5 M	10	₱ 17.5 M	8
d) Social/ Environmental Impact	d-1. No. of residents affected	20	10	2,480	10	9,600	2.5
	d-2. No. of commercial bldgs./factories affected		5	0	5	0	5
	d-3. Section length passes through residential areas		5	0.38 km	5	2.50 km	1
e) Implementation Difficulty	e-1. Land areas to be acquired	25	15	0	15	0	15
	e-2. No. of squatter families to be relocated		7	450	7	1,750	2
	e-3. Negotiation with other agency. Required, or not required		3	Required	1	Required	1
f) Construction Difficulty	f-1. Section length which requires complex structures construction methods	5	2	1.15 km	2	4.59 km	0.5
	f-2. Section length where no. of lanes need to be reduced during construction		3	4.59 km	0.5	1.00 km	3
g) Soundness of an Alignment	g-1. No. of S-shaped curves	5	3	0	3	0	3
	g-2. Section length of which gradient is more than 4%		2	0	2	0	2
	Total Score	100	100		87		72.5

- Social/environmental aspect (number of affected residents is about 1/4 and section length passes through residential area is about 1/6).

- Degree of implementation difficulty (number of squatter families to be relocated is about 1/4).

Alternative - 2 is superior over Alternative - 1 in the following aspects:

- Present number of lanes of SSH can be maintained for the most of the section.

- During construction, traffic disturbance is minimal.

In view of the above, overall superiority of Alternative - 1 is evident and recommended Alternative - 1 as an alignment of the expressway in this section.

4.4.4 Alignment of Section - 3 (From C-5 to Bicutan I/C)

1) Alternatives

Like in the Section - 1, there are two available public spaces, one is South Luzon Expressway and the other is PNR ROW. Two (2) alternatives were prepared as follows (see Figure 4.4.5).

Alternative - 1 :	An expressway is constructed over South Luzon Expressway
Alternative - 2 :	An expressway is constructed over PNR. (In this section, there is no road crossing PNR, therefore, there is no need for PNR to be elevated in the future. An expressway can be constructed at the 2nd level of PNR ROW).

2) Evaluation of Alternatives

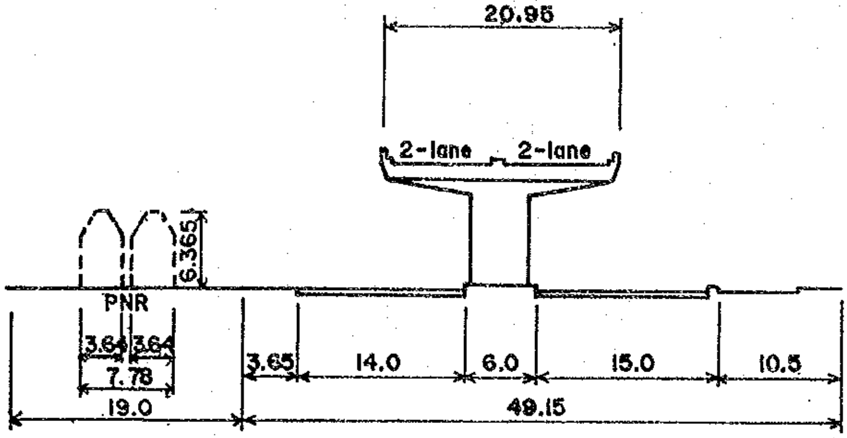
Major differences in two alternatives are as follows (See Table 4.4.2):

- Construction cost: Construction method of Alternative - 1 must be so selected that obstruction to traffic on South Luzon Expressway be minimized. Accordingly, construction cost of Alternative - 1 is estimated higher by about 30% (or about 340 million pesos) than Alternative - 2.

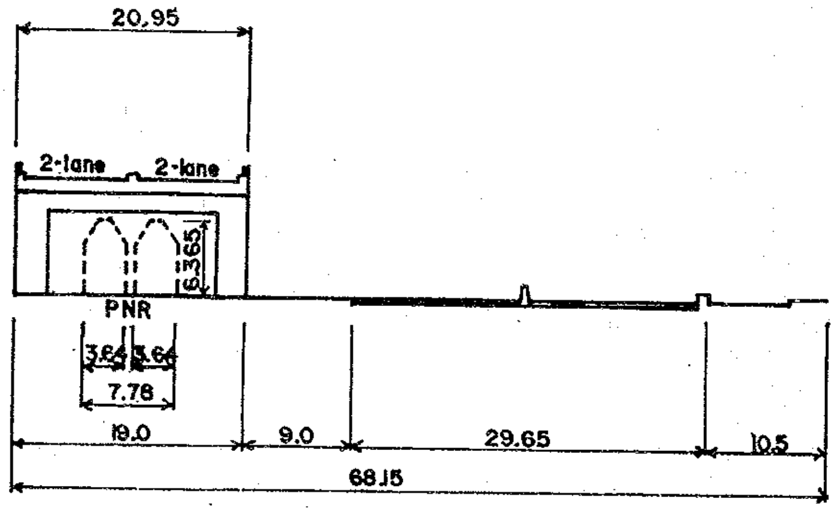
- Social impact: Alternative - 2 requires relocation of 230 squatter families in the PNR ROW, which will also affect implementation aspect though magnitude is not so significant.

- Construction difficulty: SLE is so congested that requirements for traffic management and safety measures during construction make Alternative - 1's construction more difficult.

In view of smaller investment requirement, minimal traffic disturbance to SLE traffic during construction, and insignificant social impact, Alternative - 2 was recommended for an expressway alignment in this section.



ALTERNATIVE - I (OVER SLE)



ALTERNATIVE - 2 (OVER PNR)

FIGURE 4.4.5 ALTERNATIVES FOR SECTION - 3 EXPRESSWAY ROUTE R - 3

TABLE 4.4.2 EVALUATION OF ALTERNATIVES: ROUTE R-3, SECTION-3

EVALUATION ASPECT	EVALUATION INDEX	WEIGHT		ALTERNATIVE ALIGNMENTS			
				Alternative-1		Alternative-2	
a) Expressway Network Efficiency	a-1. Linkage with related expressways and appropriateness of an alignment as a part of network	10	4	-	4	-	4
	a-2. No. of on-/off-ramps		6	-	6	-	6
b) Harmony with at-grade road	b-1. Lane reduction rate and its length	10	5	6/6	5	6/6	5
	b-2. No. of new intersection needed due to construction of a ramp		3	-	3	-	3
	b-3. No. of potential intersections which may be grade separated		2	-	2	-	2
c) Initial Investment Requirement	c-1. Construction cost	25	15	₱ 1.52 B	6	₱ 1.18 B	15
	c-2. ROW acquisition and compensation cost		10	₱ 0.5 M	9	₱ 2.3 M	10
d) Social/ Environmental Impact	d-1. No. of residents affected	20	10	300	10	1,300	5
	d-2. No. of commercial bldgs./factories affected		5	-	5	-	5
	d-3. Section length passes through residential areas		5	0.20 km	5	1.10 km	3
e) Implementation Difficulty	e-1. Land areas to be acquired	25	15	0	15	0	15
	e-2. No. of squatter families to be relocated		7	50	7	230	5
	e-3. Negotiation with other agency. Required, or not required		3	Not required	3	Required	1
f) Construction Difficulty	f-1. Section length which requires complex structures construction methods	5	2	-	2	-	2
	f-2. Section length where no. of lanes need to be reduced during construction		3	2.95 km	0	-	3
g) Soundness of an Alignment	g-1. No. of S-shaped curves	5	3	-	3	-	3
	g-2. Section length of which gradient is more than 4%		2	-	2	-	2
	Total Score	100	100		87		89

4.4.5 Alignment of Section - 5 (At Alabang Interchange)

1) Alternatives

There are two (2) alternatives with regard to the issue where to end Expressway Route R-3, i.e., to end after or at the existing Alabang Interchange.

The existing Alabang Interchange is a diamond type and SLE thru-lanes are elevated. SLE thru-lane viaduct has an approximate length of 1,500 meters and is currently operated as a 4-lane divided road which can be operated as a 6-lane divided road in the future.

Commercial buildings are developed adjacent to the SLE thru-lane viaduct and roads under the viaduct is seriously congested due to loading and unloading of passengers for buses and jeepneys as well as a lot of pedestrians.

Following alternatives were developed (see Figure 4.4.6)

Alternative - 1(A): Route R-3 ends after the existing Alabang Interchange. A new link by-passing the existing interchange is to be constructed.

Alternative - 1(B): Variation of Alternative - 1(A). A shorter alignment than Alternative - 1(A) is proposed.

Alternative - 2: Route R-3 ends at the existing Alabang Interchange, and is connected with the existing SLE thru-lane viaduct.

a) Alternative - 1

Plan and profile of Alternatives 1-(A) and (B) is shown in Figure 4.4.7. Proposed alignments of both (A) and (B) passes through mostly government's land such as BCG Laboratory, Bureau of Foods and Drugs of the Department of Health and UP Compound, therefore, ROW acquisition will be relatively easier. As an expressway passes through the said research and academic compounds, expressway structures must be so designed that it harmonizes with the area.

b) Alternative - 2

Figure 4.4.8 shows the existing condition of Alabang Interchange and the condition when Route R-3 is connected with the existing interchange. Figure 4.4.9 shows corresponding cross sections. Key issues of this alternative are as follows:

Existing Substructure and Foundation

It was assumed that the existing substructure and foundation were designed to carry only loads of existing superstructure and live loads equivalent to 6-lane, therefore, these have no capacity to carry additional loads. Thus new substructure and foundation are required to connect Route R-3 with the existing viaduct.

Number of thru-lanes

Southern section of SLE from the interchange is currently a 4-lane divided expressway with ROW width of about 60 meters. It can be easily widened to a 8-lane divided expressway within the existing ROW.

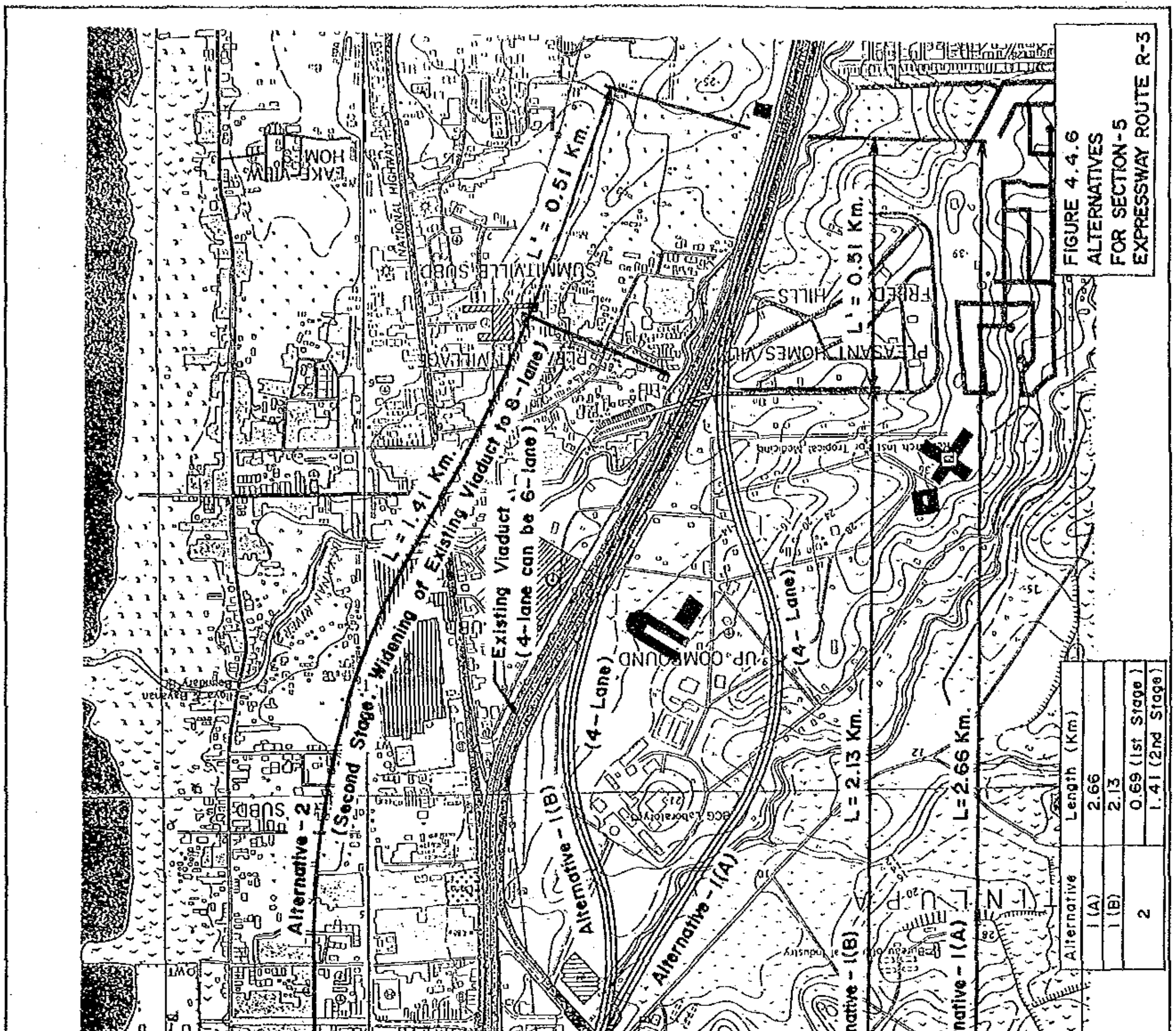


FIGURE 4.4.6 ALTERNATIVES FOR SECTION-5 EXPRESSWAY ROUTE R-3

Alternative	Length (Km)
1 (A)	2.66
1 (B)	2.13
2	0.69 (1st Stage)
	1.41 (2nd Stage)

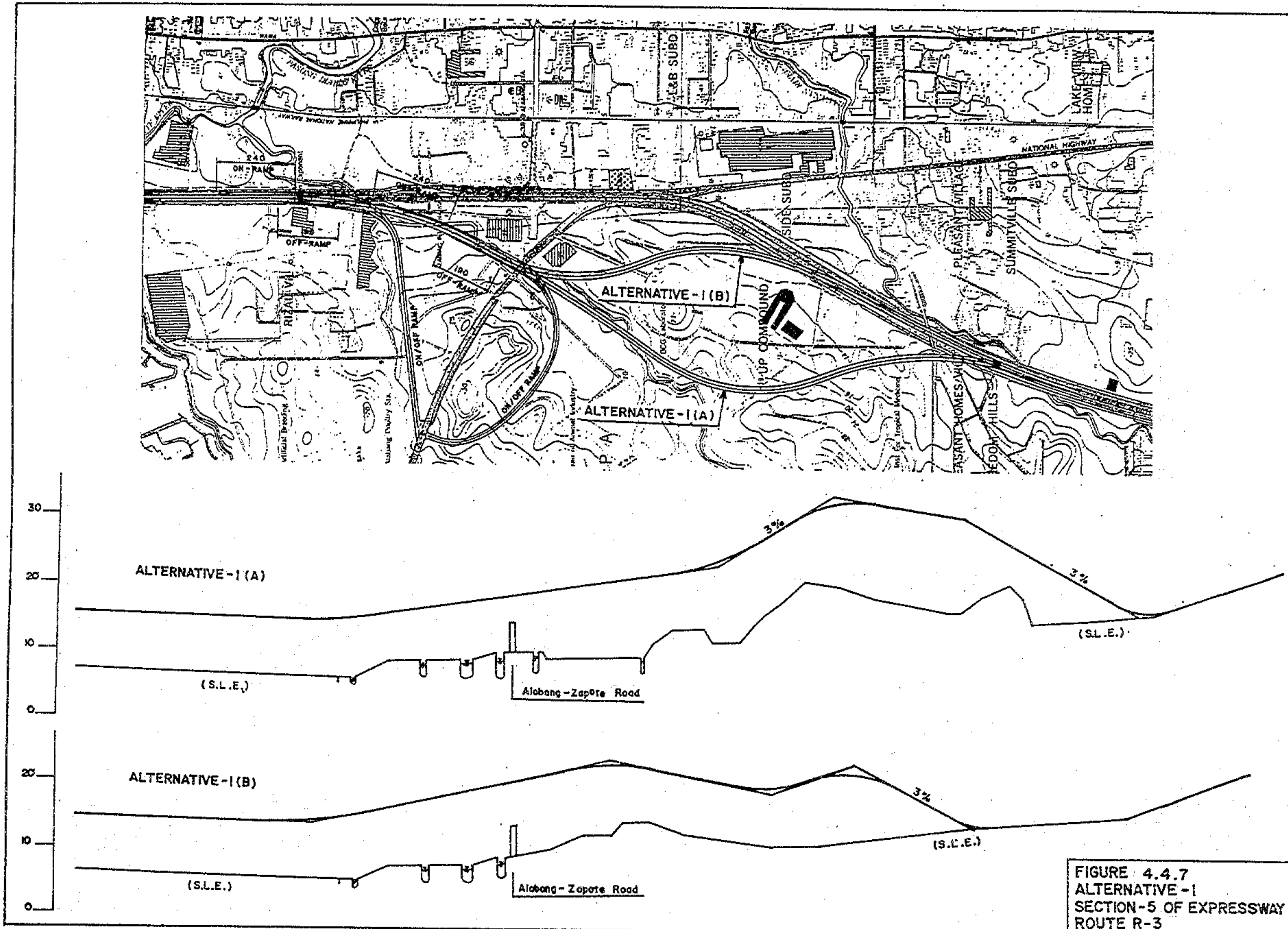
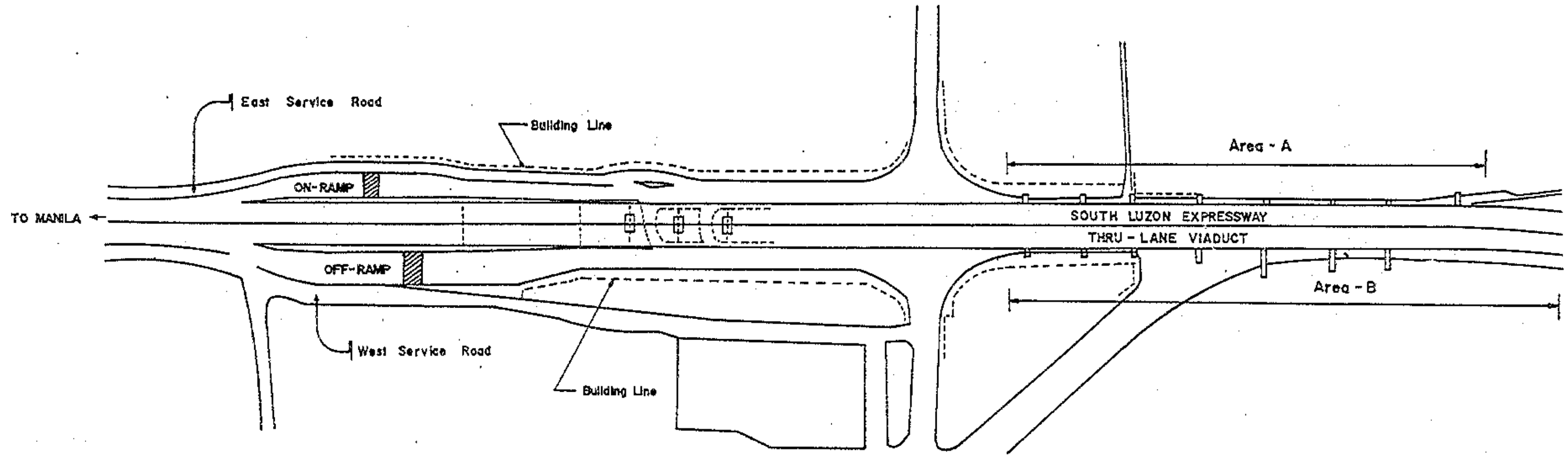
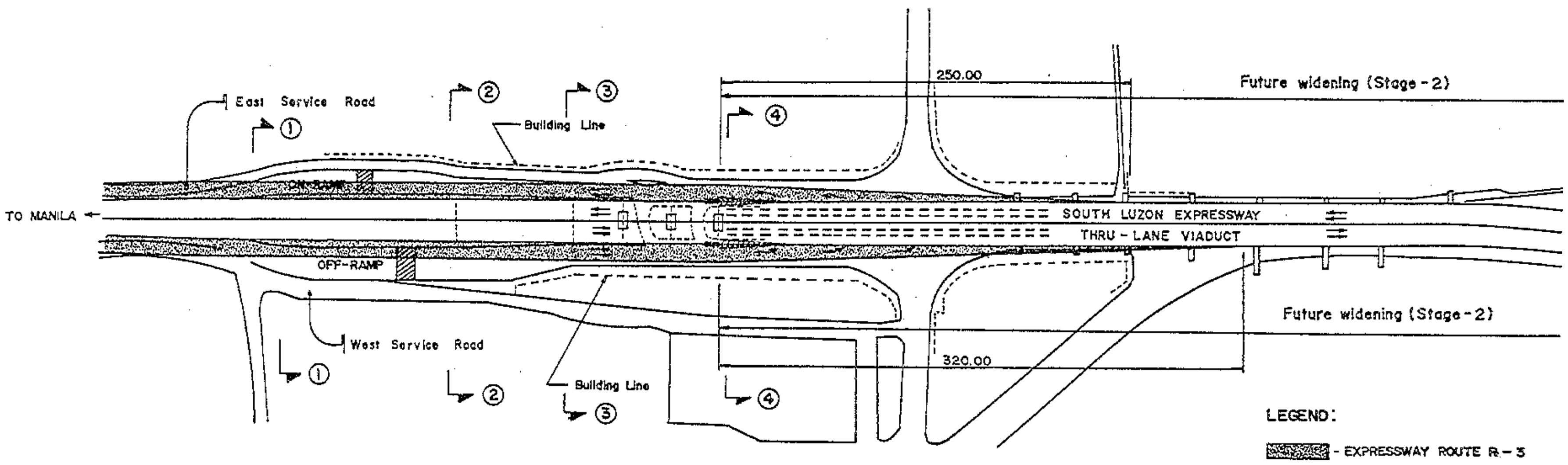


FIGURE 4.4.7
ALTERNATIVE - I
SECTION - 5 OF EXPRESSWAY
ROUTE R-3

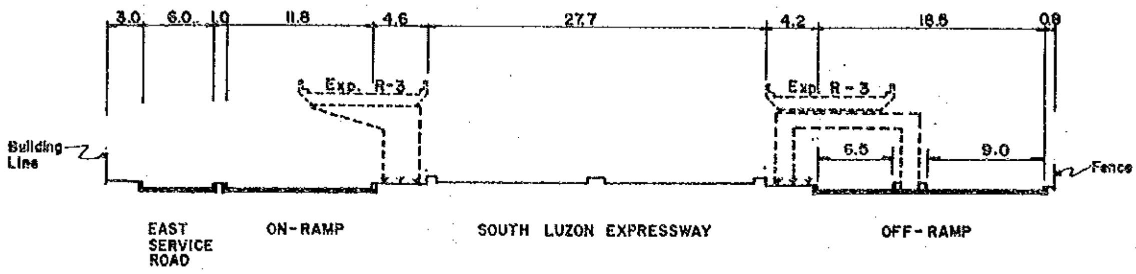


EXISTING CONDITION OF ALABANG INTERCHANGE



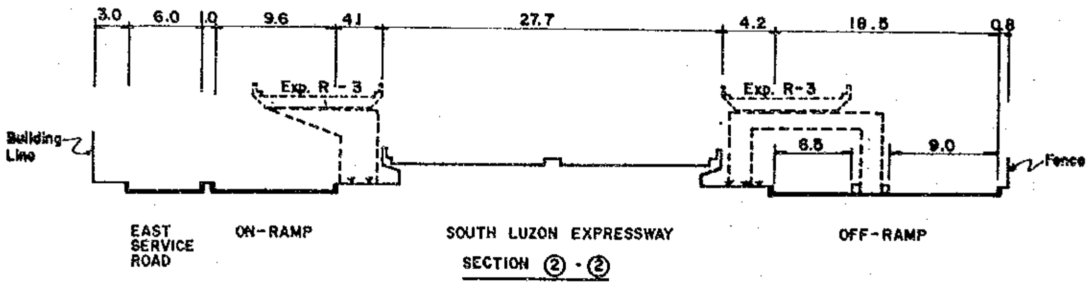
WHEN ROUTE R-3 IS CONNECTED WITH EXISTING INTERCHANGE

FIGURE 4.4.8 ALTERNATIVE - 2 : SECTION - 5 OF EXPRESSWAY ROUTE R - 3

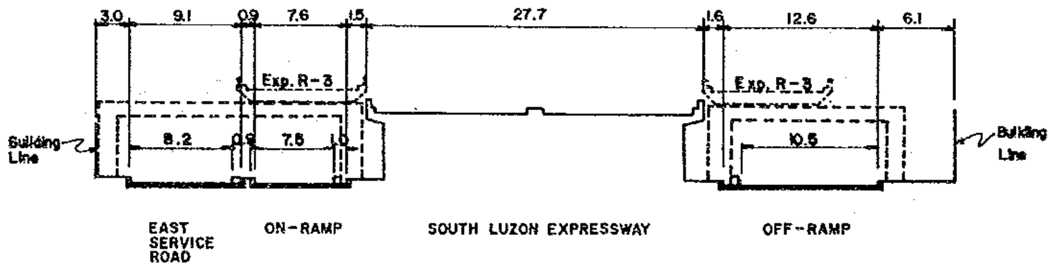


CROSS-SECTION NEAR NOSE OF EXISTING INTERCHANGE

SECTION ①-①

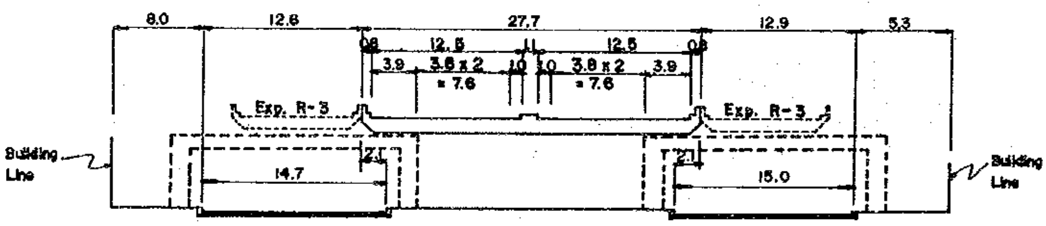


SECTION ②-②



CROSS-SECTION AT ABUTMENT

SECTION ③-③



CROSS SECTION AT PIER - 3

SECTION ④-④

FIGURE 4.4.9 ALTERNATIVE - 2 : CROSS SECTIONS

In the case of Alternative - 1, a total of 8 to 10 lanes (4 to 6-lane of the existing viaduct and 4-lane of Route R-3) can be provided at this portion.

For Alternative - 2, the only solution to cope up with future upgrading of SLE, is widening of a viaduct section. To accommodate 8 lanes, at least 4-meter widening of each side of a viaduct is required. There is a space for 4-meter widening on each side of a viaduct, however, when this widening is implemented, viaduct will be located very close to the building line.

Urban Aesthetic

When Expressway Route R-3 is connected with the existing viaduct and widening of a viaduct is implemented, at-grade roads are covered by these new superstructures at most of the sections. In addition, new substructures are to be built inbetween existing substructures. Most of these structures are located close to the buildings. Urban aesthetic would be seriously affected.

2) Evaluation of Alternatives

Evaluation results are shown in Table 4.4.3. Alternative - 1(B) and Alternative - 2 are competitive alternatives. Comparison of two alternatives are as follows:

Construction cost: Both Alternative - 1(B) and Alternative - 2 were estimated to require almost the same construction cost.

Land acquisition and compensation cost: Although Alternative - 1(B) requires wider land areas to be acquired, these lands are mostly public lands and a few houses and commercial establishments are affected. Whereas, Alternative - 2 affects a lot of commercial establishment. Thus, land acquisition and compensation costs of the two alternatives were estimated to be almost the same.

Construction difficulty: Alternative - 2 requires much difficult construction methods, as it must be executed within narrow areas and with extra care for existing traffic.

Major disadvantages of Alternative - 2 are as follows:

- Number of thru-lane is limited to be 8-lanes even when the existing viaduct is widened. Whereas, number of thru-lane after the interchange of South Luzon Expressway can be increased to even 10 lanes. Thus, Alternative - 2 is less flexible to future transport demand increase.
- At the existing viaduct, at-grade roads are completely covered by Route R-3 and additional substructures at staggered location to existing substructure must be constructed. Thus, urban aesthetic view will be seriously affected.

Alternative - 1(B) was recommended for an alignment of this section.

TABLE 4.4.3 EVALUATION OF ALTERNATIVES: ROUTE R-3, SECTION-5

EVALUATION ASPECT	EVALUATION INDEX	WEIGHT		ALTERNATIVE ALIGNMENTS					
				Alternative-1 (A)		Alternative-1 (B)		Alternative-2	
a) Expressway Network Efficiency	a-1. Linkage with related expressways and appropriateness of an alignment as a part of network	10	4	Good	4	Good	4	Fair	2
	a-2. No. of on-/off-ramps		6	–	6	–	6	–	6
b) Harmony with at-grade road	b-1. Lane reduction rate and its length	10	5	0	5	0	5	Existing Ramps L = 0.2 km	4.5
	b-2. No. of new intersection needed due to construction of a ramp		3	–	3	–	3	–	3
	b-3. No. of potential intersections which may be grade separated		2	–	2	–	2	–	2
c) Initial Investment Requirement	c-1. Construction cost	25	15	₱ 1.17 B	10	₱ 0.98 B	14.5	₱ 0.95 B	15
	c-2. ROW acquisition and compensation cost		10	₱ 0.10 B	9	₱ 0.08 B	10	₱ 0.09 B	9.5
d) Social/ Environmental Impact	d-1. No. of residents affected	20	10	130	7	90	8	0	10
	d-2. No. of commercial bldgs./factories affected		5	4	5	4	5	30	3
	d-3. Section length passes through residential areas		5	0	5	0	5	0	5
e) Implementation Difficulty	e-1. Land areas to be acquired	25	15	54,000 (Private: 14,000)	10	36,000 (Private: 14,000)	10	7,000 (Private: 7,000)	15
	e-2. No. of squatter families to be relocated		7	7	9.5	7	9.5	0	10
	e-3. Negotiation with other agency. Required, or not required		3	–	3	–	3	–	3
f) Construction Difficulty	f-1. Section length which requires complex structures construction methods	5	2	0	2	0	2	1.1 km	1
	f-2. Section length where no. of lanes need to be reduced during construction		3	0.25 km	3	0.25 km	3	1.1 km	1
g) Soundness of an Alignment	g-1. No. of S-shaped curves	5	3	–	3	–	3	–	3
	g-2. Section length of which gradient is more than 4%		2	–	2	–	2	–	2
	Total Score	100	100		88.5		95		95

4.5 EXPRESSWAY ROUTE R-4 (ALONG PASIG RIVER)

4.5.1 Features of the Corridor

Expressway Route R-4 is proposed along Pasig River and connects Route C-3 and Route C-5. At a location of at-grade C-3 in Sta. Ana, Makati, an access ramp to Makati CBD will be constructed which will be a very important link to strengthen accessibility to Makati CBD from the north (Quezon City, Caloocan City, etc.). Traffic from the north will be able to access to Makati CBD by two expressway routes; one is via Routes R-7, C-3 and R-4 and the other via Routes C-5 and R-4. Traffic from the south will be able to utilize Routes C-5 and R-4 to make access to Makati CBD. The section from Expressway Route C-3 to Makati Access Ramp is constructed under the first stage of MMUES and the rest of the section is included in the second stage.

4.5.2 Alternatives

1) Alternatives

An alignment from Route C-3 to Sta. Ana (near horse race track) was studied together with Route C-3 alignment.

Only the section where an alternative alignment study became necessary was the one at Makati Access Ramp. Makati Access Ramp branches off from Route R-4 at about proposed at-grade C-3 alignment and runs over at-grade C-3 up to Manila South Cemetery.

Alternatives were as follows (see Figure 4.5.1):

Alternative - 1: Route R-4 is constructed along the southern bank (Makati side bank) of Pasig River. An interchange is constructed over land at Makati side to avoid costly construction of an interchange over Pasig River.

Alternative - 2: Route R-4 is constructed along the northern bank (Mandaluyong side) of Pasig River. An interchange is constructed over Pasig River in order to minimize ROW acquisition and social impact.

2) Evaluation of Alternatives

Major differences between two alternatives are as follows (see Table 4.5.1):

- Construction cost: Due to construction of an interchange over Pasig River, construction cost of Alternative - 2 is higher by about 1.16 times (or 240 million pesos) than that of Alternative - 1.
- Land area to be acquired: Alternative - 1 requires more lands to be acquired by about 1.17 times (or about 3,000 sq. meters) than Alternative - 2.
- Social impact: Alternative - 2 is slightly superior over Alternative - 1 in terms of social impact, although difference is minor.

Giving priority on impact of construction, Alternative - 1 was recommended for this section.

As ROW acquisition for at-grade C-3 at this portion is not started yet, ROW acquisition plan should be amended in accordance with this interchange plan. ROW acquisition should be done not only for at-grade C-3, but also for the expressway interchange.

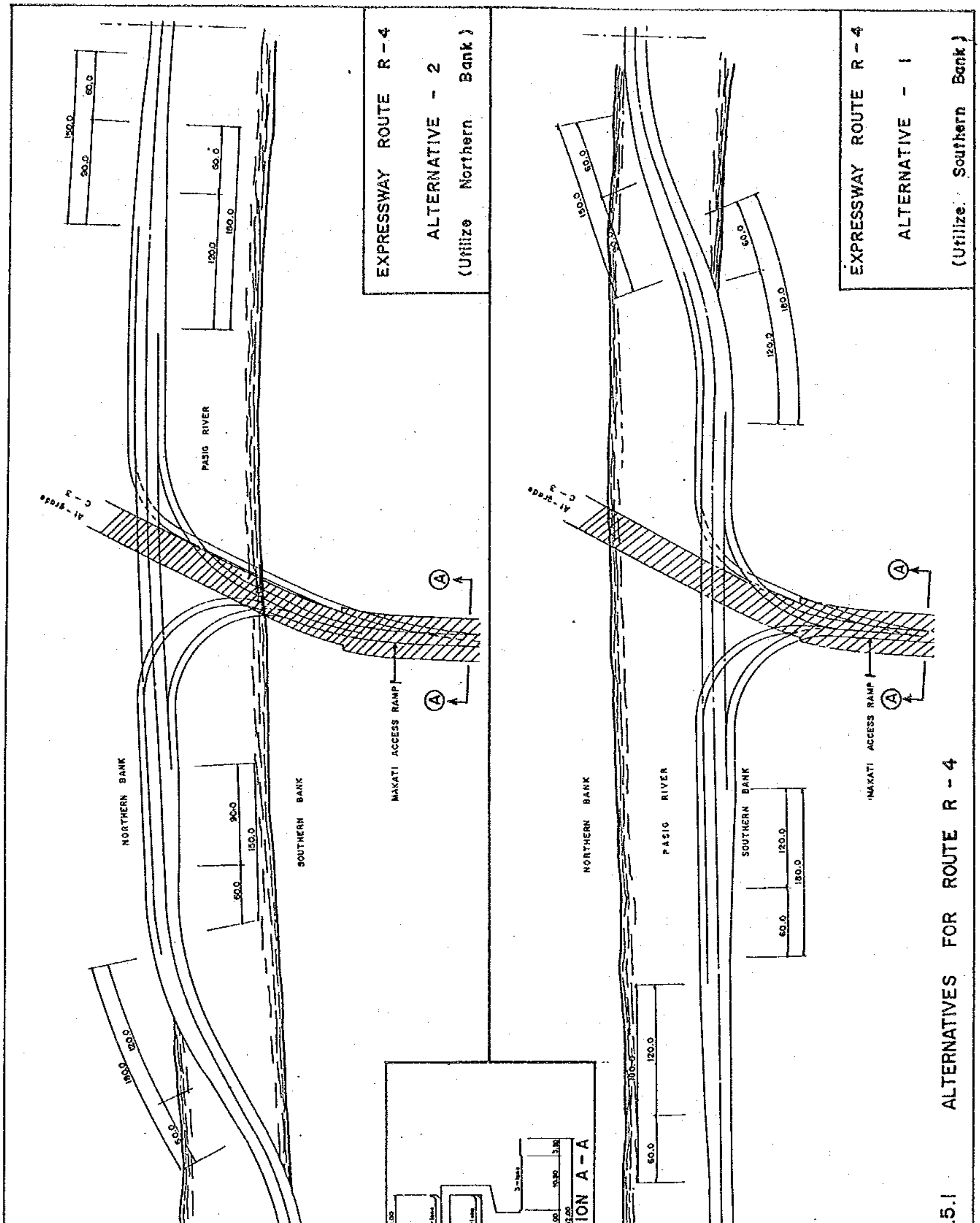


FIGURE 4.5.1 ALTERNATIVES FOR ROUTE R - 4

TABLE 4.5.1 EVALUATION OF ALTERNATIVES: ROUTE R–4

EVALUATION ASPECT	EVALUATION INDEX	WEIGHT		ALTERNATIVE ALIGNMENTS			
				Alternative–1		Alternative–2	
a) Expressway Network Efficiency	a–1. Linkage with related expressways and appropriateness of an alignment as a part of network	10	4	–	4	–	4
	a–2. No. of on–/off–ramps		6	–	6	–	6
b) Harmony with at–grade road	b–1. Lane reduction rate and its length	10	5	–	5	–	5
	b–2. No. of new intersection needed due to construction of a ramp		3	–	3	–	3
	b–3. No. of potential intersections which may be grade separated		2	–	2	–	2
c) Initial Investment Requirement	c–1. Construction cost	25	15	₱ 1.48 B	15	₱ 1.72 B	2.5
	c–2. ROW acquisition and compensation cost		10	₱ 0.12 B	9	₱ 0.09 B	10
d) Social/ Environmental Impact	d–1. No. of residents affected	20	10	1,700	8	1,100	10
	d–2. No. of commercial bldgs./factories affected		5	11	3	5	5
	d–3. Section length passes through residential areas		5	0.10 km	5	1.30 km	4
e) Implementation Difficulty	e–1. Land areas to be acquired	25	15	21,000	12	18,000	15
	e–2. No. of squatter families to be relocated		7	300	6	200	7
	e–3. Negotiation with other agency. Required, or not required		3	–	3	–	3
f) Construction Difficulty	f–1. Section length which requires complex structures construction methods	5	2	Complexed	2	Very complexed	1
	f–2. Section length where no. of lanes need to be reduced during construction		3	–	3	–	3
g) Soundness of an Alignment	g–1. No. of S–shaped curves	5	3	–	3	–	3
	g–2. Section length of which gradient is more than 4%		2	–	2	–	2
	Total Score	100	100		91		85.5

4.6 EXPRESSWAY ROUTE R-7 (ALONG QUEZON AVE. AND COMMONWEALTH AVE.)

4.6.1 Features of the Corridor

This corridor is one of the most heavily traffic loaded ones in Metro Manila. Particularly, private trip demand is expected to increase sharply along this corridor where middle and high-class residential subdivisions were and are being developed.

The route starts at Welcome Rotonda and goes along Quezon Ave. and Commonwealth Ave. up to Batasang Pambansa. Quezon Ave. has a road ROW of 36.5 to 37.5 meters with about 10 meters building setback on each side of the road. Commonwealth Ave. has a wide road ROW of 95 meters.

The expressway will be elevated from Welcome Rotonda up to Quezon Memorial Circle. The expressway will be at-grade along Commonwealth Ave. taking advantage of wide road ROW, except for the sections at intersections with major cross roads.

4.6.2 Alternatives

1) Alternatives

Two alternatives were prepared at Quezon Memorial Circle. Alternative - 1 is an elevated expressway which passes over Elliptical Road. Alternative - 2 is a depressed expressway which crosses Quezon Memorial Circle underground. Plan and profile of Alternative - 1 and Alternative - 2 is shown in Figures 4.6.1 and 4.6.2, respectively.

2) Evaluation of Alternatives

Two alternatives were evaluated as follows:

Construction cost: Both alternatives were estimated to cost almost the same.

Alternative - 1	₱1.02 Billion
Alternative - 2	₱1.04 Billion

Land acquisition: Both alternatives affects lands slightly, however, these lands are owned by the Government.

Alternative - 1:

- National Parks and Wildlife (1,100 sq. m.)
- Philippine Coconuts Authority (700 sq. m.)

Alternative - 2:

- National Parks and Wildlife (2,500 sq. m.)
- Lung Center of the Philippines (100 sq. m.)
- Philippine Coconut Authority (400 sq. m.)

Construction method/procedure: Construction method/procedure of Alternative - 2 will be more complicated in order that construction must be executed allowing existing traffic and deep excavation must be done with provision of storm water drainage.

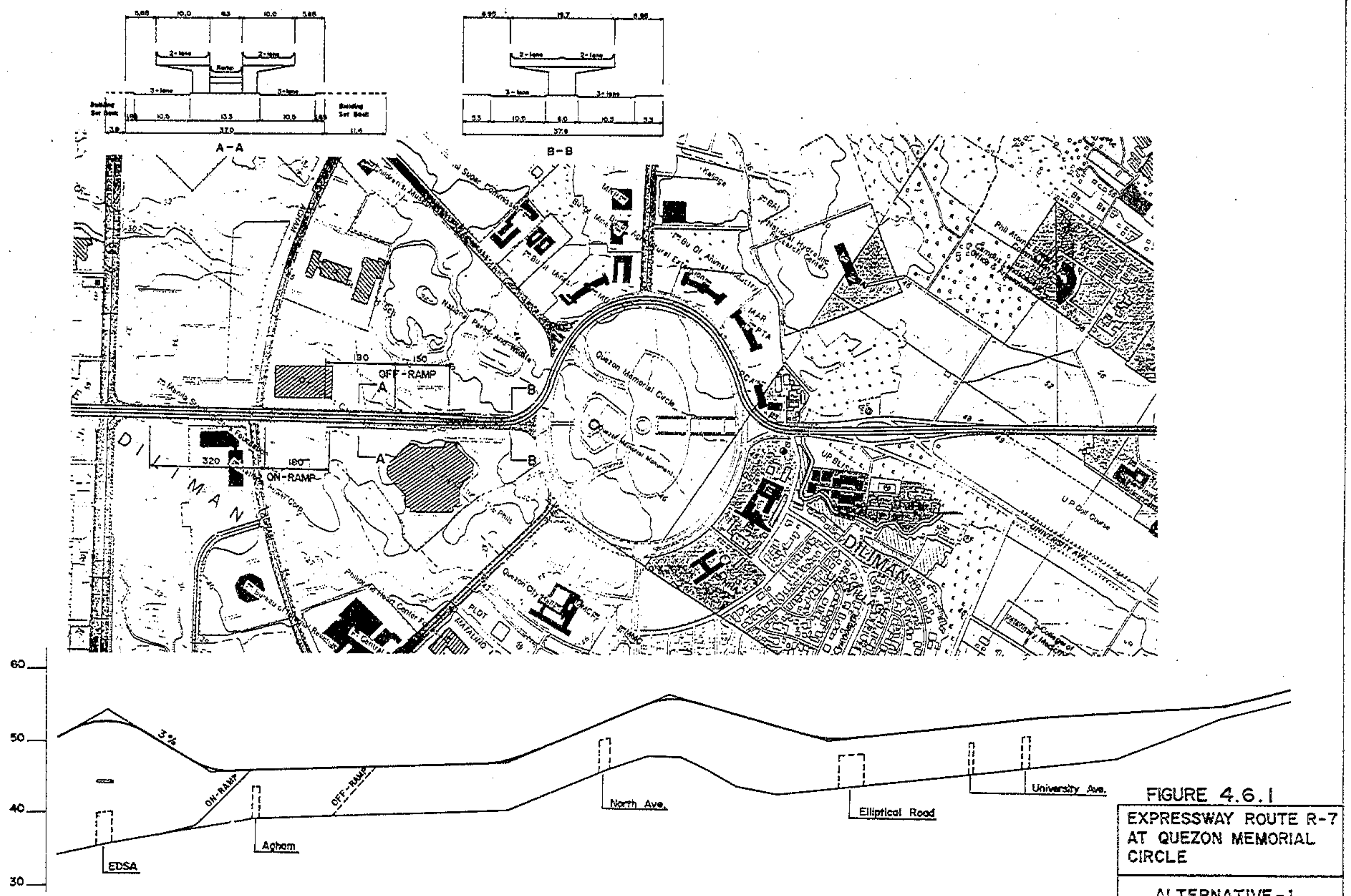


FIGURE 4.6.1

EXPRESSWAY ROUTE R-7 AT QUEZON MEMORIAL CIRCLE

ALTERNATIVE-1
ELEVATED EXPRESSWAY

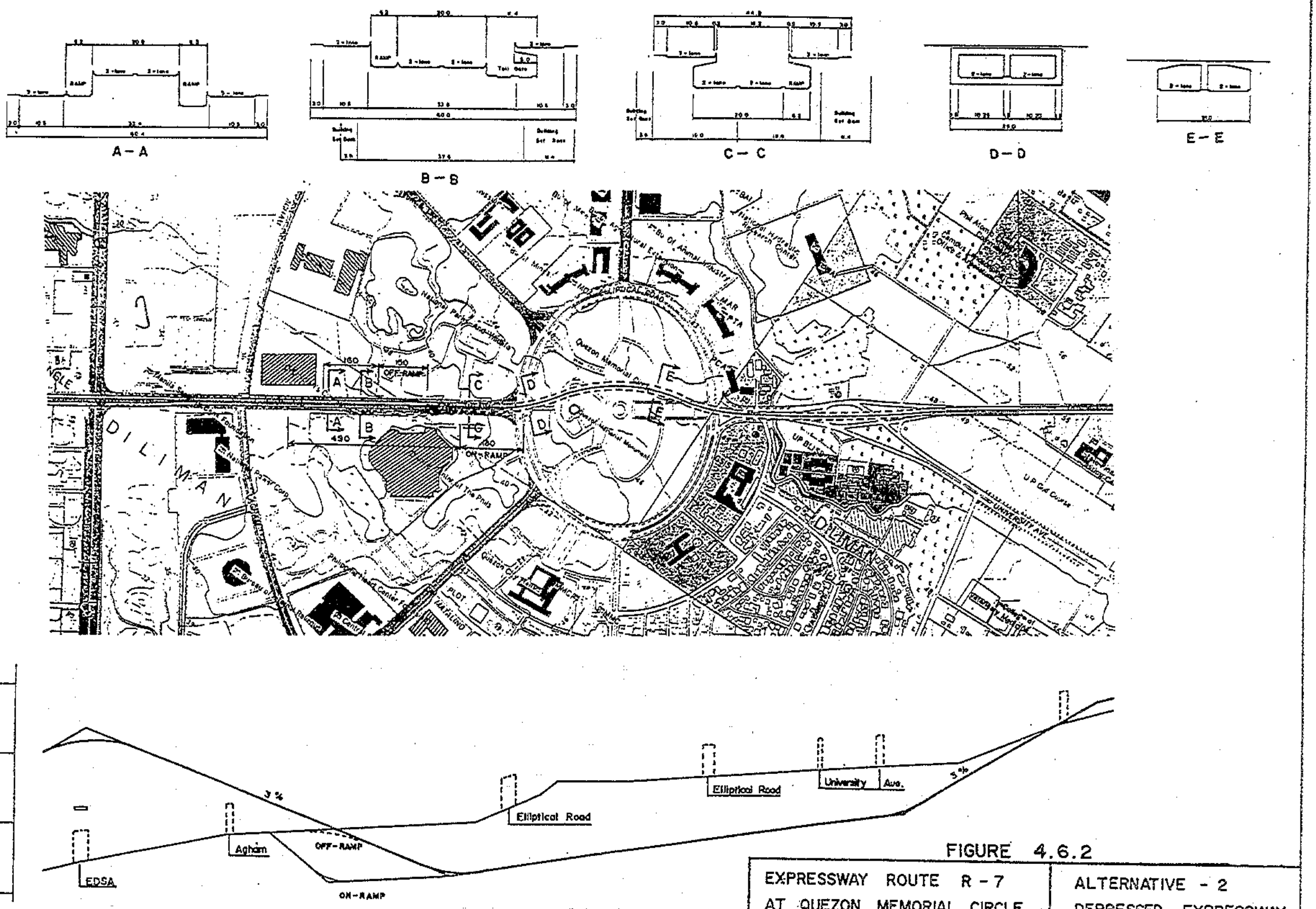


FIGURE 4.6.2

EXPRESSWAY ROUTE R - 7 AT QUEZON MEMORIAL CIRCLE	ALTERNATIVE - 2 DEPRESSED EXPRESSWAY

Traffic impact during construction: Alternative - 1 utilizes longer section of the existing roads. On the other hand, Alternative - 2 requires special construction method or procedure to mitigate adverse traffic impact during construction.

Horizontal alignment: Alignment - 2 is superior over Alternative - 1.

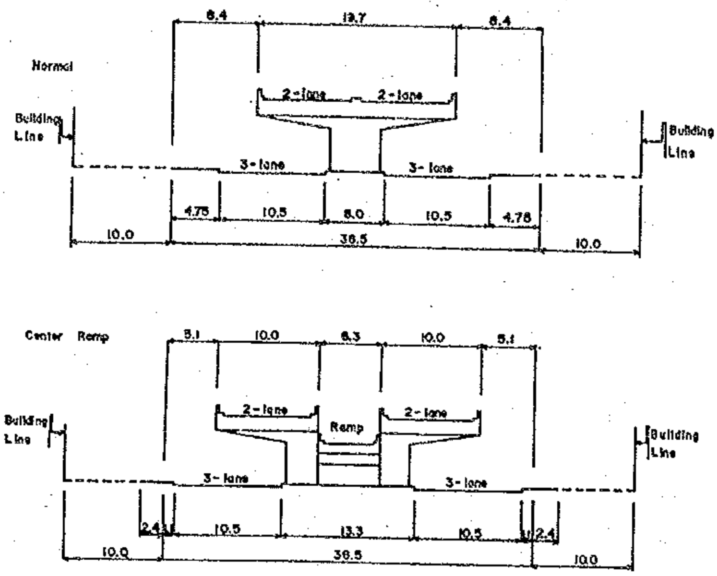
Urban aesthetic and environment: The corridor is surrounded by parks and Government offices, therefore, an expressway must harmonize with the aesthetic views and environment of adjacent areas. Alternative - 2 is much superior over Alternative - 1.

At this particular section of the route, aspect of urban aesthetic and environment should be seriously considered. Alternative - 2 was recommended for an alignment of this section.

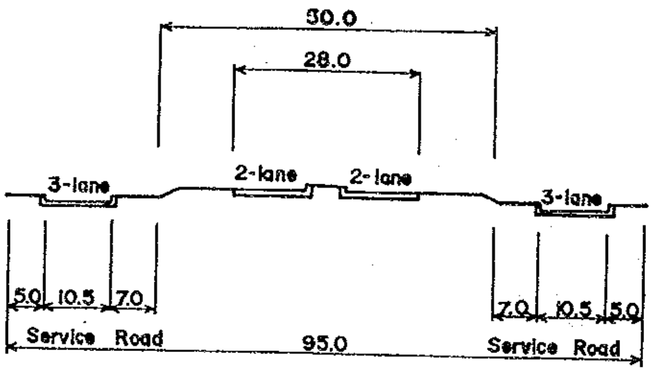
4.6.3 Other Section of the Route

The section from Welcome Rotonda to Quezon Memorial Circle, an expressway will be constructed over Quezon Ave. Typical cross section of this section is shown in Figure 4.6.3.

The section from Quezon Memorial Circle to Batasang Pambansa will be at-grade and will be accommodated within the existing ROW of 95 meters. Typical cross section is shown in Figure 4.6.3.



QUEZON AVE. FROM WELCOME ROTONDA TO QUEZON MEMORIAL CIRCLE



COMMONWEALTH AVE. FROM QUEZON MEMORIAL CIRCLE TO BATASAN PAMBANSA

FIGURE 4.6.3 TYPICAL CROSS SECTION OF ROUTE R-7

4.7 EXPRESSWAY ROUTE R-9 (ALONG A. BONIFACIO AVE. AND NORTH LUZON EXP.)

4.7.1 Features of the Corridor

The route is connected with North Luzon Expressway and serves as a vital link to distribute traffic from NLE to various areas of Metro Manila or vis-a-vis. The route also functions as a part of the north-south transport axis to cope up with the increasing traffic in that direction.

The route starts at Expressway Route C-3, goes over A. Bonifacio Ave. and NLE and ends at about 0.5 km. north of NLE Toll Plaza.

4.7.2 Alternatives

Alternatives for the section from Expressway Route C-3 to EDSA were studied together with Expressway Route C-3 in section 4.3 of this report and a double deck type of viaduct for an expressway was recommended.

The section from EDSA to the end of this expressway has no competitive alternative alignment, but to pass over the existing NLE. Outline of an expressway for this section is illustrated in Figure 4.7.1.

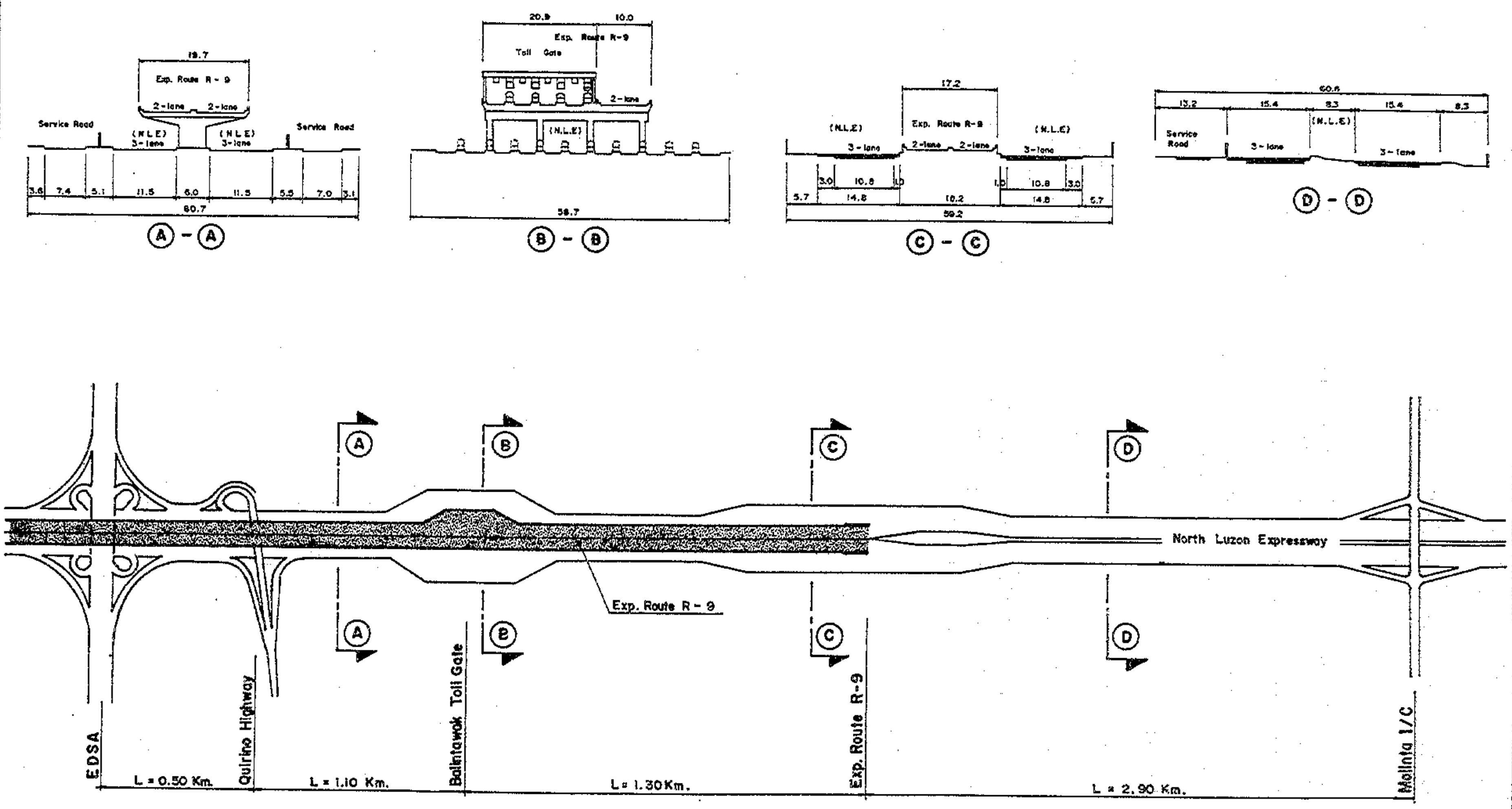


FIGURE 4.7.1 OUTLINE OF EXPRESSWAY ROUTE R-9 FROM EDSA TO THE END OF EXPRESSWAY

4.8 EXPRESSWAY ROUTE R-10 (ALONG AT-GRADE R-10)

4.8.1 Features of the Corridor

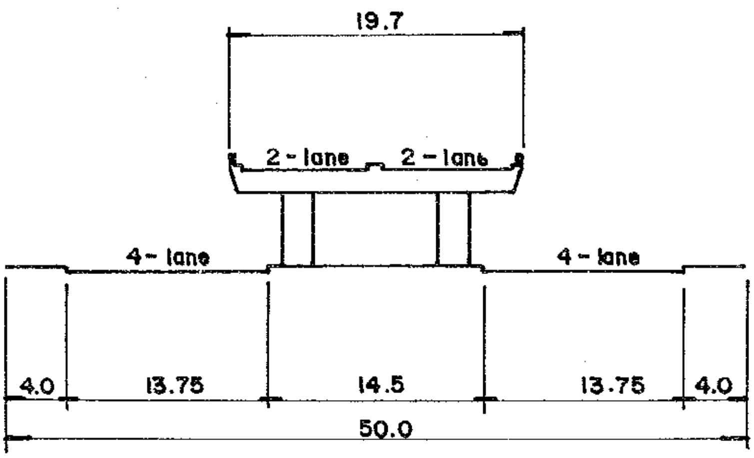
The route will be constructed over at-grade R-10 from Moriones Ave. to C-5. The route is a vital link to serve for truck traffic to/from Manila International/Domestic Harbors. The route also strengthens accessibility to the northern area of Manila CBD.

At-grade R-10 has ROW width of 50 meters. The initial stage to develop 25-meter portion of 50-meter ROW has been completed. The second stage to develop full cross section of 50 meters will be completed by year 2010.

4.8.2 Alternatives

There is no competitive alternative alignment along this corridor, but to utilize at-grade R-10 ROW. At present, the second stage of at-grade R-10 development is scheduled to be by year 2010, it is hoped that the second stage and construction of Expressway Route R-10 be so coordinated that implementation of an expressway project will not be affected.

Typical cross sections of this route is shown in Figure 4.8.1.



NORMAL SECTION

FIGURE 4.8.1 TYPICAL CROSS SECTIONS OF EXPRESSWAY ROUTE R-10

CHAPTER 5

CONSTRUCTION PHASING
OF
FIRST STAGE EXPRESSWAYS

CHAPTER 5

CONSTRUCTION PHASING OF FIRST STAGE EXPRESSWAYS

High Priority corridors selected for a feasibility study correspond to the first stage expressways in the master plan of MMUES. The first stage expressways constitute one circumferential expressway (Route C-3) and five radial expressways (Routes R-3, R-4, R-7, R-9 and R-10) which extend for about 60 kms., and requires huge amount of investment. Thus, the first stage expressways must be implemented by stage construction.

5.1 ALTERNATIVES FOR CONSTRUCTION PHASING

5.1.1 Principles in Formulating Alternatives

Following principles were adopted in selecting the Phase-1 expressway sections:

a) The most essential part of the inner core (or backbone) of MMUES.

b) These expressway sections which attract higher expressway traffic and their traffic impact on at-grade roads spreads in the wide range of areas.

c) These expressway sections of which implementation is easier in terms of right-of-way acquisition and social environmental impact.

d) These expressway sections which effectively complement insufficiency of the at-grade road network.

e) These expressway sections which support urban development.

5.1.2 Alternatives

In order to realize a) above, a part of or full stretch of Expressway Route C-3 and two or three radial expressways should be constructed first. Expressway Route C-3 constitutes an inner circumferential expressway and 5 radial expressways in the first stage of MMUES are all connected with Route C-3. Unless a part of or full stretch of Route C-3 is completed, other radial expressways function only as an independent link and effects as an expressway network are not realized. Thus, early completion of Route C-3 is very essential.

A part of Route C-3 alone has little effect on traffic. It has to be connected with two or three radial expressways so as to maximize function of Route C-3.

Most competitive radial expressways to be constructed first are Route R-3, Route R-7 and Route R-9. The priority section of Route R-3 is from Quirino Avenue to Bicutan Interchange. If traffic currently utilizing Bicutan Interchange is attracted to Route R-3, traffic condition of South Luzon Expressway will be greatly improved, particularly near the section to EDSA.

Priority section of Route R-7 is from Araneta Avenue to Quezon Memorial Circle (QMC). The section from QMC to the end passes within the road right-of-way of Commonwealth Avenue which can accommodate more traffic lanes, therefore, widening of existing road is the first option to cope up with increasing traffic prior to construction of an expressway.

Route R-9 has a length of only 4.5 kms. and can not be divided into sections, but full stretch should be constructed at one time.

With regard to b) above, preliminary traffic assignment analysis was conducted as presented in Appendix 5.1.1.

In connection with c) above, Figure 5.1.1 was prepared to show expressway sections of which implementation is expected to be difficult and adverse social impact is anticipated.

With regard to d) above, major concern was addressed to form an additional expressway route which will function as an alternative route of EDSA which, at present, suffers heavy traffic overburden.

In connection with e) above, urban or urbanizing areas of which transport accessibility be strengthened by providing expressways were identified as follows:

- Manila CBD and Makati CBD
- Rapidly urbanizing areas in the south, Quezon City and the north

Based on the above discussions, three alternatives were developed as shown in Figure 5.1.2.

<u>Alternative - 1</u>

Phase-1 involves construction of the following expressway sections:

Route C-3	:	From Route R-3 to Route R-9
Route R-3	:	From Quirino Avenue to Bicutan I/C
Route R-9	:	Full stretch

<u>Alternative - 2</u>

Phase-1 involves construction of the following expressway sections:

Route C-3	:	From Route R-3 to Route R-7
Route R-3	:	From Quirino Avenue to Bicutan I/C
Route R-7	:	From Route C-3 to Quezon Memorial Circle

<u>Alternative - 3</u>

Phase-1 involves construction of the following expressway sections:

Route C-3	:	Full stretch
Route R-3	:	From Quirino Avenue to Buendia Avenue
Route R-10	:	From Moriones St. to Route C-3

Implementation target was set as follows:

Phase-1	:	By Year 2002
Phase-2	:	By Year 2006

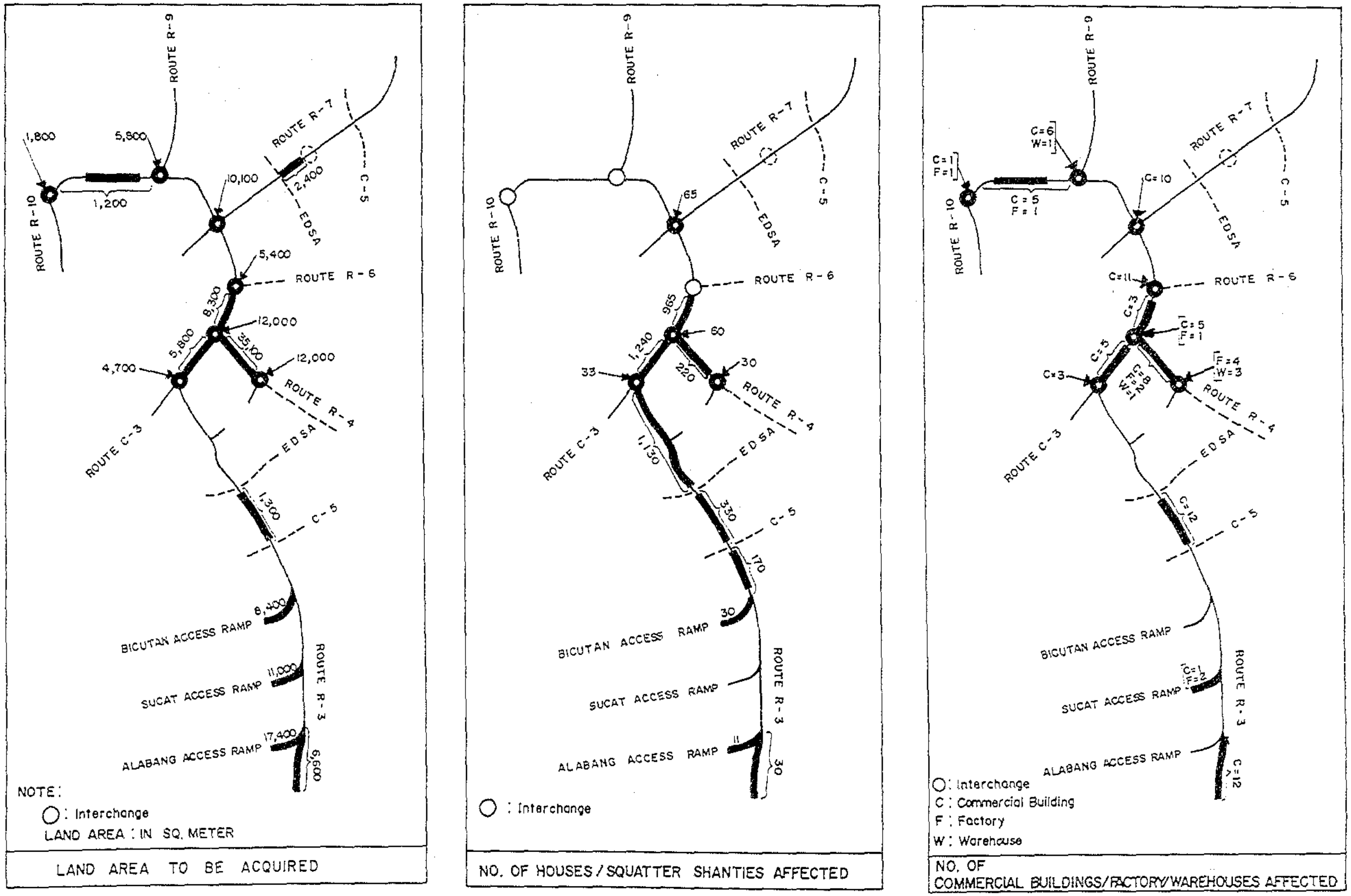
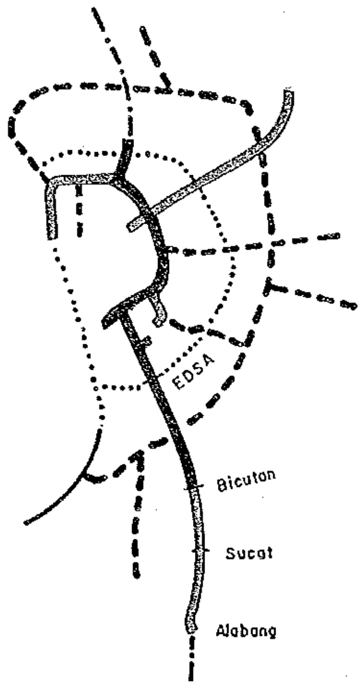
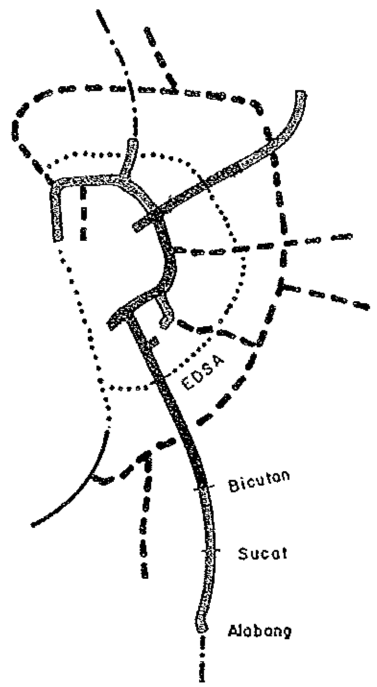
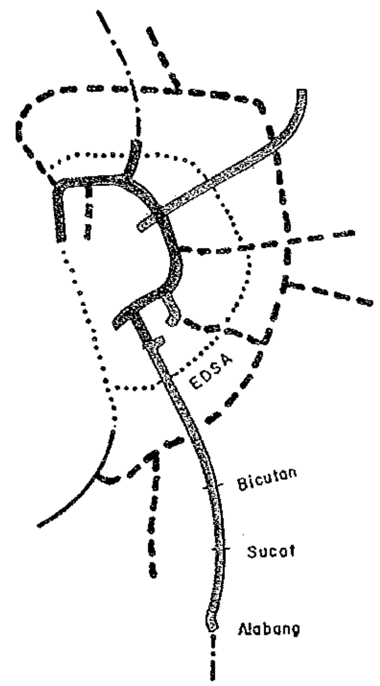


FIGURE 5.1.1 EXPRESSWAY SECTIONS WHERE IMPLEMENTATION DIFFICULTY IS EXPECTED

FIGURE 5.1.2 CONSTRUCTION PHASING ALTERNATIVES

	ALTERNATIVE – 1	ALTERNATIVE – 2	ALTERNATIVE – 3
STAGE – 1 Phase – 1 : (Year 2002) Phase – 2 : (Year 2006) STAGES – 2 and 3 :			
Basic Considerations For Selecting Phase – 1 Expressways	• To form the north–south transport axis, the existing North and South Luzon Expressways shall be linked by urban expressways • To support urban development in the north and south • To mitigate traffic congestion of North and South Luzon Expressways and EDSA	• Three major private traffic generating sources, namely Quezon City, Makati CBD and the southern Metro Manila shall be linked with each other to improve accessibility to these area • To support urban development in the said three areas • To mitigate traffic congestion of EDSA, South Luzon Expressway and Quezon Avenue	• Entire Route C–3, which is the most basic link of MMUES, shall be formed • To support revitalization of Manila CBD • To mitigate traffic congestion of streets in Manila CBD by diverting through traffic to urban expressways
EXPRESSWAY LENGTH (km) • Phase – 1 • Phase – 2 • Total	 27.4 km 31.2 km 58.6 km	 26.1 km (–1.3 km) 32.5 km (+1.3 km) 58.6 km	 26.1 km (–1.3 km) 32.5 km (+1.3 km) 58.6 km
EXPRESSWAY TRAFFIC (PCU/DAY) • Phase – 1 • Phase – 2	Toll: ₱10 ₱20 ₱30 87,600 52,900 16,400 186,000 136,800 108,000	Toll: ₱10 ₱20 ₱30 87,700 52,100 16,800 186,000 136,800 108,000	Toll: ₱10 ₱20 ₱30 78,400 50,700 15,400 186,000 136,800 108,000
PHASE – I COST (Million Pesos) • Construction Cost • ROW Cost • Total	 ₱ 11,570 M. ₱ 1,040 M. ₱ 12,610 M.	 ₱ 10,717 M. (– ₱ 853 M.) ₱ 965 M. (– ₱ 75 M.) ₱ 11,682 M. (– ₱ 928 M.)	 ₱ 10,706 M. (– ₱ 864 M.) ₱ 935 M. (– ₱ 105 M.) ₱ 11,641 M. (– ₱ 969 M.)
PHASE – 1 • Land Area to be Acquired • No. of Houses/Shanties Affected • No. of Commercial Buildings Affected • No. of Factories Affected • No. of Warehouses Affected	 61,800 sq. m. 4,023 55 1 1	 58,400 sq. m. (–3,400 sq. m.) 4,023 (0) 49 (– 6) 1 (0) 0 (– 1)	 55,100 sq. m. (–6,700 sq. m.) 3,223 (–800) 49 (– 6) 3 (+ 2) 1 (0)

Note : Figure in ( ) shows difference compared with Alternative – 1

5.2 EVALUATION OF ALTERNATIVES

Expressway extension, traffic, construction cost, etc. of three alternatives are shown in Figure 5.1.2.

Alternative - 3 was not considered as the competitive alternative due to the following reasons:

- Expressway Route R-10 will be constructed over the at-grade R-10 which is partially completed at present. Implementation of the at-grade R-10 widening is scheduled between Year 2000 and 2005. Expressway Route R-10, therefore, can only be implemented in Phase-2.
- Expressway Route C-3 will be constructed over the at-grade C-3. Implementation of the section from A. Mabini Street to Rizal Avenue of the at-grade C-3 is at present suspended due to ROW acquisition problem and is scheduled between Year 1996 and 2000, therefore, Expressway Route C-3 over the said section should be planned to be implemented in the Phase-2.

Comparison of Alternative-1 and Alternative-2 is as follows:

a) Traffic Impact

Expressway Traffic: Both alternatives attract almost same level of traffic (about 52,000 - 53,000 pcu/day at toll rate of ₱20.00 (see Figure 5.2.1).

Vehicle Hours: Vehicle hours for toll rate of 20 pesos which presents overall traffic efficiency for total road network (at-grade roads + Expressways) are as follows:

Alternative-1	1.41 Million Veh. Hour (1.00)
Alternative-2	1.46 Million Veh. Hour (1.04)

Difference between alternatives is minimal, showing slight superiority of Alternative-1.

b) Investment Requirement

Construction Cost: Difference between the two alternatives is minimal, although Alternative-1 requires slightly higher construction cost by about 1.08 times (or about 850 million pesos) due mainly to longer expressway network (1.3 km.), however, it will be offset in Phase-2.

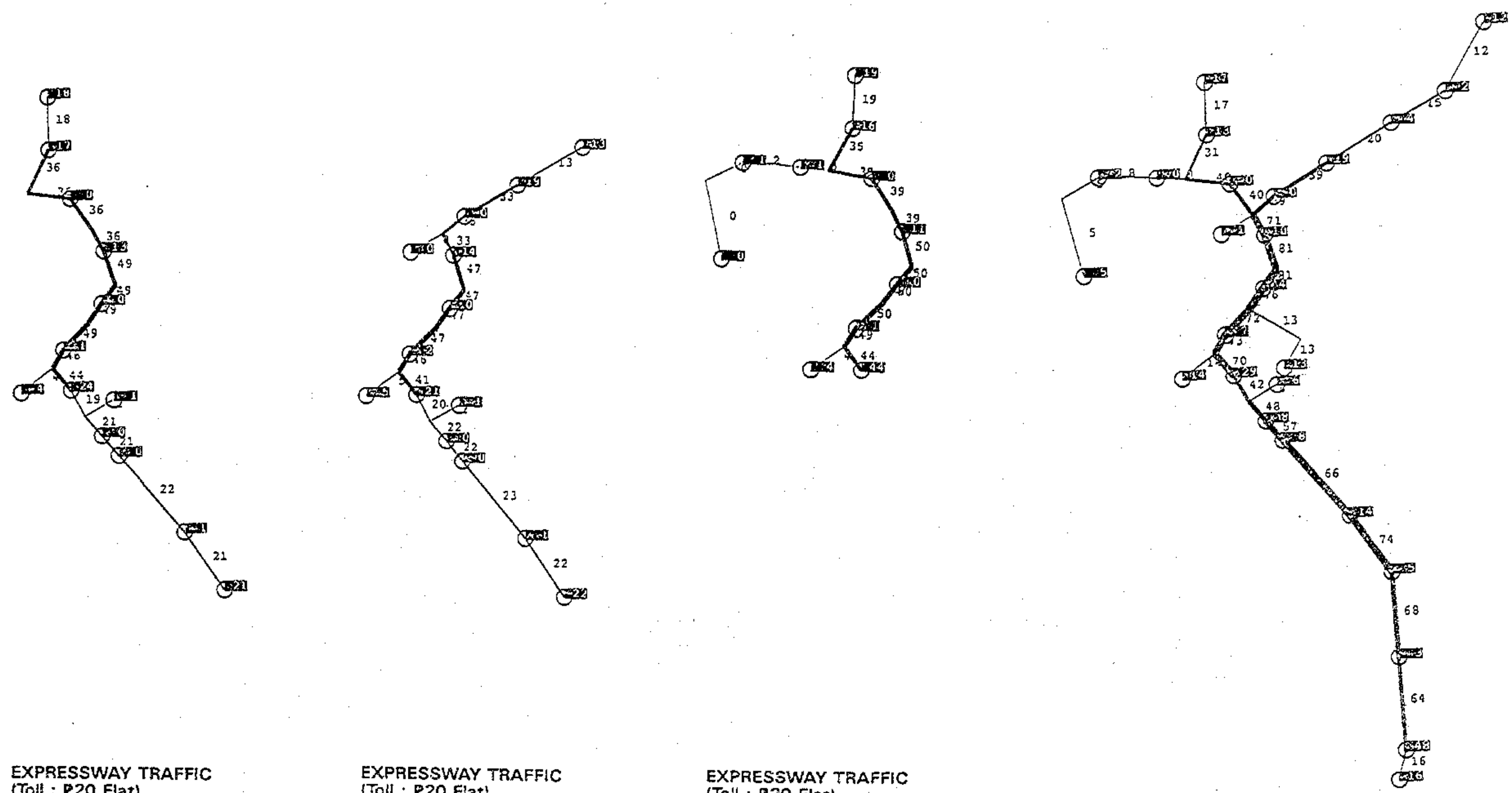
ROW Acquisition Cost: Difference between the two alternatives is minimal, though Alternative-1 requires slightly higher ROW acquisition cost by about 1.08 times (or 75 million pesos).

c) Implementation and Social Environmental Aspects

Land Area to be Acquired: Difference between the two alternatives is minimal, though Alternative-1 requires slightly wider areas to be acquired by about 1.06 times (or 3,400 square meters).

Houses/Shanties/Buildings Affected: Difference between the two alternatives is minimal.

PHASE-1 (YEAR 2002)			PHASE-2 (YEAR 2006)
ALTERNATIVE-1	ALTERNATIVE-2	ALTERNATIVE-3	



ALTERNATIVE-1	ALTERNATIVE-2	ALTERNATIVE-3	PHASE-2 (YEAR 2006)
EXPRESSWAY TRAFFIC (Toll : ₱20 Flat) 52,900 pcu/day	EXPRESSWAY TRAFFIC (Toll : ₱20 Flat) 52,100 pcu/day	EXPRESSWAY TRAFFIC (Toll : ₱20 Flat) 50,700 pcu/day	EXPRESSWAY TRAFFIC (Toll : ₱20 Flat) 136,800 pcu/day

FIGURE 5.2.1 EXPRESSWAY TRAFFIC BY ALTERNATIVE

d) Economic Aspect

Preliminary economic evaluation results for toll rate of 20 pesos are as follows:

Alternative-1	EIRR 21.0%
Alternative-2	EIRR 20.1%

Alternative-1 shows slight superiority over Alternative-2.

e) Impact of Delayed Construction

Expressway Route C-3 involves extensive right-of-way acquisition and relocation of a lot of families, especially the section between Route C-3/R-3 Interchange and Route C-3/R-6 Interchange. Construction of the said section may be delayed due to right-of-way acquisition and its associated problems. In such a case, only radial expressways would be opened for traffic until the said section of Expressway Route C-3 is completed. Under such situation, expressway traffic (Toll Rate: ₱10) would be as follows:

Alternative-1

• Route R-3 from Quirino Ave. to Bicutan I/C	:	15,800 pcu/day
• Route R-9 and Route C-3 from Routes C-3/ R-6 I/C to Routes C-3/R-9 I/C	:	34,800 pcu/day
TOTAL		50,600 pcu/day

Alternative-2

• Route R-3 from Quirino Avenue to Bicutan I/C	:	15,800 pcu/day
• Route R-7 from Welcome Rotonda to Quezon Memorial Circle and Route C-3 from Routes C-3/R-6 I/C to Routes C-3/R-7 I/C	:	36,900 pcu/day
TOTAL		52,700 pcu/day

Both alternatives attract almost the same traffic.

Above discussions indicate that there is no big difference between the two alternatives, therefore, the Government can implement the project under the implementation schedule of either Alternative-1 or Alternative-2, however, this Study recommends to adopt Alternative-1, due to the following reasons:

- Alternative-1 will realize to form the north-south transport axis which corresponds to the direction of urban expansion.
- Alternative-1 will connect the existing North and South Luzon Expressways, thus nationwide expressway network is greatly strengthened.
- Once Alternative-1 is completed, succeeding expansion of urban expressway network will be relatively easier by just adding radial expressways and a short section of Route C-3.
- Traffic on the existing North and South Luzon Expressways is currently distributed through EDSA. Upon completion of Alternative-1, these traffic will have direct access to Manila CBD and Makati CBD through urban expressways. Alternative-1 will provide a strong alternative route of EDSA, thus effectively complement insufficiency of the at-grade road network.

CHAPTER 6

TRAFFIC FORECAST

CHAPTER 6

TRAFFIC FORECAST

6.1 METHODOLOGY

Traffic forecast of the expressway traffic for the selected route for the feasibility study was made based on the methodology and data prepared in the Master Plan Study (Refer to Figure 6.1.1). However, some modifications were made to meet the specific requirements of the analysis which are explained below:

1) Preparation of OD Tables for Years 2002 and 2006: OD Tables were prepared for years 2002 and 2006 which are the opening of Phase-1 and Phase-2 of the Project Road, respectively, based on those worked out for years 2000 and 2010 in the Master Plan Study.

2) At-grade Road Network for Years 2002 and 2006: It is assumed that the planned network shown in the Master Plan Report is the base road network.

3) Traffic Assignment Model and Data Input: A software package called TRAN PLAN was used for expressway traffic assignment wherein speed-flow relationship was set as shown in Figure 6.1.2 for different types of roads as shown in Table 6.1.1.

4) Construction Phasing: Construction phasing of the First Stage Expressways explained in Chapter 5 was followed.

5) Traffic Assignment: In traffic assignment, public transport was pre-loaded for at-grade road network of respective years based on the present and estimated public transport traffic distribution pattern, while private vehicular traffic was assigned.

FIGURE 6.1.1 PROCEDURE OF TRAFFIC ASSIGNMENT

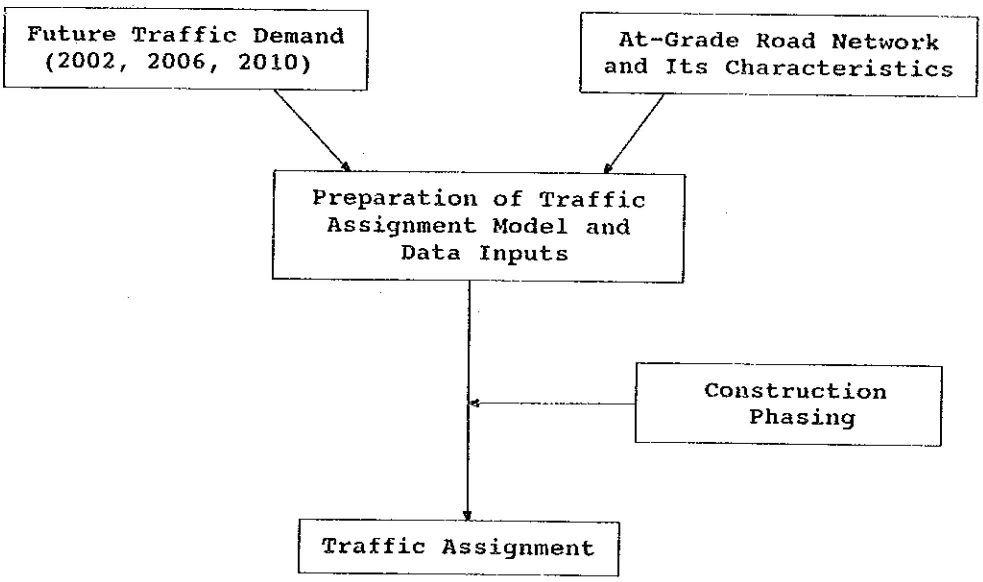


FIGURE 6.1.2
SPEED-FLOW RELATIONSHIP
(Q-V CURVE)

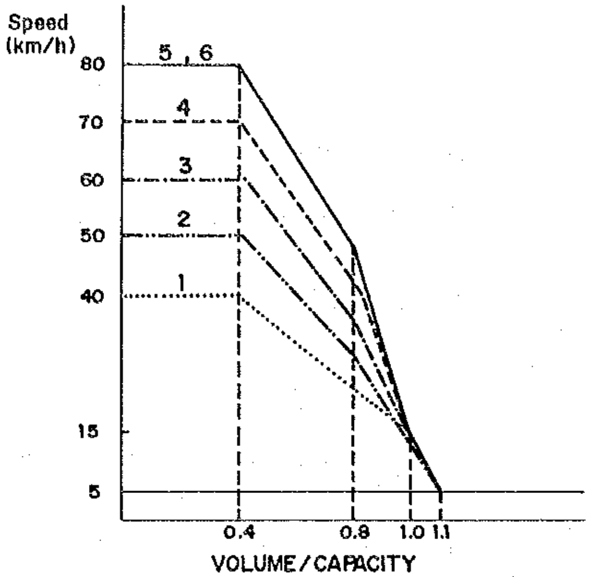


TABLE 6.1.1
CLASSIFICATION OF ROAD TYPE

QV	Road Type	No. of Lanes
1	Secondary Road	2, 4
2	Primary (Inside C-4)	2, 4, 6
3	Primary (Outside C-4)	2, 4, 6
4	Primary (Inside C-4) Expressway (Inside C-4)	8 & over 4
5	Segregated (SSH) Primary (Outside C-4)	6, 8 8 & over
	Expressway (Outside C-4)	4

Assumed Travel Speed and Capacity by Road Type

No. of Lanes	Road (QV Curve) Type	Maximum Travel Speed (kph)	Saturation Travel Speed (kph)	Minimum Travel Speed (kph)	Capacity (PCU/day)
2	1	40	15	5	26,000
4	1	40	15	5	52,800
2	2	50	15	5	26,000
4	2	50	15	5	52,800
6	2	50	15	5	81,000
2	3	60	15	5	26,000
4	3	60	15	5	52,800
6	3	60	15	5	81,000
4	4	70	15	5	60,000
8	4	70	15	5	120,000
10	4	70	15	5	150,000
4	5	80	15	5	60,000
8	5	80	15	5	120,000
10	5	80	15	5	150,000
4	6	80	15	5	72,000

6.2 ESTIMATED EXPRESSWAY TRAFFIC VOLUME

The traffic volume on the expressway were tested using three flat toll rate levels, ₱10, ₱20 and ₱30, and the results are shown in Table 6.2.1. Under the ₱20 toll level, the expressway traffic will be 53,000 pcu, 137,000 pcu and 196,000 pcu for years 2002, 2006, and 2010, respectively. The average traffic growth rate during years 2000 - 2010 is approximately six percent per annum.

TABLE 6.2.1 EXPRESSWAY TRAFFIC VOLUME BY TOLL LEVEL

(000 pcu)

Toll Level (Flat Rate)	FIRST STAGE		
	Phase 1 (2002)	Phase 2 (2006)	2010
₱10	88	186	244
₱20	53	137	196
₱30	16	108	147

A reduction in expressway users of about 40% was reflected for the year 2002 when the toll rate was increased from ₱10 to ₱20. The decrease for the same year was more significant, about 70% when it was raised further to ₱30. The reduction in traffic for the other forecast periods were not as high, as these were all below 30%. The lower sensitivity to toll rates can be attributed to the longer expressway coverage available to the users during the said years.

6.3 EXPRESSWAY TRAFFIC CHARACTERISTICS

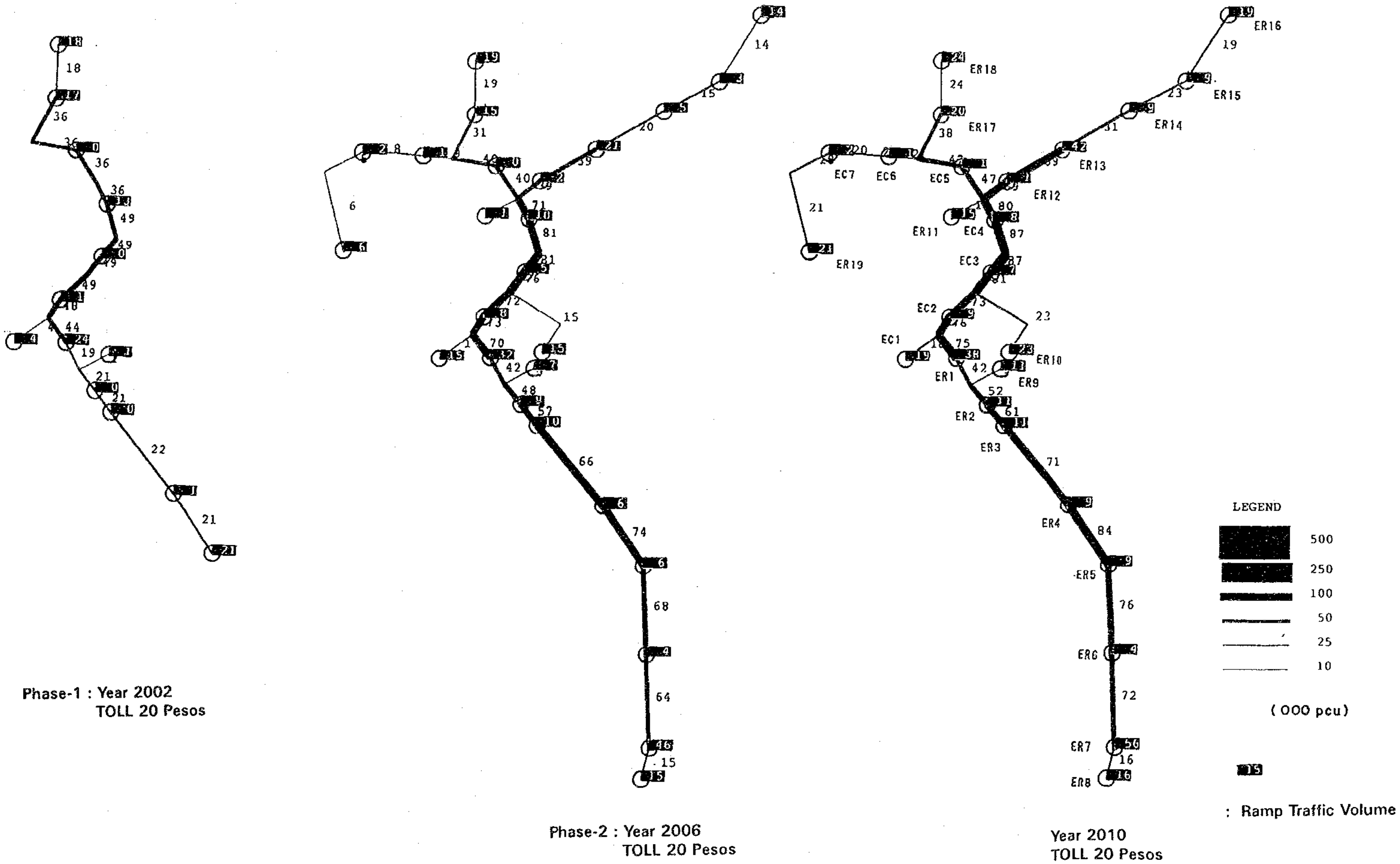
1) Traffic Distribution

Expressway traffic for the forecast years 2002, 2006 and 2010 are shown in Figure 6.3.1 High traffic volume is registered along Expressway Route C-3 ranging from 36,000 to 49,000 pcus, while Expressway Route R-3 traffic is approximately 20,000 pcus.

A dramatic increase in traffic is being forecasted with the opening of the additional expressway segments along Expressways Route R-7 and R-3 in year 2006, particularly along the latter where it ranges from 56,000 to 66,000 pcus, except along the section of Alabang to Susana Hts. where the volume is only about 14,000 pcus. Expressway Route C-3 traffic rose to about 81,000 pcus on the section between Expressway Routes R-6 and R-4. Expressway Route R-7 traffic is from 15,000 to 40,000 pcus.

For the year 2010, Expressway Route C-3 traffic slightly decreased due to the operation of Expressway Route C-5. Traffic along Expressway Route C-5 is fairly high particularly from Mindanao Avenue up to the SLE with values from 40,000 to 87,000 pcus. Traffic along the rest of Expressway Route C-5 sections are considerably low. There is also a minimal reduction in traffic along Expressway Route R-3 attributed to the opening of Expressway Route R-2.

FIGURE 6.3.1 EXPRESSWAY TRAFFIC VOLUME



2) Trip Length of Expressway Traffic

The trip length distribution for the year 2010 for both the expressway and non-expressway users are given in Table 6.3.1. Expressway users have relatively longer trip lengths, with an average of about 18.7 km. Furthermore, about 87% have trip lengths of 24.9 km. and below.

TABLE 6.3.1 TRIP DISTRIBUTION BY TRIP LENGTH

(000 pcu)

Trip Length (km)	Expressway Traffic		Other Traffic		Total Traffic	
	No. of Trips	(%)	No. of Trips	(%)	No. of Trips	(%)
0 - 4.9	0	0.0	1361	38.5	1361	31.6
5 - 9.9	34	10.2	1100	31.1	1100	26.4
10 - 14.9	111	33.2	845	18.2	756	17.6
15 - 19.9	104	20.9	213	6.0	317	7.4
20 - 24.9	180	22.5	143	4.0	323	7.5
25 - 29.9	129	5.6	44	1.2	172	4.0
30 & Above	206	7.7	33	0.8	239	5.6
Ave. Trip Length	18.7 km		8.51 km			

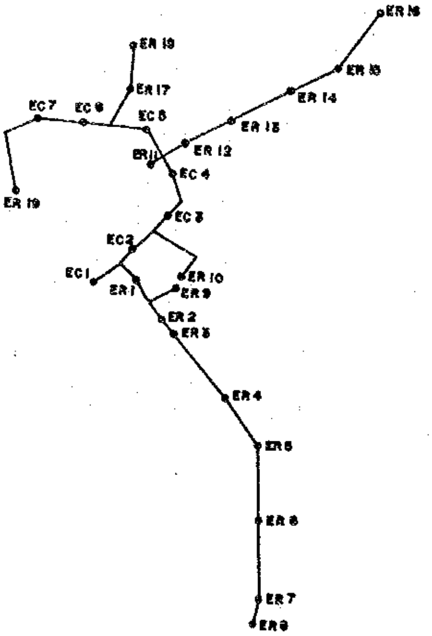
6.4 ON/OFF RAMP TRAFFIC

1) Ramp Traffic Volume

The total entry and exit ramp traffic are shown in Table 6.4.1. For the year 2006, substantial traffic was registered at ER7: SLE/Alabang I/C ramps (46,300 pcu) and ER1: SSH/Vito Cruz ramps (31,900 pcu).

For the year 2010, ramp traffic at ER7 will increase to 42,200 pcu and at ER1 to 38,200 pcu. Ramps of ER13: Quezon Ave./EDSA, ER18: NLE/Toll Plaza, ER10: J.P. Rizal/Makati Access, and ER19: Moriones/North Harbor will be utilized by more than 20,000 pcu.

TABLE 6.4.1 RAMP TRAFFIC VOLUME



(00 pcu)

Ramp	Year 2006			Year 2010		
	In	Out	Total	In	Out	Total
1. EC1 Quirino Ave./Adriatico	37	114	151	49	136	185
2. EC2 Quirino Ave./Pedro Gil	76	2	78	86	3	89
3. EC3 R. Magsaysay/Old Sta. Mesa	36	17	53	36	34	70
4. EC4 G. Araneta/E. Rodriguez	50	53	103	28	47	75
5. EC5 G. Araneta/Del Monte	2	2	4	2	4	6
6. EC6 C3/Rizal Ave. Ext.	0	10	10	0	10	10
7. EC7 C3/Dagat-Dagatan Ave.	18	6	24	17	7	24
8. ER1 SSH/Vito Cruz	188	131	319	216	166	382
9. ER2 SSH/Pasay Road	51	40	91	47	63	110
10. ER3 SSH/EDSA	41	55	96	52	61	113
11. ER4 SLE/C5	33	30	63	40	52	92
12. ER5 SLE/Bicutan I/C	23	34	57	40	49	89
13. ER6 SLE/Sucat I/C	23	19	42	20	19	39
14 ER7 SLE/Alabang I/C	235	228	463	284	274	558
15. ER8 SLE/Alabang South	61	93	154	69	94	163
16. ER9 SSH/Buendia	38	33	71	65	44	109
17. ER10 J.P. Rizal/Makati Access	55	91	146	112	116	228
18. ER11 Quezon Ave./E. Rodriguez	8	3	11	99	48	147
19. ER12 Quezon Ave./West Ave.	20	0	20	14	0	14
20. ER13 Quezon Ave./EDSA	89	123	212	171	251	422
21. ER14 Commonwealth Ave./UP	28	24	52	45	40	85
22. ER15 Commonwealth Ave./Luzon Ave.	14	12	26	35	50	85
23. ER16 Commonwealth Ave./D. Antonio	63	72	135	105	84	189
24. ER17 NLE/EDSA	80	65	145	98	95	193
25. ER18 NLE/Toll Plaza	86	99	185	114	122	236
26. ER19 Moriones Rd./North Harbor	40	20	60	116	90	206

2) Inter-Ramp OD Traffic Volume

Table 6.4.2 shows the inter-ramp traffic volumes for the years 2006 and 2010. It is noteworthy to mention that of the total entry ramp traffic, about 12.7% are from ER7: SLE/Alabang I/C and fairly distributed over the destination ramps. This also applies to the exit ramp traffic, 12.3% of which are bound for ER7. Major OD pairs are as follows:

ER1 SSH/Vito Cruz
- ER13 Quezon Ave./EDSA
- ER16 Commonwealth Ave./D. Antonio
- ER17 NLE/EDSA
- ER18 NLE/Toll Plaza

ER7 SLE/Alabang I/C
- ER2 SSH/Pasay
- ER3 SSH/EDSA
- ER10 J.P. Rizal/Makati Access

OD pairs of which volume is more than 3,000 pcu are illustrated in Figure 6.4.1.

TABLE 6.4.2 INTER-RAMP OD TRAFFIC VOLUME

		1 EC1	2 EC2	3 EC3	4 EC4	5 EC5	6 EC6	7 EC7	8 ER1	9 ER2	10 ER3	11 ER4	12 ER5	13 ER6	14 ER7	15 ER8	16 ER9	17 ER10	18 ER11	19 ER12	20 ER13	21 ER14	22 ER15	23 ER16	24 ER17	25 ER18	26 ER19	Total
1	EC1	0	0	0	0	0	0	0	0	0	0	0	26	0	176	165	0	0	0	0	0	0	0	0	0	0	0	367
2	EC2	0	0	0	33	4	1	3	0	0	0	0	11	23	351	36	0	0	0	0	146	27	9	22	29	42	23	760
3	EC3	0	0	0	0	0	15	12	0	0	0	0	0	0	0	0	0	0	0	0	151	0	7	49	45	76	5	360
4	EC4	86	8	0	0	0	0	0	169	0	0	3	7	16	168	41	0	4	0	0	0	0	0	0	0	0	0	502
5	EC5	10	2	4	0	0	0	0	2	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	24
6	EC6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	EC7	17	6	15	0	0	0	0	49	0	0	7	3	12	22	12	0	35	0	0	0	0	0	0	0	0	0	177
8	ER1	0	0	0	60	12	44	19	0	0	0	0	3	0	71	8	0	0	0	0	192	120	36	352	402	547	13	1879
9	ER2	0	0	0	0	0	0	0	0	0	0	0	64	1	352	89	0	0	0	0	0	0	0	0	0	0	0	506
10	ER3	0	0	0	0	0	0	0	0	0	0	0	8	0	339	66	0	0	0	0	0	0	0	0	0	0	0	413
11	ER4	0	0	0	40	0	1	2	0	0	0	0	1	0	153	52	0	0	0	0	24	8	2	9	12	24	0	328
12	ER5	17	0	0	41	0	2	1	0	4	0	0	0	0	0	0	120	11	0	0	20	0	0	2	3	12	1	234
13	ER6	0	0	0	27	0	4	6	0	0	0	0	0	0	0	0	0	26	0	0	71	8	3	15	22	35	14	231
14	ER7	130	0	0	312	1	18	9	0	344	478	165	0	0	0	0	156	350	0	0	156	18	4	68	37	68	37	2351
15	ER8	48	0	0	13	1	10	6	0	51	72	42	0	0	0	0	50	14	0	0	93	10	1	23	36	119	24	613
16	ER9	0	0	0	0	0	0	0	0	0	0	0	130	0	199	60	0	0	0	0	0	0	0	0	0	0	0	389
17	ER10	0	0	0	0	0	1	5	0	0	0	0	7	0	98	10	0	0	0	0	142	16	7	131	63	61	4	545
18	ER11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	45	33	0	0	0	78
19	ER12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	ER13	308	2	18	0	0	0	0	144	0	0	40	28	44	139	78	0	53	0	0	0	0	0	0	0	0	36	890
21	ER14	47	0	4	0	0	0	0	94	0	0	5	0	9	23	5	0	60	21	0	0	0	0	0	0	0	10	278
22	ER15	38	0	2	0	0	0	0	38	0	0	2	1	4	8	16	0	14	11	0	0	0	0	0	0	0	6	140
23	ER16	42	0	8	0	0	0	0	337	0	0	3	32	11	36	26	0	107	2	0	0	0	0	0	0	0	26	630
24	ER17	266	5	71	0	2	0	0	236	0	0	15	6	22	32	45	0	98	0	0	0	0	0	0	0	0	0	798
25	ER18	131	2	47	0	0	0	0	231	0	0	15	8	34	74	193	0	124	0	0	0	0	0	0	0	0	0	859
26	ER19	0	0	0	0	0	0	0	14	0	0	0	1	14	33	26	0	11	0	0	233	31	7	20	0	9	0	399
Total		1140	24	169	526	20	96	63	1314	399	550	297	336	190	2280	928	326	907	34	0	1228	238	121	724	649	993	199	13751

(YEAR2006 : 10PCU)

		1 EC1	2 EC2	3 EC3	4 EC4	5 EC5	6 EC6	7 EC7	8 ER1	9 ER2	10 ER3	11 ER4	12 ER5	13 ER6	14 ER7	15 ER8	16 ER9	17 ER10	18 ER11	19 ER12	20 ER13	21 ER14	22 ER15	23 ER16	24 ER17	25 ER18	25 ER19	Total
1	EC1	0	0	0	0	0	0	0	0	0	0	5	39	10	261	170	0	0	0	0	0	0	0	0	0	0	0	485
2	EC2	16	0	0	11	0	7	1	0	0	0	19	20	16	462	74	0	3	0	0	78	11	24	11	39	45	24	861
3	EC3	0	0	0	0	0	12	10	0	0	0	0	0	0	0	0	0	0	0	0	211	5	0	16	65	40	1	360
4	EC4	12	5	0	0	0	0	0	60	0	0	5	11	9	142	30	0	6	0	0	0	0	0	0	0	0	0	280
5	EC5	1	1	0	0	0	0	0	2	0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0	0	0	19
6	EC6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	EC7	14	4	30	0	0	0	0	39	0	0	10	4	8	24	12	0	25	0	0	0	0	0	0	0	0	0	170
8	ER1	0	0	0	108	0	53	32	0	0	0	0	8	0	1	0	0	0	0	0	551	47	145	336	344	535	0	2161
9	ER2	0	0	0	0	0	0	0	0	0	0	0	70	0	319	78	0	0	0	0	0	0	0	0	0	0	0	467
10	ER3	0	0	0	0	0	0	0	0	0	0	0	57	0	402	60	0	0	0	0	0	0	0	0	0	0	0	519
11	ER4	0	0	0	11	0	0	1	0	0	0	0	0	0	246	70	0	0	0	0	11	2	4	3	14	33	1	396
12	ER5	41	0	0	41	2	4	4	0	41	46	4	0	0	0	0	143	22	0	0	20	2	0	2	7	17	2	398
13	ER6	0	0	0	14	0	5	3	0	1	0	0	0	0	0	0	3	37	0	0	55	8	6	10	17	31	11	201
14	ER7	267	3	0	254	41	10	11	0	514	501	287	0	0	0	0	220	357	0	0	151	17	23	42	45	84	11	2838
15	ER8	83	0	0	30	0	4	6	0	73	61	68	0	0	0	0	75	16	0	0	69	13	13	12	39	126	6	594
16	ER9	0	0	0	0	0	0	0	0	0	0	0	184	8	384	78	0	0	0	0	0	0	0	0	0	0	0	654
17	ER10	65	0	0	0	0	0	6	0	0	0	0	16	49	106	15	0	0	0	0	325	25	28	185	132	163	0	1115
18	ER11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	475	193	171	149	0	0	0	988
19	ER12	65	0	0	0	0	0	0	36	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	36	140
20	ER13	310	10	179	0	0	0	0	498	0	0	44	28	28	141	73	0	152	0	0	0	0	0	0	0	0	248	1711
21	ER14	33	0	0	0	0	0	0	102	0	0	3	12	0	30	8	0	44	113	0	0	0	0	0	0	0	106	451
22	ER15	35	0	4	0	0	0	0	60	0	0	1	0	1	8	7	0	13	132	0	0	0	0	0	0	0	89	350
23	ER16	43	0	23	0	0	1	0	363	0	0	4	26	5	29	22	0	179	233	0	0	0	0	0	0	0	117	1045
24	ER17	271	3	35	0	0	0	0	229	0	0	22	4	14	40	40	0	117	0	0	100	0	0	0	0	0	106	981
25	ER18	101	0	63	0	0	0	0	269	0	0	47	8	25	110	185	0	187	0	0	0	0	0	0	0	0	145	1140
26	ER19	0	0	1	0	0	0	0	0	0	0	1	1	19	20	13	0	4	0	0	463	80	82	78	248	147	0	1157
Total		1357	26	335	469	43	96	74	1658	629	608	520	488	192	2743	935	441	1152	478	0	2569	403	496	844	950	1222	903	19581

(YEAR2010 : 10PCU)

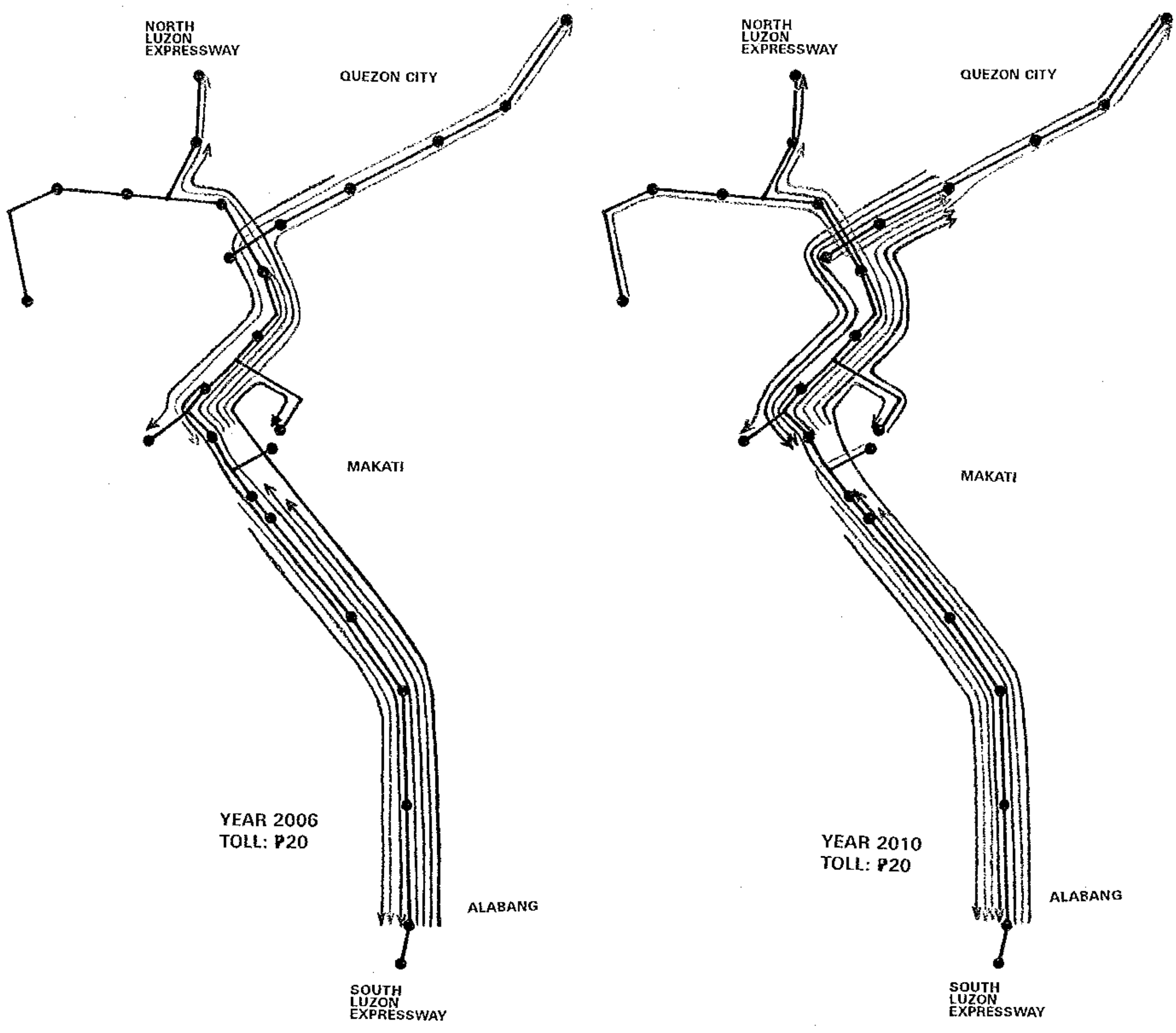


FIGURE 6.4.1 OD PAIRS WITH MORE THAN 3000 PCU

3) Impact on Local Roads

The entry and exit ramp traffic show varying impacts on local roads. As mentioned earlier, the highest two-direction traffic, which is about 46,300 pcu in 2006 and 55,800 pcu in 2010, occurs at ER7: SLE/Alabang I/C. With such a volume, congestion of Alabang-Zapote Road is likely to occur therefore, widening of the said road will be required.

Traffic management at the following ramp terminals with at-grade roads must be carefully implemented:

- ER1 : SSH/Vito Cruz
- ER13: Quezon Avenue/EDSA

Particularly, when their exit ramps are located close to the intersections, weaving traffic will disturb the flow of traffic, therefore, location of exit ramps must be carefully selected. In the preliminary design, the exit ramp of ER1 was selected after the intersection. Exit ramp of ER13 was selected at the location 640 meters away from the intersection.

6.5 INTERCHANGE TRAFFIC VOLUME

Traffic flows on the interchanges for the year 2006 are shown in Figure 6.5.1. The largest total traffic occurs at the Routes C-3/R-7 interchange which is about 65,000 pcu, distributed over the north-south and the east-south directions. Single direction flows range from zero to 34,600 pcu, the latter occurring at the west to east direction of the Routes C-3/R-4 interchange. Its opposite direction has about 33,800 pcu. The east to south direction of the Routes C-3/R-3 interchange also has a high traffic flow of about 32,800 pcu. The rest have flows lower than 20,000 pcu.

6.6 AT-GRADE ROADS TRAFFIC VOLUME

Figures 6.6.1 shows the traffic volumes on at-grade roads for the forecast years 2002, 2006 and 2010. The changes in percentages are shown in Figure 6.6.2.

As expected, significant reductions in traffic were reflected on at-grade roads directly beneath the proposed expressways. Increase in traffic volumes, on the other hand, were very minimal, except for certain portions of Mindanao Avenue and Ayala Blvd. This is due to the increase accessibility of these roads, causing them to be included in the shortest paths and consequently in the traffic assignment, resulting to higher volumes.

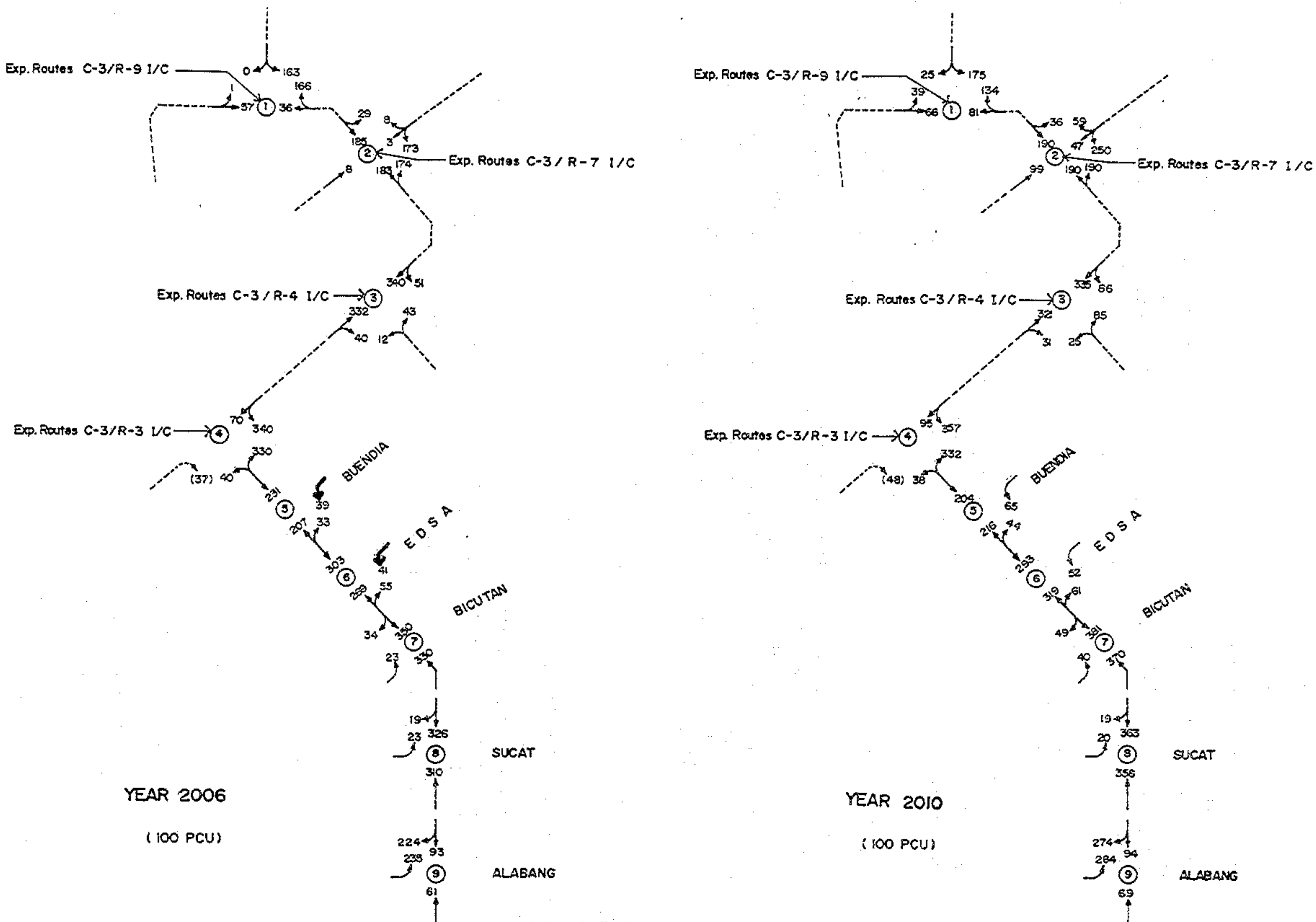


FIGURE 6.5.1 EXPRESSWAY INTERCHANGE TRAFFIC VOLUME

FIGURE 6.6.1
AT-GRADE ROADS TRAFFIC VOLUME

PHASE 1 (2002)　　PHASE 2 (2006)　　YEAR 2010

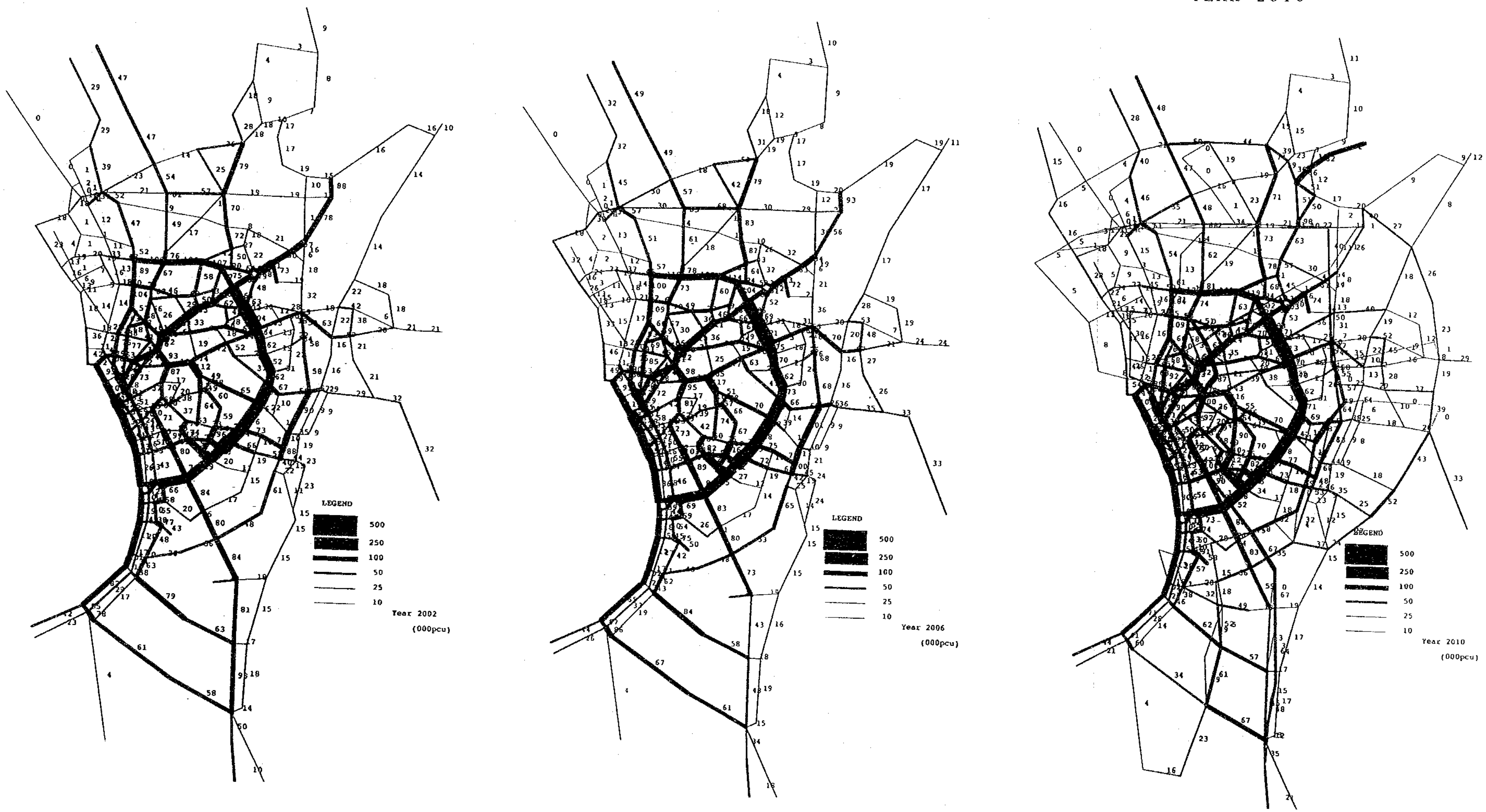
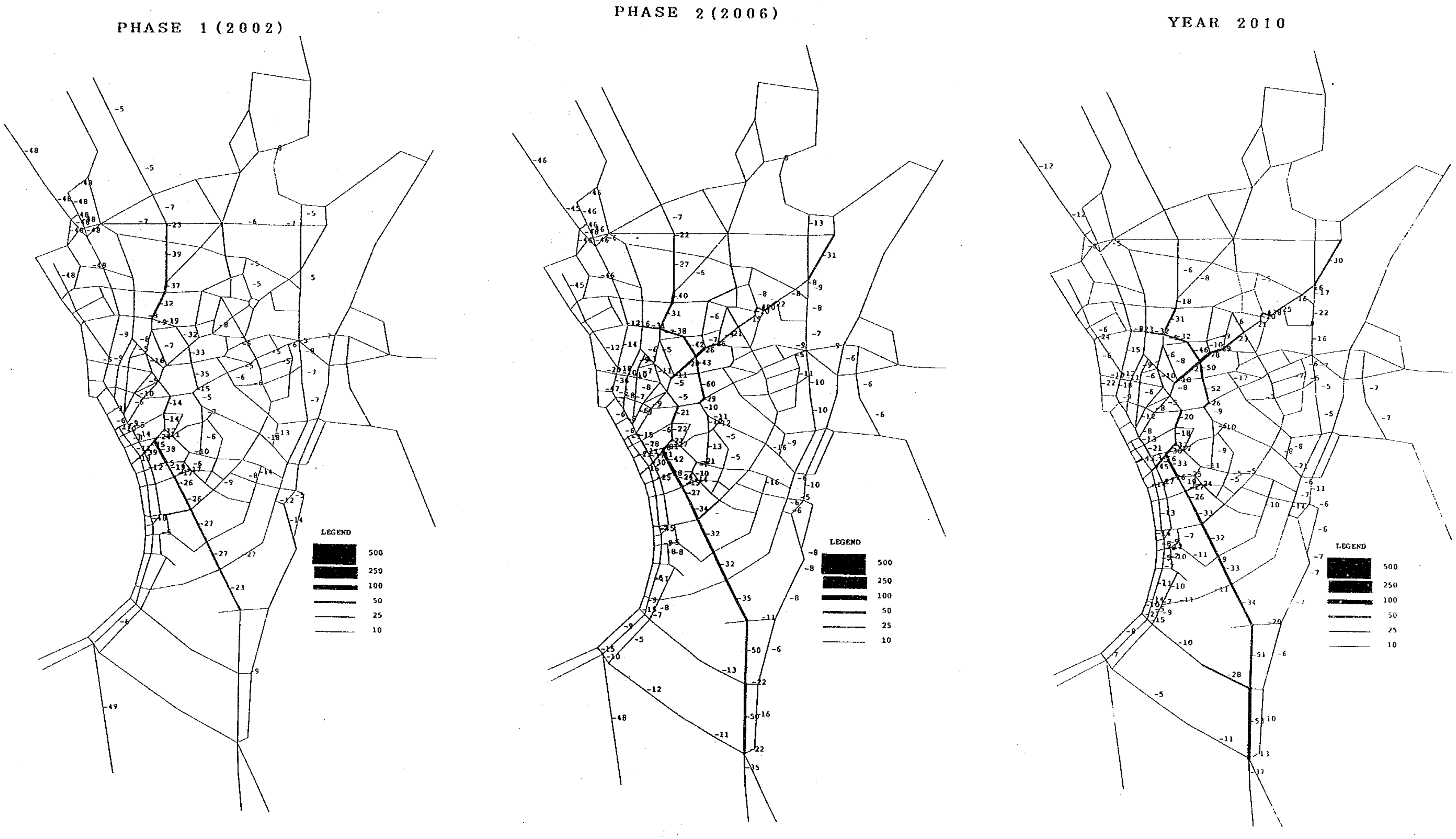


FIGURE 6.6.2
EXPRESSWAY TRAFFIC IMPACT ON AT-GRADE ROADS



DECREASE %: NUMBER SHOWS DECREASED TRAFFIC VOLUNE BY PERCENTAGE

6.7 TRAFFIC IMPACT OF EXPRESSWAYS

Traffic impacts of expressways are summarized in Table 6.7.1. When the Phase-1 expressways are completed in 2002, an average travel speed on at-grade roads will be improved from 18.4 km/hour (without expressway case) to 20.3 km/hour (with expressway case). In year 2010, an average travel speed on at-grade roads will be 15.6 km/hour for "without expressway case" which will be improved to 18.4 km/hour for "with expressway case"

Significant improvement will be expected for vehicle-hours. In year 2002, vehicle-hours of at-grade roads will be 1.5 million per day for "without expressway case" which will be reduced to 1.3 million per day for "with expressway case". About 200,000 vehicle-hours will be saved daily on at-grade roads. In year 2010, about 560,000 vehicle-hours will be saved for at-grade roads users. Thus, construction of expressways is also beneficial to at-grade road users.

Savings in vehicles km. will not be expected. As expressway users prefer to save travel time, even though longer travel distance is required, vehicle-km. of "with expressway case" will be slightly higher than that of "without expressway case".

TABLE 6.7.1 TRAFFIC IMPACT OF EXPRESSWAYS

Traffic Characteristics	Year	Without Expressway	With Expressways		
			At-grade Roads	Expressways	Total
Average Travel Speed (km/hour)	2002	18.4	20.3	44.3	21.6
	2006	14.8	15.3	45.2	17.1
	2010	15.6	18.4	44.5	20.2
Vehicle-Hours (in 1,000/day)	2002	1,501	1,322	26.4	1,348
	2006	2,042	1,907	46.4	1,953
	2010	2,271	1,706	99.0	1,805
Vehicle-km (in 1,000/day)	2002	27,682	26,818	1,169	27,987
	2006	30,310	29,167	2,098	31,265
	2010	35,439	31,396	4,651	36,047

CHAPTER 7

PRELIMINARY DESIGN

CHAPTER 7

PRELIMINARY DESIGN

7.1 DESIGN STANDARDS

7.1.1 Geometric Design Standards

An expressway's primary function is to transport large volume of traffic with faster speed. Design speed of an expressway should be as high as possible. In case of urban expressways which pass through highly urbanized and developed areas, higher design standards usually require more lands to be acquired, which results in not only high project costs but also difficult and prolonged implementation.

Since the geometric design standard of urban expressway in the Philippines is not clearly defined, the standards adoptable to the country were established based on A Policy on Geometric Design of Highways and Streets, AASHTO, 1984, reviving the standards applied in the other countries.

The major factors of geometric design standards which affect functionality, project costs, right-of-ways, construction difficulty are design speed, lane width and shoulder width. These three (3) fundamental factors were discussed in the Master Plan Report of Metro Manila Urban Expressway System, and the following standards were finally adopted.

(1) Design Speeds

The two different design speeds were adopted based on the following reasons.

<u>Class A: Expressway Outside C-4; 80 km per hour</u>

For expressways outside C-4, higher design standards than those inside C-4 are required due to the following viewpoints:

- Some of them will be, in the future, linked with an inter-city expressway which has design speed of 80 to 100 km per hour.
- To reduce traffic burden of C-4, expressways outside C-4 should be planned with high design standards so that traffic on C-4 is attracted to expressways.
- To strengthen accessibility to and transport interlinkage among urban centers growing along and outside C-4, expressways should be planned with high design standards.

Thus, design speed of 80 km. per hour is most appropriate for expressways outside C-4.

Class B: Expressway inside C-4; 60 km per hour

As the areas inside C-4 are highly developed, extensive ROW acquisition is quite difficult. Therefore, an expressway alignment will be so selected as to maximumly utilize existing public spaces such as existing at-grade major roads and rivers which control an expressway alignment to a great extent. At-grade major roads inside C-4 were designed with design speed of 60 km. per hour, thus it is practical to select design speed of 60 km. per hour for expressways inside C-4.

(2) Lane Width

Lane widths vary from 3.25 m (highly urbanized areas) to 3.50 m (urbanized areas). Taking into consideration the manuever of Filipino drivers and present driving practices in the country, the following two different widths were adopted:

- Class A; Expressway outside C-4; 3.5 m
- Class B; Expressway inside C-4; 3.25 m

(3) Outer Shoulder Width

Traffic demand for expressways in Metro Manila is high, thus all traffic lanes will be in use for the most of time of a day. Where shoulder width is not sufficient, a stopped vehicle will disrupt traffic not only on the occupied lane but on all lanes in that direction. For the purpose, there are two solutions, 1) provision of 2.0 meter shoulder through expressway or, 2) provision of 1.25 meters outer shoulder with emergency parking bay at certain intervals.

It is expected that a rate of vehicle breakdown on an expressway may be high due to many obsolete vehicles which are in use in Metro Manila.

In view of the above, 2.0 meters of wide outer shoulder width was accepted to be provided throughout an expressway.

(4) Geometric Design Standards and Cross Section

Geometric design standards to be adopted for an expressway, an interchange and an on/off ramp of MMUES are summarized in Table 7.1.1, 7.1.2, 7.1.3 and 7.1.4, respectively. Figure 7.1.1 graphically shows the standard cross sections.

TABLE 7.1.1 GEOMETRIC DESIGN STANDARDS FOR AN EXPRESSWAY

DESCRIPTION		UNIT	CLASS–A (OUTSIDE EDSA)	CLASS–B (INSIDE EDSA)
Design Speed		km/h	80	60
Lane Width		m	3.50	3.25
Inner Shoulder Width		m	0.75	0.75
Outer Shoulder Width		m	2.00	2.00
Median Width		m	2.25	2.00
Median Island Width		m	1.25	1.00
Horizontal Alignment	Minimum Radius	m	280 (230)	150 (130)
	Minimum Curve Length	m	140	100
	Maximum Superelevation	%	10.0	10.0
	Minimum Transition Length	m	70	50
Vertical Alignment	Maximum Gradient	%	4.0	5.0
	Minimum Radius of Vertical Curve (Crest)	m	5,000 (3,000)	2,000 (1,400)
	Minimum Radius of Vertical Curve (Sag)	m	3,000 (2,000)	1,500 (1,000)
	Minimum Vertical Curve Length	m	70	50
Minimum Stopping Sight Distance		m	140 (110)	85 (75)
Pavement Cross Fall		%	2.0	2.0
Composite Gradient		%	10.5	10.5
Vertical Clearance		m	4.7	4.7

Note: The figure in ( ) shows absolute minimum value to be used only when the conditions necessitate.

TABLE 7.1.2 GEOMETRIC DESIGN STANDARDS FOR AN INTERCHANGE

DESCRIPTION		UNIT	CASE–1	CASE–2	CASE–3
Design Speed		km/h	80	60	50
Lane Width		m	3.50	3.25	3.25
Inner Shoulder Width		m	0.75	0.75	0.75
Outer Shoulder Width	1–lane	m	2.00	2.00	2.00
	2–lane	m	1.25	1.25	1.25
Horizontal Alignment	Minimum Radius	m	280 (230)	150 (120)	100 (80)
	Minimum Curve Length	m	140	100	80
	Maximum Super–elevation	%	10.0	10.0	10.0
	Minimum Transition Length	m	70	50	40
Vertical Alignment	Maximum Gradient	%	4	5	6
	Minimum Radius of Vertical Curve (Crest)	m	5,000 (3,000)	2,000 (1,400)	1,200 (800)
	Minimum Radius of Vertical Curve (Sag)	m	3,000 (2,000)	1,500 (1,000)	1,100 (700)
	Minimum Curve Length	m	70	50	40
Minimum Stopping Sight Distance		m	140 (110)	85 (75)	65 (55)
Pavement Cross Fall		%	2.0	2.0	2.0
Composite Gradient		%	10.5	10.5	11.0
Vertical Clearance		m	4.7	4.7	4.7

Note:

- Use Case–1 when intersecting expressways are both Classes–A
- Use Case–2 when intersecting expressways are Class–A and Class–B or both Classes B
- Could be downgraded from Case–1 to Case–2 or Case–2 to Case–3, only when the conditions necessitate
- The figure in (   ) shows absolute minimum value to be used only when the conditions necessitate

TABLE 7.1.3 STANDARD SPEED CHANGE LANE

		EXPRESSWAY DESIGN SPEED	
		80 KM/H	60 KM/H
Single Acceleration Lane	Acceleration Length (m)	160	120
	Taper Length (m) for Parallel Design	80	60
Single Deceleration Lane	Deceleration Length (m)	110	90
	Taper Length (m) for Parallel Design	80	60

TABLE 7.1.4 ON/OFF RAMP GEOMETRIC DESIGN STANDARD

<table>
<tr><th colspan="2">DESCRIPTION</th><th>UNIT</th><th>EXPRESSWAY CLASS-A</th><th>EXPRESSWAY CLASS-B</th></tr>
<tr><td colspan="2">Design Speed of Street to be connected</td><td>km/h</td><td>80, 60, 50</td><td>80, 60, 50</td></tr>
<tr><td colspan="2">Design Speed of on/off Ramp</td><td>km/h</td><td>50</td><td>40</td></tr>
<tr><td colspan="2">Lane Width</td><td>m</td><td>3.25</td><td>3.25</td></tr>
<tr><td colspan="2">Inner Shoulder Width</td><td>m</td><td>0.75</td><td>0.75</td></tr>
<tr><td colspan="2">Outer Shoulder Width</td><td>m</td><td>1.50</td><td>1.50</td></tr>
<tr><td rowspan="4">Horizontal Alignment</td><td>Minimum Radius</td><td>m</td><td>90 (70)</td><td>50 (40)</td></tr>
<tr><td>Minimum Curve Length</td><td>m</td><td>–</td><td>–</td></tr>
<tr><td>Maximum Superelevation</td><td>%</td><td>10.0</td><td>10.0</td></tr>
<tr><td>Minimum Transition Length</td><td>m</td><td>40</td><td>35</td></tr>
<tr><td rowspan="4">Vertical Alignment</td><td>Maximum Gradient</td><td>%</td><td>6.0</td><td>7.0</td></tr>
<tr><td>Minimum Radius of Vertical Curve (Crest)</td><td>m</td><td>800</td><td>450</td></tr>
<tr><td>Minimum Radius of Vertical Curve (Sag)</td><td>m</td><td>700</td><td>450</td></tr>
<tr><td>Minimum Curve Length</td><td>m</td><td>40</td><td>35</td></tr>
<tr><td colspan="2">Minimum Stopping Sight Distance</td><td>m</td><td>65 (55)</td><td>50 (40)</td></tr>
<tr><td colspan="2">Pavement Cross Fall</td><td>%</td><td>2.0</td><td>2.0</td></tr>
<tr><td colspan="2">Composite Gradient</td><td>%</td><td>11.0</td><td>11.0</td></tr>
<tr><td colspan="2">Vertical Clearance</td><td>m</td><td>4.7</td><td>4.7</td></tr>
</table>

Note:
- Use design speed of 40 km/h in case for design speed of street of 40 km/h or ramp with toll facility
- The figure in ( ) shows absolute minimum value to be used only when conditions necessitate

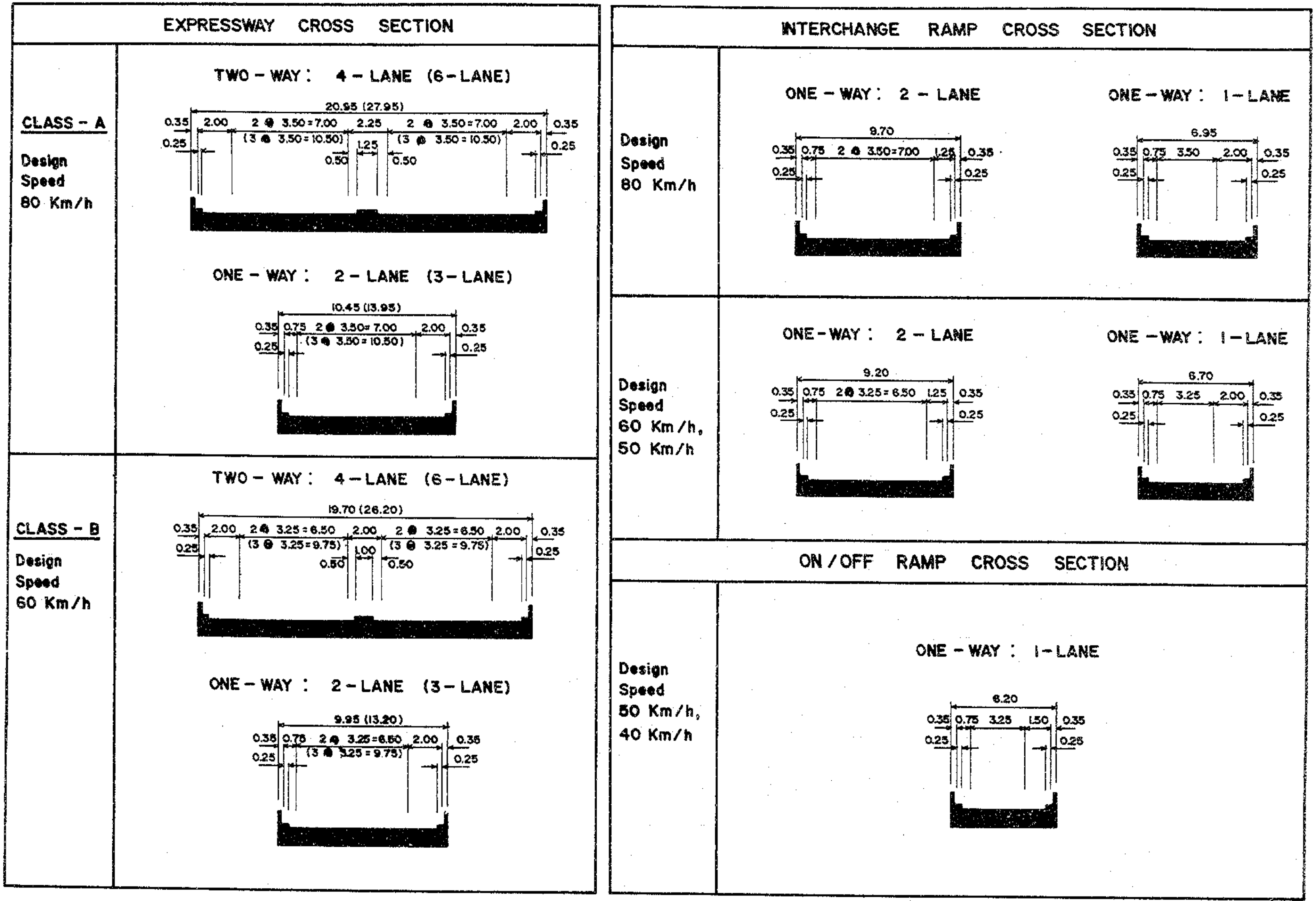


FIG. 7.1.1 STANDARD CROSS SECTION

7.1.2 Structural Design Standard

The structural design standards for highway bridges in the Philippines are based on "Design Guideline Criteria and Standards" and "National Structural Code of the Philippines, Volume II Bridges". The following standards for MMUES were developed based on these specifications and "Standard Specifications for Highway Bridges, AASHTO 1991" as a supplement.

(1) Loads

- Dead Loads

The dead load shall consist of the weight of the entire structure including the roadway and other public utility services.

The weight of major construction items are to be completed as follows:

Concrete	2.400 t/m^3
Steel	7.850 t/m^3
Gravel	1.900 t/m^3

- Live Loads

MS18 Loading (a tractor with semi-trailer, concentrated load - 80 KN for Moment, Uniform Load 9.4 KN per meter of Load lane, formerly H20-S16 Loading) was adopted.

- Earthquake

AASHTO "Standard Specifications for Seismic Design of Highway Bridges '83" shall be a basis for the seismic design of viaducts and bridges.

The AASHTO standard specification for seismic design have considered that the effect of an earthquake on a structure depends on the structure's elastic characteristics and the distribution of weight. However, still several unknown parameter shall be established for the proper seismic design in the Philippines such as design acceleration coefficient by area and seismic motion for dynamic earthquake analysis. In this study, an acceleration coefficient of 0.4 was adapted due to lack of adequate data.

- Collision Loads

Pier and column for viaduct/bridge shall be designed to resist an equivalent static loads of 500 KN applied at an angle of 10° from the direction of the road centerline passing under viaduct.

- Other Loadings

Loadings not mentioned in the above shall be used in accordance with AASHTO "Standard Specifications for Highway Bridges, 1991".

7.1.3 Miscellaneous Standards

Drainage system for expressway shall be designed in accordance with the DPWH Design Guidelines Criteria and Standards Volume II and AASHTO Highway Drainage Guidelines, 1987.

Pavement design shall be undertaken in accordance with the methods and procedures specified in DPWH Design Guidelines Criteria and Standards Volume II and AASHTO Guide for Design of Pavement Structures, 1986.

7.2 TRAFFIC VOLUME AND EXPRESSWAY CAPACITY

7.2.1 Expressway Segment

Traffic capacity of expressway segment was analyzed in accordance with "Highway Capacity Manual, 1985" (Special Report 209, Transportation Research Board, USA), for Class-A expressways (for those outside EDSA, design speed 80 km/hour) and Class-B expressways (for those inside EDSA, design speed 60 km/hour). Table 7.2.1 shows estimated service volume in terms of hourly and daily volume in pcu.

Expressway traffic volume was estimated for years 2002, 2006 and 2010, and presented in Chapter 6. Level of service of expressways will be as follows (the peak hour ratio was assumed to be 6.5%):

Year 2002 (opening year of Phase-1)

Expressway traffic volume ranges from 18,000 pcu to 49,000 pcu. Level of service of C will be enjoyed for full stretch of expressways.

Year 2006 (opening year of Phase-2)

Expressway traffic volume ranges from 5,000 pcu to 81,000 pcu. Level of service will decrease to E on Expressway Route C-3 from Route R-3 to Route R-7. Most sections of Expressway Route R-3 will be level of service D and the rest of the section will be level of service C.

Year 2010 (8 years from the opening of Phase-1)

The section from Route R-3 to R-7 of Expressway Route C-3 will have 73,000 to 87,000 pcu of which level of service is E and will approach to F after 2010. It is expected that completion of Expressway Route C-5 will lessen traffic volume on Expressway Route C-3.

Most sections of Expressway Route R-3 will have traffic volume of 72,000 to 84,000 pcu and level of service will be D for the most of sections and partially E and will approach to F after year 2010, which suggests that Expressway Route R-2 should be constructed as planned schedule.

The rest of expressways will enjoy level of service C or D.

7.2.2 Ramp and Ramp Junctions

Urban expressways are built in the highly developed areas, therefore, facilities must be planned under the physical constraints. Particularly, spaces for toll plazas are limited, thus service volume of on-ramps is usually controlled by number of toll booths which can be provided under the physical constraint. Service volume of off-ramps is usually considered to be 1,500 pcu/hour. Table 7.2.2 shows ramp traffic volume, number of lanes and number of toll booths together with their service capacity.

Level of services of critical ramp junctions are shown in Table 7.2.3.

TABLE 7.2.1 SERVICE VOLUME OF EXPRESSWAY SEGMENT

A. HOURLY TRAFFIC CAPACITY

ITEM			2-LANE CLASS-B (Design Speed: 60 km/h)	2-LANE CLASS-A (Design Speed: 80 km/h)
LANE WIDTH (M)			3.25	3.50
LATERAL CLEARANCE	RIGHT	(M)	2.00	2.00
	LEFT	(M)	0.80	0.80
HEAVY VEHICLE		(%)	5.0	5.0
ADJUSTMENT FACTOR	LANE WIDTH AND LATERAL CLEARANCE	L	0.95	0.98
	HEAVY VEHICLE	T	1.0	1.0
	DRIVER POPULATION	D	1.00	1.00
PEAK HOUR FACTOR			0.95	0.95
BASIC CAPACITY (PCU/HOUR/LANE)			1,900	1,900
SERVICE VOLUME For 2-lane (pcu/H.R.)	LOS=C (F=0.67)		2,290	2,370
	LOS=D (F=0.83)		2,840	2,930
	LOS=E (F=1.00)		3,430	3,530

Where F: Level of Service Factor

B. DAILY SERVICE VOLUME FOR 4-LANE

	CLASS-B (Design Speed: 60 km/hour)			CLASS-A (Design Speed: 80 km/hour)		
	PR=6.0%	PR=6.5%	PR=7.0%	PR=6.0%	PR=6.5%	PR=7.0%
LOS=C	69,400	64,100	59,500	71,800	66,300	61,600
LOS=D	86,100	79,400	73,800	88,800	82,000	76,100
LOS=E	103,900	95,900	89,100	107,000	98,700	91,700

Where PR: Peak Hour Ratio (Directional Distribution Assumed is 55%)

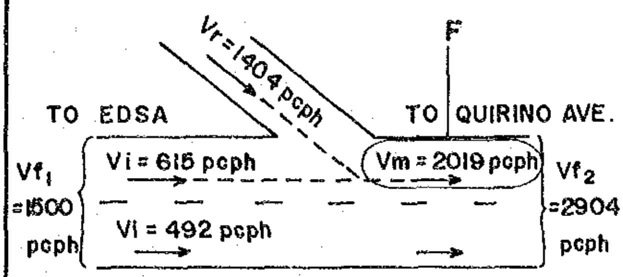
TABLE 7.2.2 RAMP TRAFFIC, NO. OF LANES AND NO. OF TOLL BOOTH

No.	Code	Ramp	Year 2010 Daily Vol. (100 PCU) IN	Daily Vol. OUT	Hourly Vol. (100 PCU) IN	Hourly Vol. OUT	No. of Lanes IN	No. of Lanes OUT	No. of Toll Booth IN	Service Capacity per hour	Remarks
1.	EC1	Quirino Ave./Adriatico	49	136	320	880	1	2	2	1,200	
2.	EC2	Quirino Ave./Pedro Gil	86	3	560	20	1	1	2	1,200	
3.	EC3	R. Magsaysay/Old Sta. Mesa	36	34	230	220	1	1	2	1,200	
4.	EC4	G. Araneta/E. Rodriguez	28	47	180	310	1	1	2	1,200	
5.	EC5	G. Araneta/Del Monte	2	4	15	30	1	1	2	1,200	
6.	EC6	C3/Rizal Ave. Ext.	–	10	–	65	–	1	–	–	
7.	EC7	C3/Dagat–Dagatan Ave.	17	7	110	45	1	1	2	1,200	
8.	ER1	SSH/Vito Cruz	216	166	1,400	1,080	1	1	4	1,500	2 Tandem Booths
9.	ER2	SSH/Pasay Road	47	63	310	410	1	1	2	1,200	
10.	ER3	SSH/EDSA	52	61	340	400	1	1	2	1,200	
11.	ER4	SLE/C5	40	52	260	340	1	1	2	1,200	
12.	ER5	SLE/Bicutan I/C	40	49	260	320	1	1	2	1,200	
13.	ER6	SLE/Sucat I/C	20	19	130	125	1	1	2	1,200	
14.	ER7	SLE/Alabang I/C	284	274	1,850	1,780	2	2	4	2,400	
15.	ER8	SLE/Alabang South	69	94	450	610	2	2	4	960	SLE users
16.	ER9	SSH/Buendia	65	44	420	290	1	1	2	1,200	
17.	ER10	J.P. Rizal/Makati Access	112	116	730	760	2	2	4	2,400	
18.	ER11	Quezon Ave./E. Rodriguez	99	48	650	320	1	1	2	1,200	
19.	ER12	Quezon Ave./West Ave.	14	–	90	–	1	–	2	1,200	
20.	ER13	Quezon Ave./EDSA	171	251	1,120	1,630	1 + 1	1 + 1	2 + 2	1,200 + 1,200	IN 840, OUT 1,226
21.	ER14	Commonwealth Ave./UP	45	40	290	260	1	1	2	1,200	
22.	ER15	Commonwealth Ave./Luzon Ave.	35	50	230	330	1	1	2	1,200	
23.	ER16	Commonwealth Ave./D. Antonio	105	84	680	550	2	2	4	2,400	
24.	ER17	NLE/EDSA	98	95	640	620	1	1	2	1,200	
25.	ER18	NLE/Toll Plaza	114	122	740	790	2	2	6	1,440	NLE users
26.	ER19	Moriones Rd./North Harbor	116	90	760	590	2	2	4	1,440	Heavy Truck

Notes: Assumed service time for toll collection as follows:
For flat toll : 6 sec/vehicle (600 veh/hour/booth)
For distance proportional toll rate : 15 sec/veh (240/veh/hour/booth)
For Exp. Route R–10 near Harbor : 10 sec/veh (360/veh/hour/booth)
ER13 Quezon Ave./EDSA: Two pairs of on– and off ramps are provided. A pair of on and off ramps inside EDSA is assumed to serve 75% of total ramp traffic.

TABLE 7.2.3 LOS OF RAMP JUNCTION

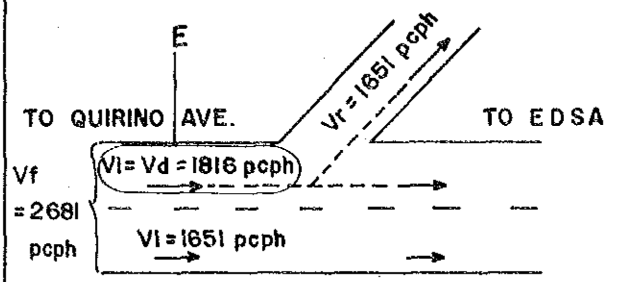
1. Exp. R – 3 Vito Cruz ON – RAMP LEFT SIDE ON – LANE



Um = 2019 / 0.95 = 2125 pcph (LOS = F)

Uf = 2904 / 0.95 = 3057 pcph (LOS = D)

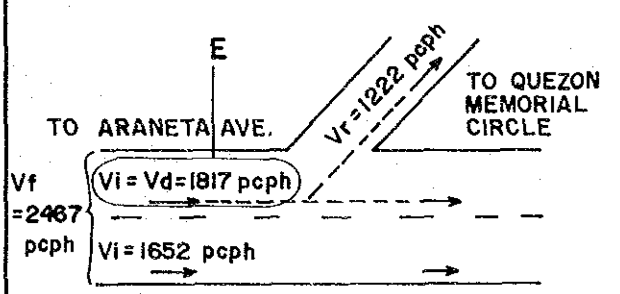
2. Exp. R – 3 Vito Cruz OFF – RAMP LEFT SIDE ONE – LANE



Ud = 1816 / 0.95 = 1912 pcph (LOS = E)

Uf = 2681 / 0.95 = 2822 pcph (LOS = D)

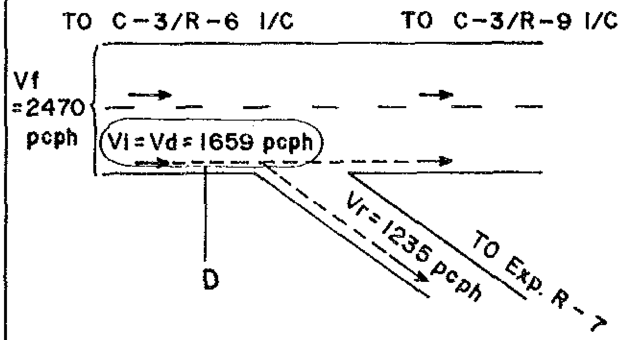
3. Exp. R – 7 EDSA OFF – RAMP LEFT SIDE ONE – LANE



Ud = 1817 / 0.95 = 1913 pcph (LOS = E)

Uf = 2467 / 0.95 = 2597 pcph (LOS = C)

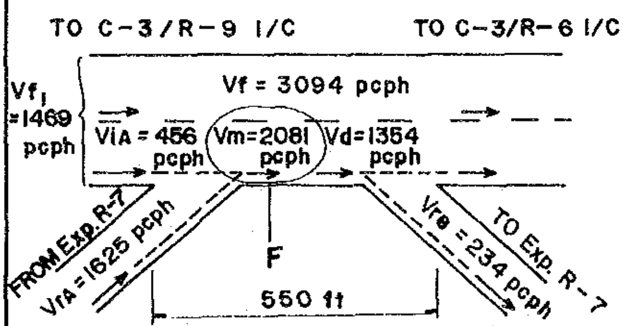
4. Exp. C – 3 / R – 7 INTERCHANGE OFF – RAMP ONE – LANE



Ud = 1659 / 0.95 = 1746 pcph (LOS = D)

Uf = 2470 / 0.95 = 2600 pcph (LOS = C)

5. Exp. C – 3 / R – 7 INTERCHANGE ON – RAMP, OFF RAMP



Um = 2081 / 0.95 = 2190 pcph (LOS = F)

Ud = 1354 / 0.95 = 1416 pcph (LOS = C)

Uf = 3094 / 0.95 = 3257 pcph (LOS = E)

NOTE:

Vf	:	total expressway volume at a ramp junction, pcph
Vr	:	total ramp volume, pcph
Vm	:	total merge volume, pcph
Vd	:	total diverge volume, pcph
Vi	:	lane i volume, pcph
V_1	:	volume in lane (shoulder lane) of an expressway immediately upstream of a ramp junction, pcph
Uf	:	total expressway flow rate in one direction upstream of off-ramp and/or downstream of on-ramp, pcph
Um	:	lane-1 flow rate plus ramp flow rate one-lane, right-side on-ramps, pcph
Ud	:	lane-1 flow rate immediately upstream of off-ramp for one-lane, right-side ramps, pcph
LOS	:	level of service

Based on the above analysis, the critical ramps are as follows:

ER1 : Vito Cruz Ramp on Expressway Route R-3

On-ramp traffic volume in 2010 was estimated to be 21,600 pcu/day which will require two pairs of tandem booths (due to limited space, additional booth in parallel is hardly provided). Level of service of merging section will be F.

Off-ramp traffic volume in 2010 will be about 16,600 pcu (or 1,080 pcu per hour). Level of service of diverging area will be E.

Thus, sections at Vito Cruz Ramp will be congested. However, since most traffic is generated from Makati CBD, an alternative on-ramp which is Makati Access Ramp will be utilized when traffic congestion at this section becomes very severe.

ER7 : Alabang Ramp on Expressway Route R-3

Although heavy traffic utilize this ramp, enough number of lanes and toll booths can be accommodated, therefore, serious traffic congestion is not expected, provided that Alabang-Zapote Road will be widened.

Expressway Route C-3/R-7 Interchange

Traffic from Quezon City to Makati (or from the east to the south) or vice versa is heavy. Merging area of traffic from the east on Expressway Route R-7 and traffic from the north on Expressway Route C-3 will be congested in year 2010 and its level of service will be F. Number of lanes is preferred to be increased, however, the site is highly urbanized and additional land taking was judged to be very difficult. During the detailed engineering design, careful study will be required. Another factor to be considered is that when Expressway Route C-5 is completed, increase in traffic volume at this interchange would be minimal. This interchange should be planned in due consideration of the above factors.

7.3 PRELIMINARY DESIGN OF EXPRESSWAY ROUTES

7.3.1 Expressway Alignments and Routes

In Chapter 4, several alternative alignments for specific sections of each expressway route were evaluated and the most appropriate alignments were selected. Based on the findings, the preliminary design of expressway route was conducted making the best use of photo-mosaics at a scale of 1:2,500 and spot elevation survey.

The characteristics of alignment/highway of each expressway route are summarized in Table 7.3.1, together with the reasons of alignment selected as discussed in Chapter 4, and briefly described hereunder.

<u>Expressway Route C-3</u>

This route serves as an inner circumferential expressway and distributes traffic to/from radial expressways.

The route starts at Quirino Ave./Adriatico intersection and follows Quirino Ave. towards the east up to about Paco Station of PNR. From the point, the route extends towards northeast direction and crosses Aurora Blvd., then turns to northward direction following San Juan River or an at-grade C-3 up to Sgt. River St. At the intersection between Araneta Ave. and Sgt. Rivera St., the route goes towards the west until it merges with Expressway Route R-10 which is the end of the route. The route has an approximate length of 15.9 kms. and will be an elevated expressway.

The expressway crosses over LRT Line-1 at Taft Ave., LRT Line-2 at E. Rodriguez Ave. and LRT Line-1 at Rizal Ave. Extension.

The route between Araneta Ave., and R-10 utilizes ROW at-grade C-3 where DPWH is encountering difficulty in acquiring ROW. ROW acquisition for at-grade C-3 will be one of the key factors to realize this route, therefore, should be expedited.

The interchange between this route and Route R-7 (Quezon Avenue - Commonwealth Ave. Route) will be a 4-leg interchange that requires ROW acquisition of wide area. All other interchanges with radial expressways are planned to be 3-leg interchanges.

<u>Expressway Route R-3</u>

The carrier serves traffic from the rapidly progressing southern Metro Manila to Manila CBD, Makati CBD and other urban centers.

This route is also called as Manila South Tollway (MST) and located along South Super Highway (SSH) and South Luzon Expressway (SLE). It starts at the intersection between Quirino Ave. and SSH, then runs towards the south up to Alabang Interchange of SLE. The route has a total length of 20.2 km with a mostly elevated expressway.

The maximum grade of this route is 4.0% just after Sucat Interchange to follow the existing grade of SLE. Minimum grade 0.3% was adapted for the requirement of drainage functionality. In general, 2.0 - 3.0% grades are adapted for adjusting elevation from 2nd to 3rd level to maintain the functionality of expressway.

Horizontal curvature for shifting alignment from SLE to PNR was adapted 2000 meters without cloithoid curve. At the end of R-3 route, Alabang Interchange, R = 400 - 1000 meters were adapted with clothoid of parameter of A = 180 to 300 to divert toward western part of the existing interchange.

TABLE 7.3.1 (1) PROPOSED ALIGNMENT OF EXPRESSWAY ROUTE

PROPOSED ALIGNMENT OF EXPRESSWAY ROUTE C–3 (ALONG CIRCUMFERENTIAL ROAD 3); TOTAL LENGTH 15.9 KM

NO.	SECTION	LENGTH (KM)	REASONS OF ALIGNMENT SELECTED	CHARACTERISTICS OF ALIGNMENT/HIGHWAY
1	From Quirino Avenue/South Superhighway Intersection To Araneta Avenue/Aurora Blvd. Intersection	4.2	• Shorter length of alignment • Less utilization of private lands • Easy construction of on/off ramp at R. Magsaysay Blvd.	• Alignment along Pres. Quirino, PNR (Nagtahan Link Road, 3rd level over PNR) and R. Magsaysay Blvd. (Double Deck Type) • New Pasig River Bridge to be constructed • 2–Interchanges with Exp. R–3 and Exp. R–4
2	From Araneta Avenue/Aurora Blvd. To End of Araneta Avenue	4.9	• Less construction cost • Less R.O.W. acquisition • Less no. of squatters affected	• Alignment along Araneta Ave. (R.O.W. 40 m) • Crossing with LRT–2 at E. Rodriguez Avenue • An Interchange with Exp. R–6 • An Interchange with Exp. R–7 (Exp. C–3 2nd Level, Exp. R–7 3rd Level)
3	From End of Araneta Avenue to R–10	6.8	• No R.O.W. acquisition • Less construction cost	• Alignment along C–3 • 3rd Level crossing with LRT 1 at Rizal Ave. Ext. • 3–Interchanges with Exp. R–9 (Double Deck Viaduct), Exp. R–10 (A) and Exp. R–10 • No existing R.O.W. after Rizal Ave. Extension

PROPOSED ALIGNMENT OF EXPRESSWAY ROUTE R–3 (ALONG MANILA SOUTH EXPRESSWAY); TOTAL LENGTH 20.2 KM

NO.	SECTION	LENGTH (KM)	REASONS OF ALIGNMENT SELECTED	CHARACTERISTICS OF ALIGNMENT/HIGHWAY
1	From Quezon Avenue To EDSA (C–4)	4.6	• Less construction cost • Less no. of squatter affected	• Utilize South Luzon Highway • Utilize PNR side at Buendia Ave. and EDSA Interchange • 3rd level over PNR near Buendia Avenue • 4th level at EDSA interchange
2	From EDSA (C–4) To C–5	3.6	• No possible candidate alignment was proposed	• Occupy PNR R.O.W. at 2nd level • At interchange of C–5 and MSE, Exp. R–3 is at–grade (Alabang bound) and depressed (Manila Bound)
3	From C–5 To Bicutan Interchange	3.1	• Less construction cost • Less no. of squatters affected • Minimum traffic disturbance to SLE	• Construct over PNR
4	From Bicutan Interchange To Alabang Interchange	7.6	• No possible candidate alignment was proposed	• Construct over SLE
5	At Alabang Interchange	1.3	• Less construction cost • A few houses and commercial establishment are affected, but public land to be acquired	• Exp. R–3 ends after existing Alabang Interchange • A new link by passing–existing Interchange shall be constructed

PROPOSED ALIGNMENT OF EXPRESSWAY ROUTE R–4 (ALONG PASIG RIVER); TOTAL LENGTH 2.4 KM

NO.	SECTION	LENGTH (KM)	REASONS OF ALIGNMENT SELECTED	CHARACTERISTICS OF ALIGNMENT/HIGHWAY
1	From Exp. C–3 To Sta. Ana Race Track	2.4	• No possible candidate alignment was proposed	• Along E. Gorge St., Tingson Compound, Int'l. Plywood Exp. and Sta. Ana Race Track and the South Exp. of Pasig River • 2 new bridges over Pasig River • Lot of new R.O.W. to be acquired
2	Makati Access Ramp From Exp. R–4 To J. P. Rizal		• Less construction cost • A little land to be acquired	• Along proposed at–grade C–3 • To be connected with J.P. Rizal

TABLE 7.3.1 (2) PROPOSED ALIGNMENT OF EXPRESSWAY ROUTE

PROPOSED ALIGNMENT OF EXPRESSWAY ROUTE R–7 (ALONG QUEZON AVENUE AND COMMONWEALTH AVE).
TOTAL LENGTH 12.3 KM

NO.	SECTION	LENGTH (KM)	REASONS OF ALIGNMENT SELECTED	CHARACTERISTICS OF ALIGNMENT/HIGHWAY
1	From Welcome Rotonda To Quezon Memorial Circle	5.6	• No possible candidate alignment was proposed	• Along over Quezon Avenue • At Interchange with Exp. C–3, Exp. C–3; 2nd level Exp. R–7; 3rd level
2	Near Quezon Memorial Circle	1.0	• Depressed type is superior in urban aesthetic and environment	• Depressed semi–tunnel type under Quezon Memorial Circle
3	From Quezon Memorial Circle To Batasang Pambansa	5.7	• No possible candidate alignment and proposal	• Along Commonwealth Avenue • Exp. R–7 is at–grade except crossing local roads • An interchange with Exp. C–5 to be constructed

PROPOSED ALIGNMENT OF EXPRESSWAY ROUTE R–9 (ALONG A. BONIFACIO AVE. AND NORTH LUZON EXPRESSWAY);
TOTAL LENGTH 4.5 KM

NO.	SECTION	LENGTH (KM)	REASONS OF ALIGNMENT SELECTED	CHARACTERISTICS OF ALIGNMENT/HIGHWAY
1	From Express C–3 To EDSA	1.7	• No R.O.W. acquisition is possible due to highway developed commercial and residential area	• Along A. Bonifacio • Express R–9 is double deck type, 2nd level; South bound 3rd level; North bound • Over existing EDSA Interchange
2	From EDSA To End	2.8	• No possible candidate alignment was proposed	• Along over Manila North Expressway • Over existing Balintawak Toll Gate

PROPOSED ALIGNMENT OF EXPRESSWAY ROUTE R–10; TOTAL LENGTH 3.3 KM

NO.	SECTION	LENGTH (KM)	REASONS OF ALIGNMENT SELECTED	CHARACTERISTICS OF ALIGNMENT/HIGHWAY
1	From Exp. Route C–3 To Moriones Avenue	3.3	• No possible candidate alignment was proposed	• Along at–grade R–10 (R.O.W. 50 m) • Elevated viaduct over R–10

Expressway Route R-4

Route R-4 is planned to play as an important road link to strengthen accessibility to Makati CBD from the northern Metro Manila. It connects an expressway Route C-3 and Route C-5.

The route runs along Pasig River from Route C-3 to Makati Access Road of about 2.4 kms. and is constructed as an elevated structure. Access ramp to Makati CBD from this route will be very important, which will branch off at about Sta. Ana Race Track, then go over South Ave. and be extended close to Buendia Ave.

Expressway Route R-7

This corridor is one of the most heavily traffic loaded routes in Metro Manila connecting Manila CBD to the eastern Metro Manila. Particularly, private trip demand along this corridor is expected to increase sharply.

The route starts at Welcome Rotonda and goes along Quezon Ave. and Commonwealth Ave. up to Batasang Pambansa. The route has a length of about 12.3 kms.

The expressway will be elevated from Welcome Rotonda up to Quezon Memorial Circle. It will pass under Quezon Memorial Circle and be at-grade along Commonwealth Ave.

Expressway Route R-9

The route is connected with North Luzon Expressway and serves as a vital link to distribute traffic from NLE into area of Metro Manila or vis-a-vis.

The route starts at Expressway Route C-3, goes over A. Bonifacio Ave. and NLE and ends at about 1.3 km. north of NLE Toll Plaza. It has a length of about 4.5 kms.

A. Bonifacio Ave. has rather narrow ROW (28 meters), therefore, a double deck type of structure was proposed.

Expressway Route R-10

The route is a vital link to serve for traffic to/from Manila International/Domestic Harbors.

The route will be constructed over at-grade R-10 from Moriones Ave. to C-3 for an extension of about 3.3 kms.

At-grade R-10 has a wide ROW of 50 meters, however, one half of ROW has been occupied by squatters. Relocation of affected people will have to be done so as to minimize social problems.

7.3.2 Miscellaneous Structure Design

- Drainage Design

  Rainwater on viaduct shall be drained effectively for the safety of traffic during rain. Proper drainage system is to be provided to attain the basic drainage requirements. Predicated on the actual water condition on viaduct as per actual experiences in Metro Manila, sufficient drainage facilities taking into consideration of maintenance condition shall be properly provided.

Downdrains should be provided for the viaduct which run down the side/inside of the piers or column. Care should be taken that the runs are straight and that accessible clean-out parts are provided at the bents for maintenance.

- Pavement Design

  Pavement design is the process of determining the type, thickness and strength thereof laid on viaduct structure or embankment.

  Properly designed pavement or cover shall be provided a non-skid, stable and desirable surface for efficient, smooth and safe flow of traffic.

  Factors to be considered for pavement design are pavement performance, traffic type and volume, road bed soil conditions, materials of construction, drainage, reliability, environment and life-cycle cost.

7.3.3 Required Right-of-Way

Right-of-way acquisition is the usual problem for projects in Metro Manila.

To minimize the right-of-way problem, the expressway routes were proposed basically along wide road, PNR and river bank corridor. Table 7.3.2 shows the R.O.W. width of each route and section. Most of the proposed alignment can be accomodated within existing R.O.W. except R-4 route.

However, at the area of the proposed interchange, a great number of R.O.W. acquisition is inevitable for provision of ramps. Table 7.3.3 shows the summary of required R.O.W. area for the interchange construction.

TABLE 7.3.2 REQUIRED R.O.W.

ROUTE	SECTION STA.	SECTION STA.	R.O.W. WIDTH (M) ORIGINAL R.O.W.	R.O.W. WIDTH (M) ADDITIONAL	REMARKS
C – 3	–1–450	0+000	33.0	–	2–lane viaduct
	0+000	1+200	34.0	–	– do –
	1+200	3+000	30.0	–	4–lane viaduct (PNR R.O.W.)
	3+000	4+000	–	24.5	Residence
	4+000	4+200	36.6	–	Magsaysay Blvd.
	4+200	7+500	40.0	–	G. Araneta
	7+500	9+000	40.0	–	Talayan Creek
	9+000	12+000	32.0	–	Sgt. E. Rivera
	12+000	14+500	40.0	–	C–3 Road
R – 3	0+000	2+000	30.0 + 38.0	–	PNR + SLE
	2+000	3+500	30.0 + 40.5	–	– do –
	3+500	5+500.	30.0 + 38.0	–	– do –
	5+500	7+000	19.0 + 49.15	–	– do –
	7+000	11+000	19.0 + 49.15	–	– do –
	11+000	19+000	0 + 50.50	–	SLE
	19+000	20+200	–	–	Government Property
R – 4	0+000	0+400	–	29.9	Estero de Pandacan
	0+400	2+000	–	29.7	Residence
	2+000	2+435	–	15.0	Pasig River Bank
R – 7	–1+000	0+000	37.4	–	Quezon Avenue
	0+000	3+000	36.5	–	– do –
	3+000	3+500	37.6	–	– do –
	3+500	4+500	52.9	6.0	– do –
	4+500	5+000	–	–	Quezon Memorial Circle
	5+000	11+000	95.0	–	Commonwealth Avenue
R – 9	0+000	1+500	28.0	–	A. Bonifacio Avenue
	1+500	3+000	39.6	–	N.L.E.
	3+000	4+510	59.2	–	N.L.E.
R – 10	0+000	3+300	50.0	–	R–10 road

TABLE 7.3.3 R.O.W. REQUIRED FOR INTERCHANGES

ROUTE	INTERCHANGE	LAND AREA (SQ. M)	Affected Establishment (Nos) Residential H.	Squatter	Commercial	Others
C – 3	C–3 / R–3	4,700	8	25	3	0
	C–3 / R–4	12,000	40	20	5	1
	C – 3 / R–6	5,400	–	–	10	1
	C – 3 / R–7	10,100	25	40	10	–
	C – 3 / R–9	5,800	–	–	6	1
	C – 3 / R–10	1,800	–	–	1	1
		39,800	73	85	35	4
R – 3	Buendia Access Ramp	–	–	–	–	–
	EDSA Access Ramp	–	–	–	–	–
	R–3 / C–5	–	–	–	–	–
	Bicutan Access Ramp	8,400	10	20	–	–
	Sucat Access Ramp	11,000	–	–	1	2
	Alabang Access Ramp	17,400	11	–	–	–
R – 4	R–4/Makati Access Road	12,000	–	30	–	7
R – 7	R–7 / C–3	Same as C–3	R–7			
R – 9	R–9 / C–3	Same as C–3	R–9			
R – 10	R–10 / C–3	Same as C–3	R–10			

7.4 PRELIMINARY DESIGN OF STRUCTURES

7.4.1 Superstructure

(1) Elevated Viaduct

As an urban structure, an elevated viaduct type of Metro Manila Urban Expressway was recommended with few exceptional sections, because of the following advantages.

- Aesthetic view to be met as an urban structure

- Maximum utilization of spaces below elevated structures thus;

  - Minimize R.O.W. acquisition
  - Easier provision of traffic lanes of at-grade roads
  - Effective utilization of spaces for other purposes

- Less traffic disturbance during construction

- Faster construction

Table 7.4.1 approximately summarizes the length of elevated viaduct for each expressway routes.

TABLE 7.4.1 LENGTH OF ELEVATED VIADUCTS

EXPRESSWAY ROUTE	ELEVATED VIADUCT (KM)	DEPRESSED/ AT-GRADE (KM)	APPROACH (KM)	TOTAL (KM)
C-3	15.7	–	0.2	15.9
R-3	18.7	1.3 1/	0.2	20.2
R-4	2.4	–	–	2.4
R-7	7.2	0.8, 4.1 2/	0.2	12.3
R-9	4.3	–	0.2	4.5
R-10	3.1	–	0.2	3.3
TOTAL	51.4	6.2	1.0	58.6

1/ Depressed Road due to NAIA navigation clearance
2/ 0.8 km Semi-Tunnel for Quezon Memorial Circle
4.1 km at-grade road along Commonwealth Avenue

(2) Type of Superstructure

Type of superstructure to be adopted for the expressway was studied taking into consideration the several factors, viz; construction factors, cost, aesthetic view, etc. The following three types of structures were compared.

- AASHTO I-Type Girder (Pre-fabricated pre-stresses concrete)

- T-Type Girder (Pre-fabricated pre-stressed concrete)

- Box Girder (Cast-in-place concrete/Block segment Method)

Based on the comparative study, the following types were recommended. Refer to Figure 7.4.1.

- As a standard type of viaduct, AASHTO I Type Girder with a span length of 30 m, was adopted wherever applicable, because of the advantage such as easy pre-fabrication girder at yard, possible erection of girder during night time, comparatively less construction cost, etc.

- For horizontal curved structure, pre-stressed concete box girder was recommended because of its torsional rigidity.

- For Pasig River Bridges, special types such as rigid frame/integrated box girder type was recommended because of construction method and cost.

7.4.2 Substructure

Type of substructure was examined considering the site conditions such as available space, geological conditions, and are classified into four groups as shown in Figure 7.4.2,

- Group I ; Single Column Type
- Group II ; Two Column Type
- Group III ; Two Column (3rd Level and Split) Type
- Group IV ; Special Type

As foundation type, the following four type were recommended.

- Spread footing on stable stratum
- Concrete or pre-stressed pile foundation
- Bored pile/spec. pile foundation
- Deep foundation with large size diameter

For the bridge foundation at Pasig River crossing, a pile bent would be adapted considering constructability, lesser cost due to minimum temporary works for foundation and faster construction.

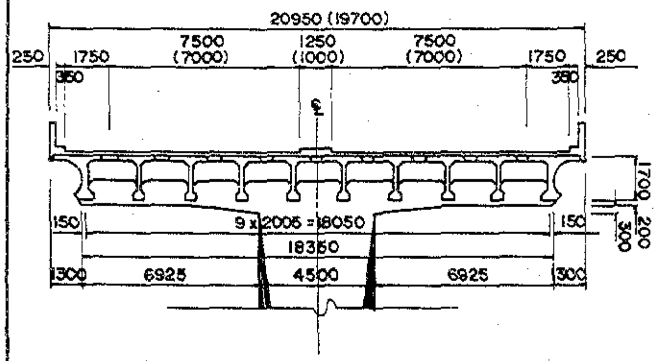
The size of the pile bents with consideration of hydraulics, particularly those used in concepts with vertical piles only, is influenced by lateral deflections of the foundations induced by horizontal loading. The deflection must be within tolerable limits specified by design standard.

The idea of proposed pile bent foundation shall be combined with a concept of integration to superstructure to form a monolithic multi-column system for the purpose of earthquake resistant design.

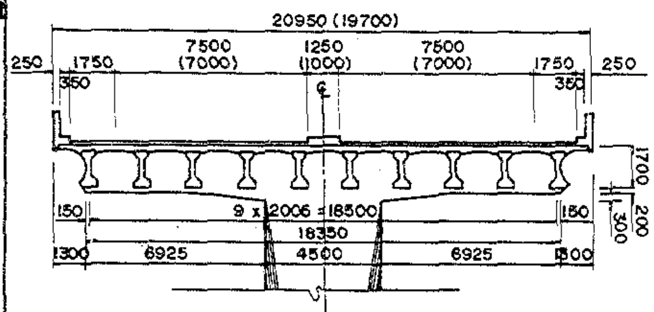
For expressway R-9 (A. Bonifacio Avenue), the double deck type structure was proposed. Refer to Figure 7.4.3.

FIGURE 7.4.1 SUMMARY OF SUPERSTRUCTURE TYPE

TYPE	VIADUCT OVER STREET/PNR RAILROAD	CURVED BRIDGE FOR INTERCHANGE & ON/OFF RAMP	RIVER BRIDGE
TYPICAL CROSS SECTION	T - GIRDER TYPE; AASHTO GIRDER TYPE	HOLLOW SLAB TYPE; BOX GIRDER TYPE	RIGID FRAME BOX GIRDER TYPE (C-3 Route Pasig River Bridge); INTEGRATED BOX GIRDER TYPE (R-4 Route Pasig River Bridge)

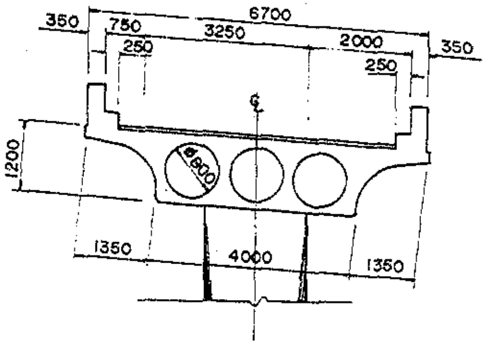


T - GIRDER TYPE

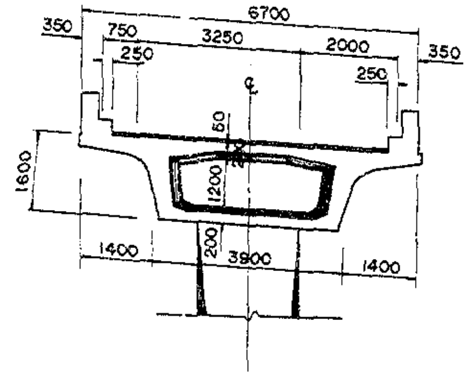


NOTE : Dimension of width with parenthisis shows for design speed 60 KPH for others for 80 KPH

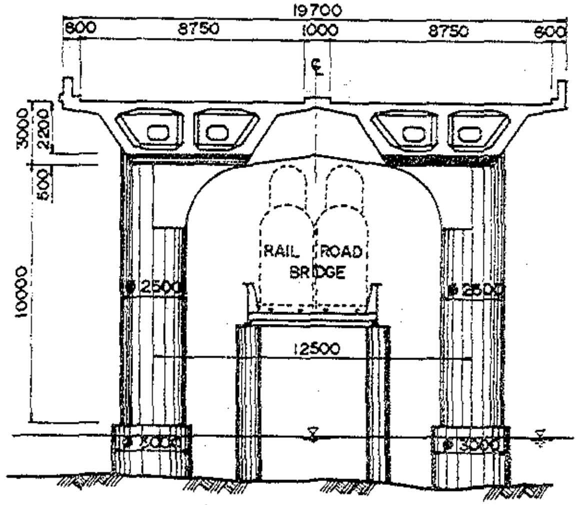
AASHTO GIRDER TYPE



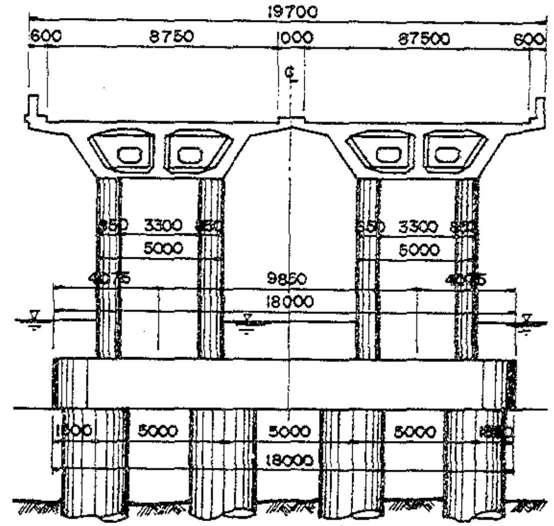
HOLLOW SLAB TYPE



BOX GIRDER TYPE



RIGID FRAME BOX GIRDER TYPE
(C-3 Route Pasig River Bridge)



INTEGRATED BOX GIRDER TYPE
(R - 4 Route Pasig River Bridge)

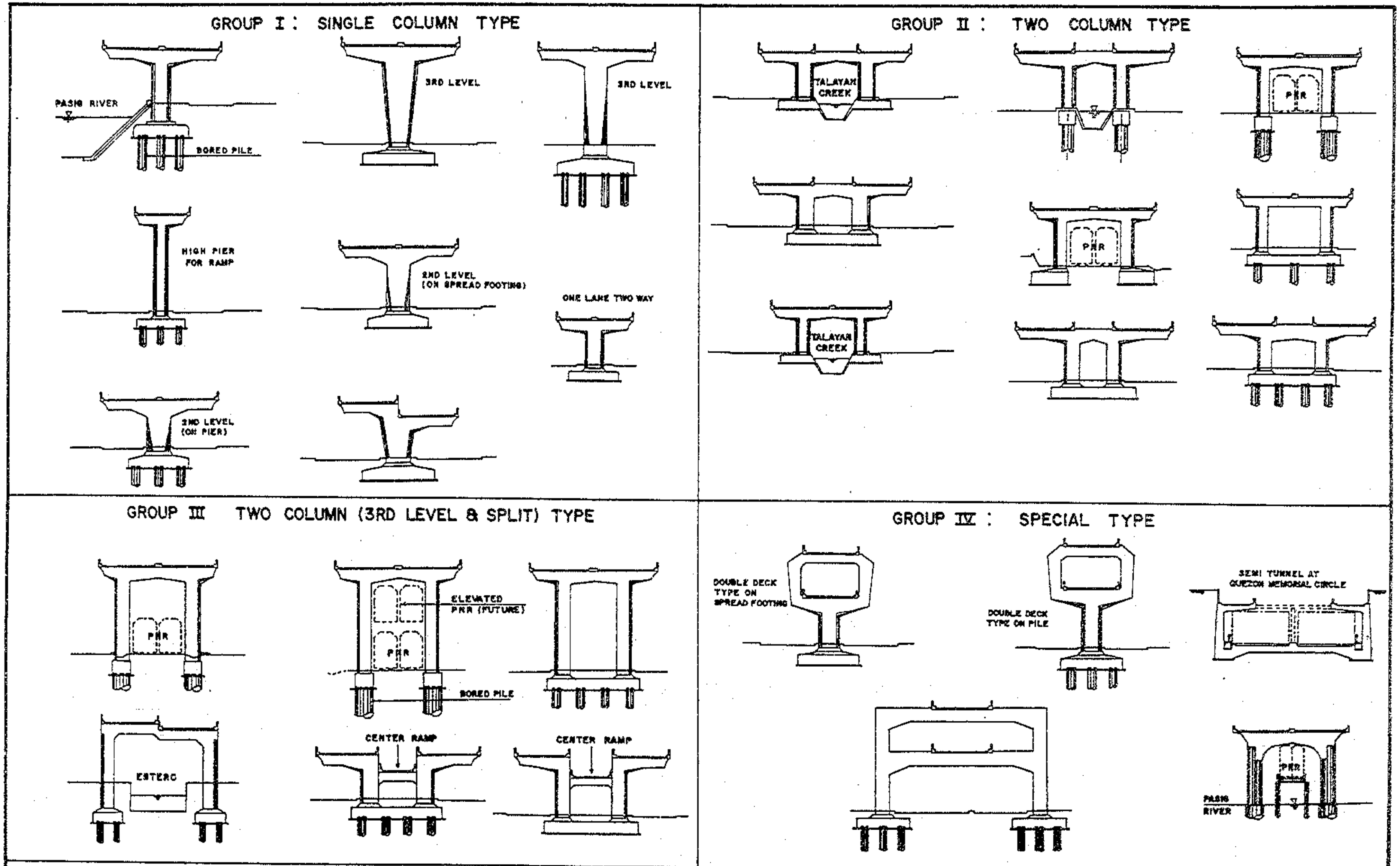


FIG. 7.4.2 TYPE OF SUBSTRUCTURE

FEASIBILITY STUDY ON METRO MANILA URBAN EXPRESSWAY SYSTEM

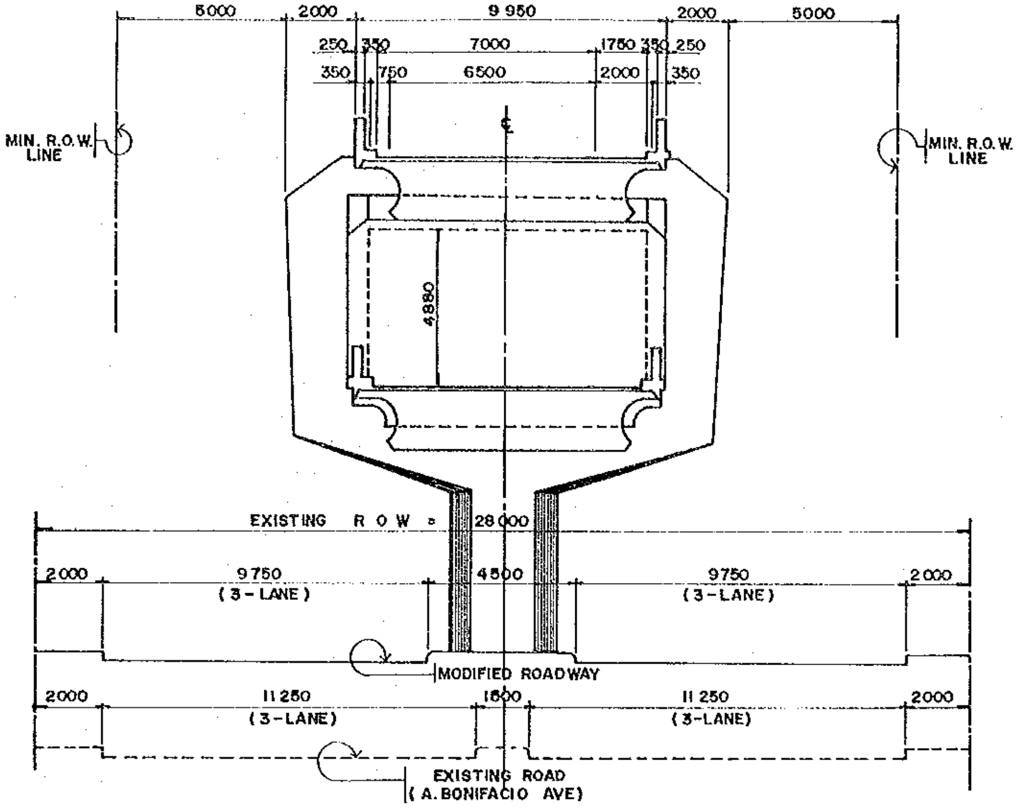


FIGURE 7.4.3 DOUBLE DECK VIADUCT DUE TO THE R.O.W. LIMITATION

7.4.3 Seismic Design

It is uneconomical to design a viaduct/bridge to resist a large earthquake elastically, however, the viaduct/bridge should be designed to resist small-to-moderate earthquakes in the elastic range. In the recent design approach, the member forces are determined from one of elastic design response spectra, proposed by AASHTO and Japan Road Association, for a maximum credible earthquake. In selecting an elastic response spectra, effects of site conditions and distance from the seismic source zone will be taken into account, although the characteristics of ground shaking and the corresponding spectra are influenced by several other factors.

The present DPWH Design guidelines 1982 (Volume II) recommends the use of the Holings Report as the minimum criteria for the seismic design of highway bridges. The concept, design philosophy and design procedures specified in the Report are in general with modern codes. Since further research and experience from later earthquakes have been incorporated into the latest international seismic design codes, those new concepts are embodied in the AASHTO Guide Specifications for Seismic Design of Highway Bridges.

In the detailed design, it is recommended that multi-mode spectral analysis shall be carried out for the complicated viaducts/bridges to consider the effects of higher modes of vibration. The maximum value of a force or displacement may be obtained by taking the square root of the sum of the squares of the individual mode response. In carrying out the dynamic analysis of the bridge, the superstructure and substructure system is idealized by a lumped mass system including the soil.

The minimum support length to be given will be dependent on the deck length between expansion joints and the column height since both dimensions influence one or more of the factors that cause the differential displacements. With respect to the minimum support length, the recommended length by AASHTO and Japan Road Association shall be respected. In addition, in designing the bridge supports, the following possible methods will be considered to prevent spans from falling off their supports during earthquakes:

- Installation of adequate stoppers at expansion bearings to resist excessive movement

- Installation of devices for preventing the girder from falling off

7.4.4 Aesthetic Design

In designing an urban structure, an aesthetic consideration is one of the major elements, though a judgment may be largely dependent on several factors as summarized as follows.

- As well known, there is not accounting for taste of beauty. The average taste of people or even the taste of individuals is never a reliable measure of aesthetic qualities.

- The judgment of aesthetic characteristics is largely dependent, however, on feelings which are derived from sensory perceptions. Beauty, then, cannot be rationally measured.

- The great majority of people have agreed that a certain landscape, great painting, or structure is beautiful.

- Beautiful surroundings arouse feelings of delight in almost all people, but an ugly, dirty environment causes discomfort. Only the degree of discomfort will differ.

- Good judgment of aesthetic values requires a broad education.

- People have different talents and inclination, since they grew up in different backgrounds, and therefore their tastes will always be different. However, there is always a certain majority agreement on the judgment of beauty.

- Beauty cannot be strictly proven, however a zone of freedom around what is generally felt to be beautiful and what is felt to be ugly must be given. There is a generally recognized concept of beauty which is proven by the consistent judgment.

- Engineers must argue, so that they can strengthen and refine it. Taste depends on their education, which can be developed by serious discussion with others or by guidance from those more experienced.

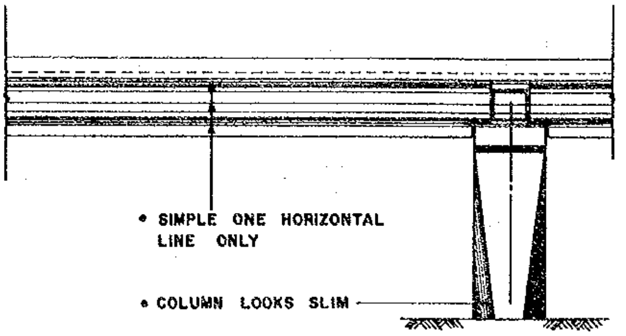
In the Study, the following two ideas were recommended for further study. Refer to Figure 7.4.4 and 7.4.5.

- Side View of Girder

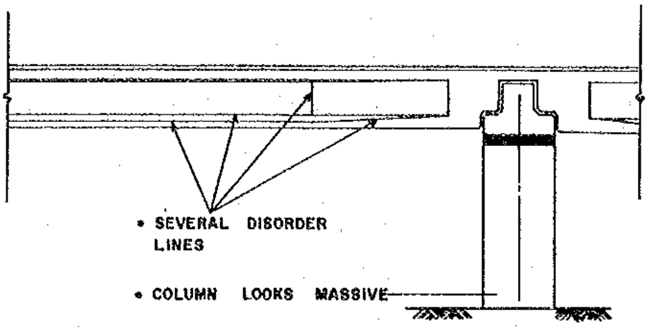
  To provide order in the line and edges of the superstructure, an order achieved by limiting the direction was given. Figure 7.4.4 is an example of this consideration.

- Integration of Coping and Girder

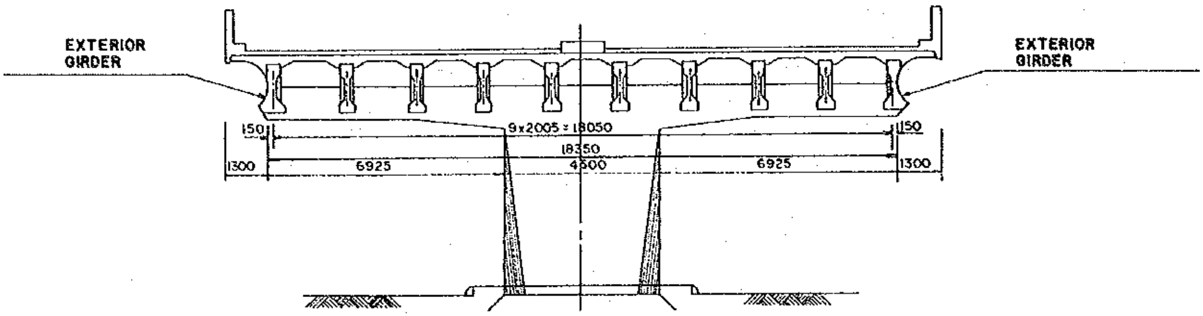
  By introducing ledger beam and ledger coping, two members can look like monolithic as shown in Figure 7.4.4. This idea is oftenly adapted in the Philippines but further aesthetic design would be required to achieve fantastic viaduct.



AESTHETIC DESIGN



ORDINARY DESIGN



AESTHETICALLY DESIGNED EXTERIOR GIRDER

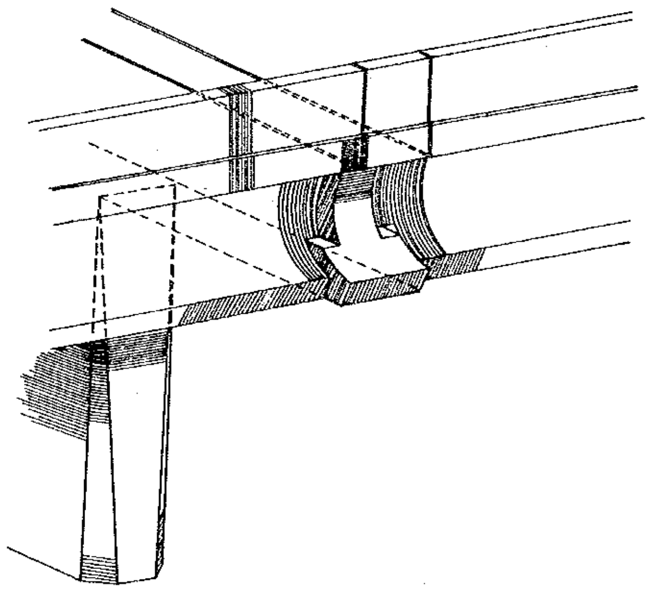


FIGURE 7.4.4 PERSPECTIVE FOR INTEGRATION OF COPING AND GIRDER

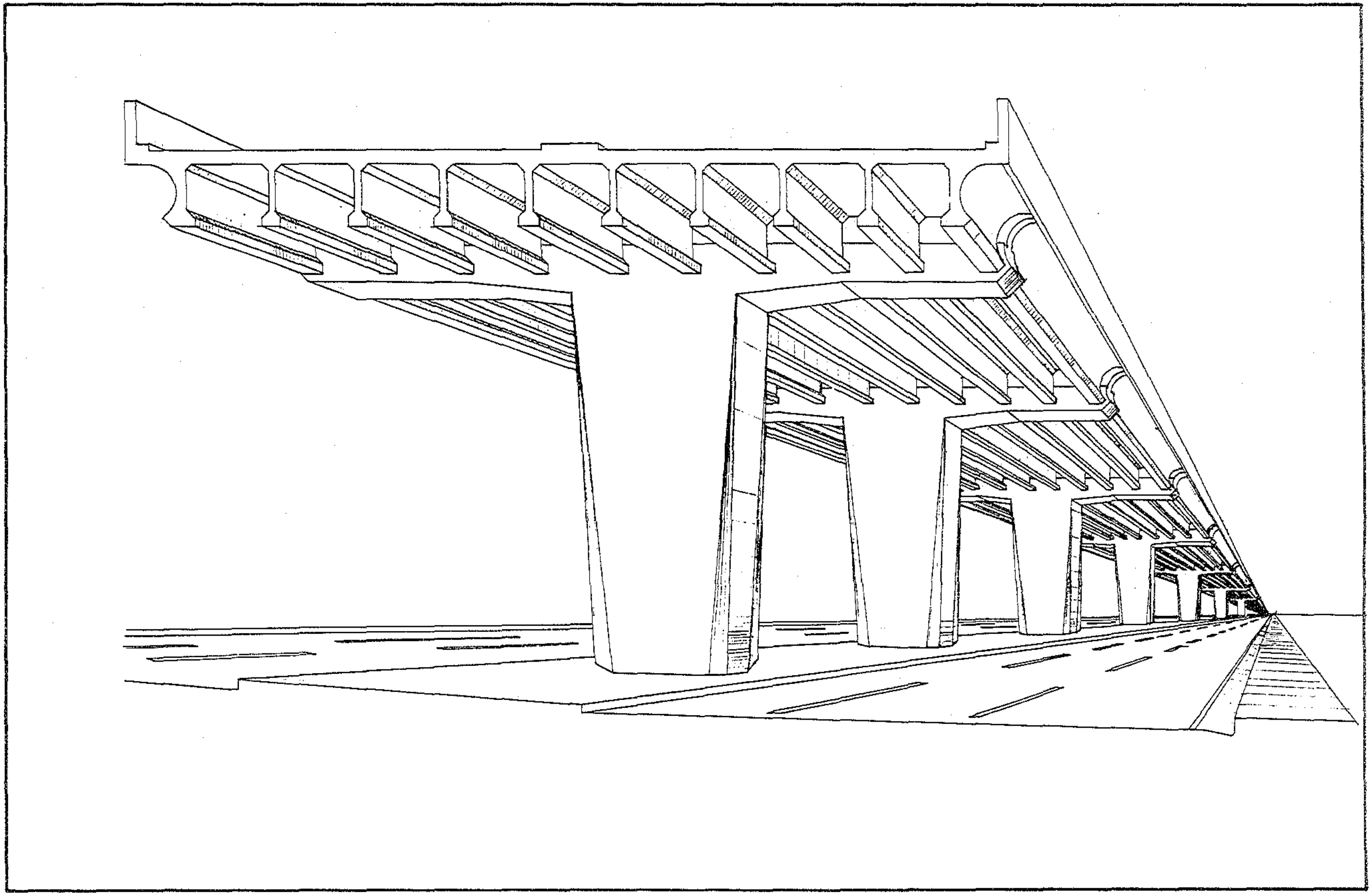


FIGURE 7.4.5 VIEW OF VIADUCT

7.5 PRELIMINARY DESIGN OF INTERCHANGES

7.5.1 Location of Interchanges

Figure 7.5.1 graphically shows the location of interchanges along MMUES Stage 1 routes, and Table 7.5.1 summarizes the type of interchanges adopted.

TABLE 7.5.1 LOCATION OF INTERCHANGE

ROUTE	NAME OF INTERCHANGE	TYPE OF INTERCHANGE	REMARKS
C–3	• C–3/R–3	Partial 3–Leg Directional	T–Type
	• C–3/R–4	3–Leg Directional	T–Type
	• C–3/R–6	3–Leg Directional	T–Type, (Future Implementation)
	• C–3/R–7	Partial Cloverleaf	2 Loops and 2 Directional
	• C–3/R–9	3–Leg Directional	T–Type
	• C–3/R–10A	3–Leg Directional	T–Type, (Future Implementation)
	• C–3/R–10	3–Leg Directional	T–Type, (Future Implementation)
R–3	• R–3/C–4	Partial 3–Leg Directional	Connection with existing Magallanes Interchange
	• R–3/C–5	3–Leg Directional	Depress Type Inter–change (Future Implementation)
R–7	• R–7/C–5	Partial 4–Leg Directional	Directional Ramps for major flow (Future Implementation)

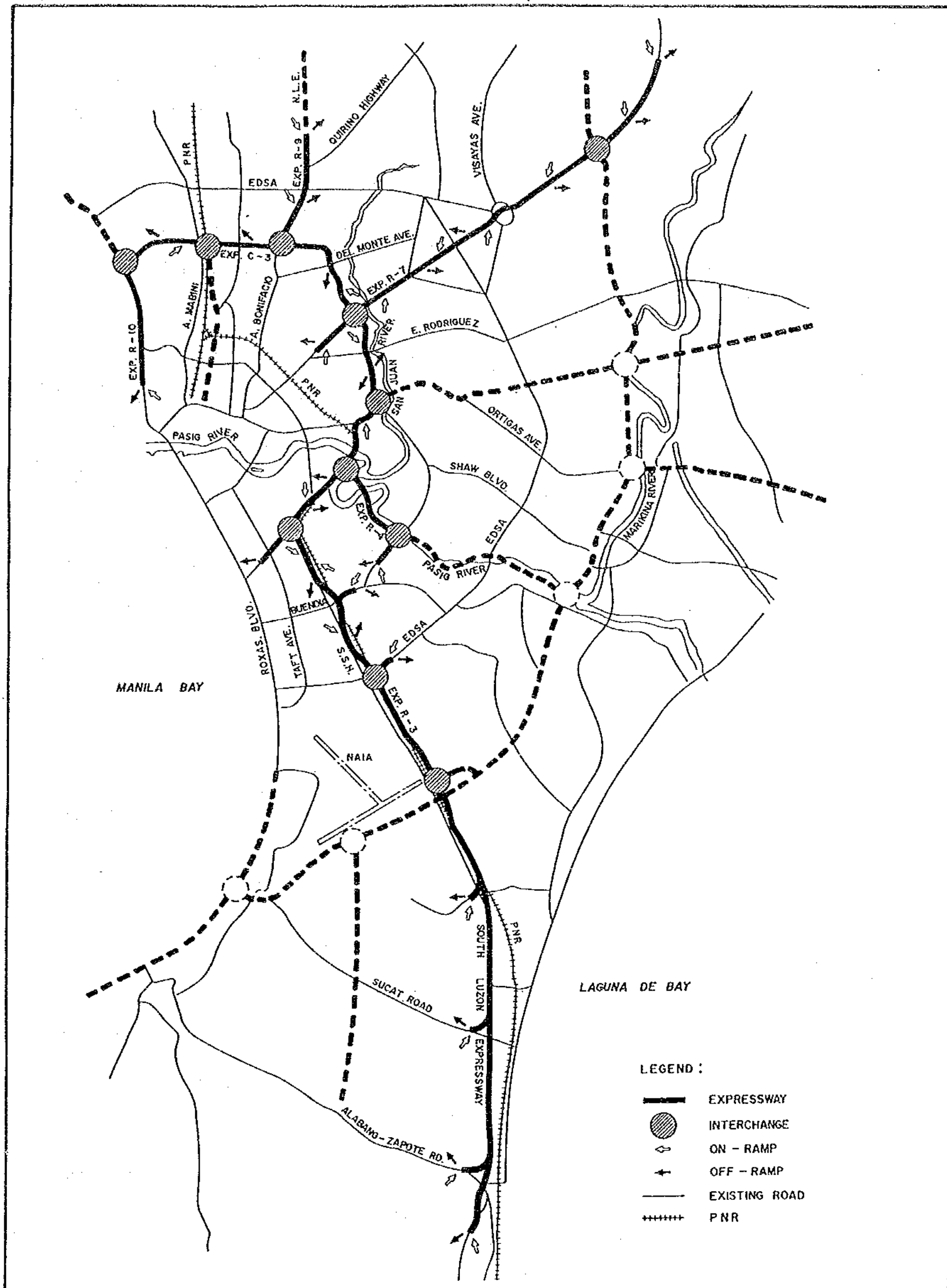


FIG. 7.5.1' LOCATION OF INTERCHANGE

FEASIBILITY STUDY ON METRO MANILA URBAN EXPRESSWAY SYSTEM

7.5.2 Alternative Scheme of Interchanges

The basic schemes of interchange types are shown in Figure 7.5.2 and briefly described as follows.

- T- and Y- Interchanges

  A trumpet interchange is suitable for orthogonal or skewed junctions. Trumpet type favors the left turn on the expressway with the provision of a semi-direct connecting ramp. T-type interchange has advantages that all turning movement are facilitated similar to trumpet type.

- Diamond Interchanges

  A diamond interchange is fitting to urban area because of small right-of-way acquisition required. The major flow is grade separated, but minor flow directions have intersections at-grade. One disadvantage of the diamond interchange is the possibility of wrong-way turns which can cause accidents.

- Partial and Full Cloverleaf

  In place of diamond interchange, the partial cloverleaf are sometimes adapted. Traffic can leave the major flow either before or after the grade separation structure, depending on the quadrant layout.

  The more conventional arrangement of the full cloverleaf eliminates at-grade crossings of all traffic streams for both major and minor roads. Although all crossing movements are eliminated, the cloverleaf design has the following disadvantages:

  - A layout requires large land area

  - Decelerating traffic wishing to leave the through lanes must weave with accelerating traffic entering the through lanes, but by using collector-distributor roads to overcome this disadvantage.

- Directional Interchange

  Generally, the directional interchanges are used whenever one freeway joints or intersects another expressway. The outstanding design characteristics of this type of interchange is the use of a high design speed throughout, with curved ramps and roadways with large radius.

  Recent experience shows that directional interchanges has revealed operational problems associated with left-hand entrance and exit ramps, since most drivers expect to exit freeways to the right and to enter from the left.

7.5.3 Recommended Types of Interchanges

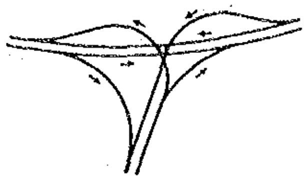
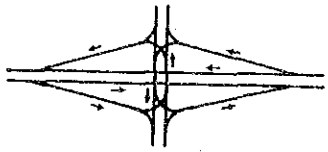
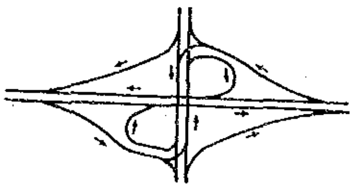
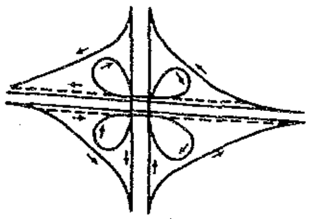
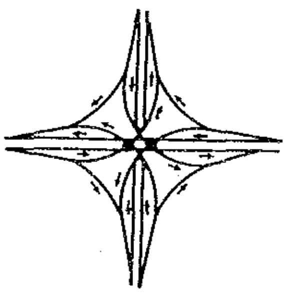
Factors to be considered in selecting the most appropriate types of interchanges includes:

- Design speed of expressway connecting
- Functionality according to traffic volume and highway capacity
- Construction cost
- Difficulty in R.O.W. acquisition
- Topographical feature
- Environmental/aesthetic consideration

The comparative study interchange types were exercised as reported in Appendix 7.2.

Figure 7.5.3, 7.5.4 and 7.5.5 show the interchange type for recommendation.

FIGURE 7.5.2 INTERCHANGE TYPES

INTERCHANGE TYPE	TYPICAL DIAGRAMMATICAL PLAN	VARIATION TYPE
T and Y Interchanges		• Y–Type (3–Leg Directional) • T–Type (3–Leg Directional) • Trumpet Type
Diamond Interchange		• Conventional Diamond Type • Compressed Diamond Type • Split–Diamond Type
Partial and Full Cloverleaf	 	• Full Cloverleaf • Full Cloverleaf with Collector–Distributor Roads • Partial Cloverleaf (2–Loops) • Partial Cloverleaf (3–Loops)
Directional		• Four–Level Full Directional • Three–Level Full Directional • Semi–Directional • Rotary Type

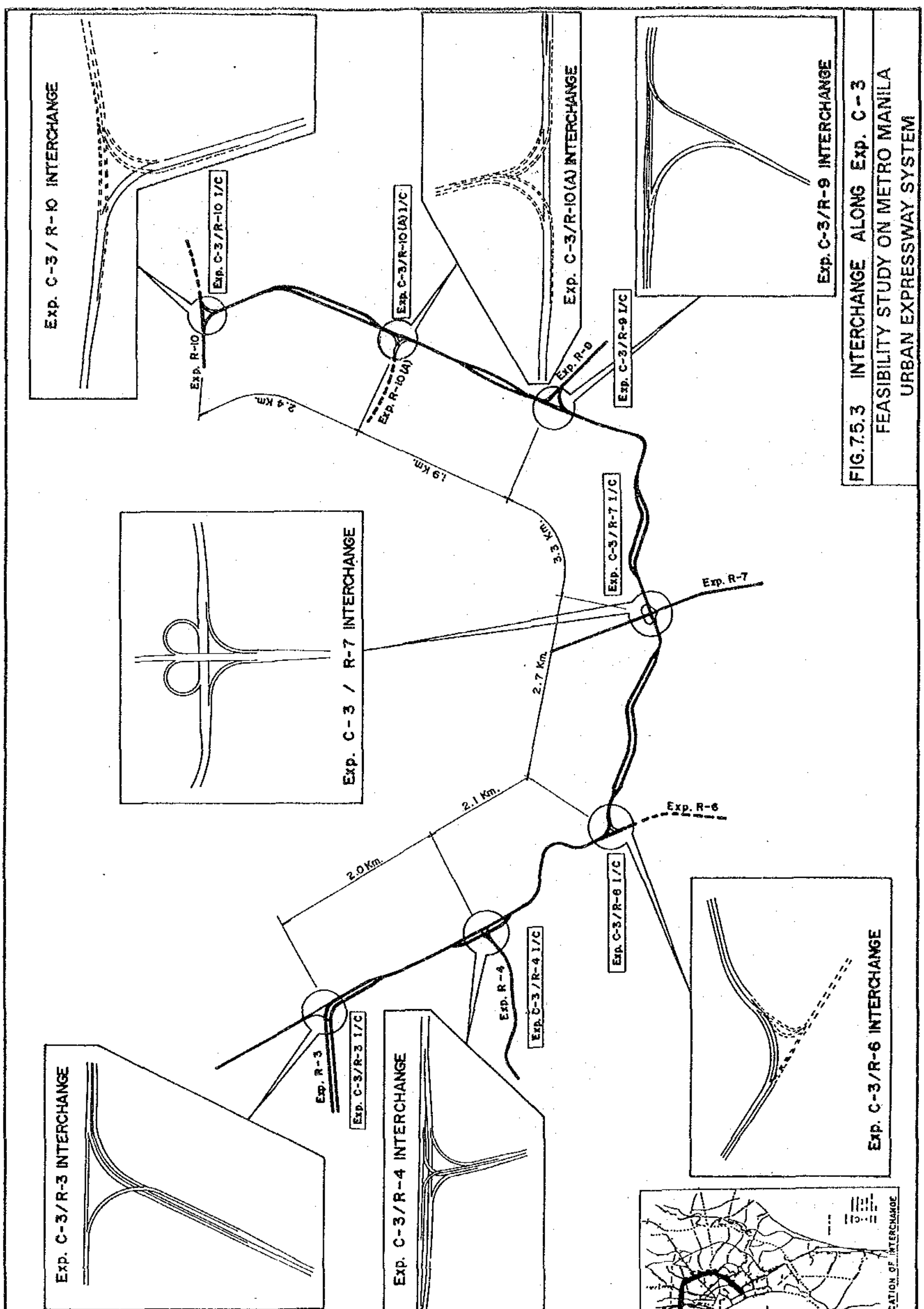


FIG. 7.5.3 INTERCHANGE ALONG Exp. C-3
FEASIBILITY STUDY ON METRO MANILA URBAN EXPRESSWAY SYSTEM
Exp. C-3 / R-10 INTERCHANGE
Exp. C-3/R-10(A) INTERCHANGE
Exp. C-3/R-9 INTERCHANGE
Exp. C-3 / R-7 INTERCHANGE
Exp. C-3/R-6 INTERCHANGE
Exp. C-3/R-4 INTERCHANGE
Exp. C-3/R-3 INTERCHANGE
Exp. C-3/R-10 I/C
Exp. C-3/R-10(A) I/C
Exp. C-3/R-9 I/C
Exp. C-3/R-7 I/C
Exp. C-3/R-6 I/C
Exp. C-3/R-4 I/C
Exp. C-3/R-3 I/C
Exp. R-10
Exp. R-10(A)
Exp. R-9
Exp. R-7
Exp. R-6
Exp. R-4
Exp. R-3
2.4 Km.
1.9 Km.
3.3 Km.
2.7 Km.
2.1 Km.
2.0 Km.
LOCATION OF INTERCHANGE

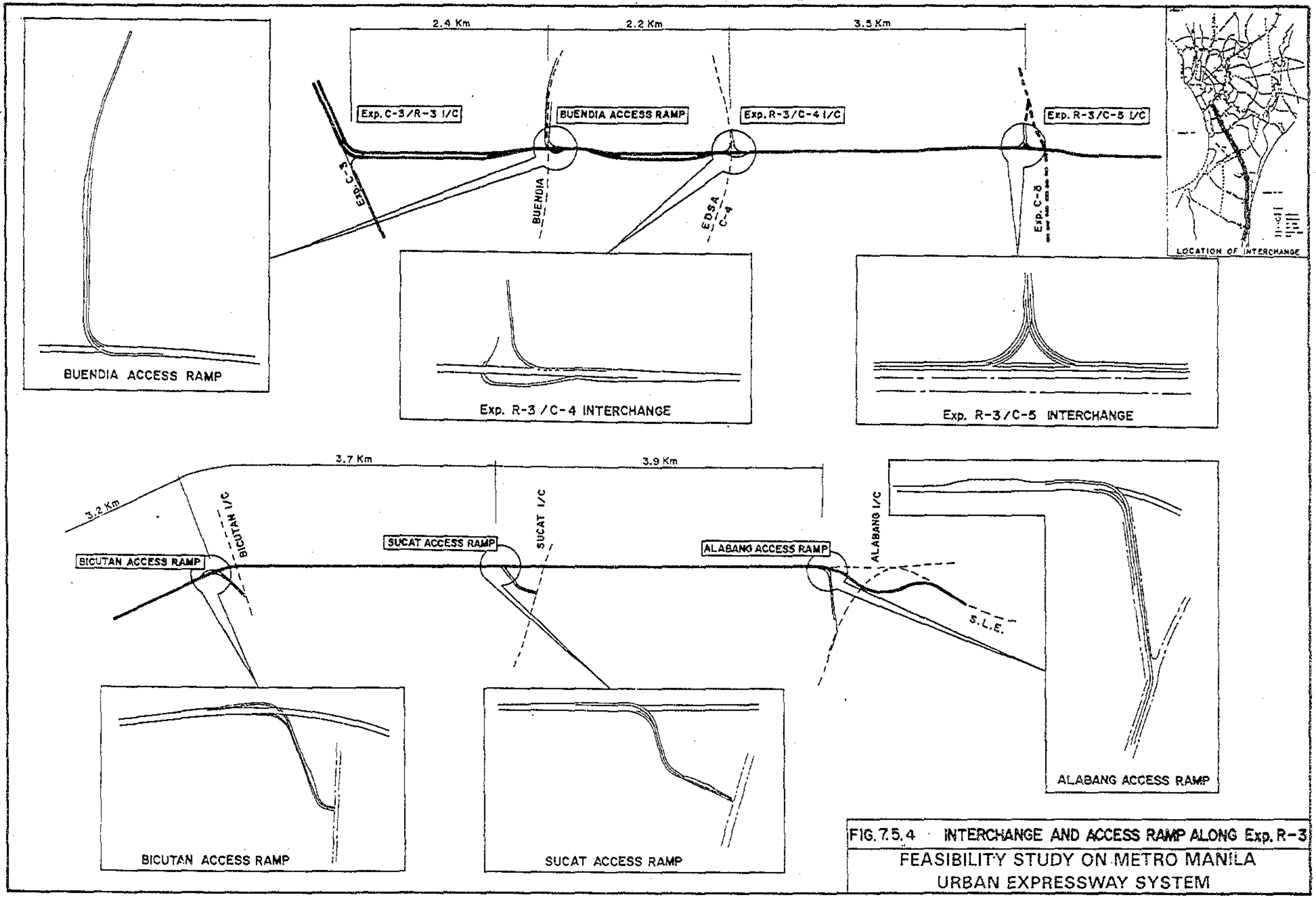


FIG. 7.5.4 INTERCHANGE AND ACCESS RAMP ALONG Exp. R-3

FEASIBILITY STUDY ON METRO MANILA
URBAN EXPRESSWAY SYSTEM

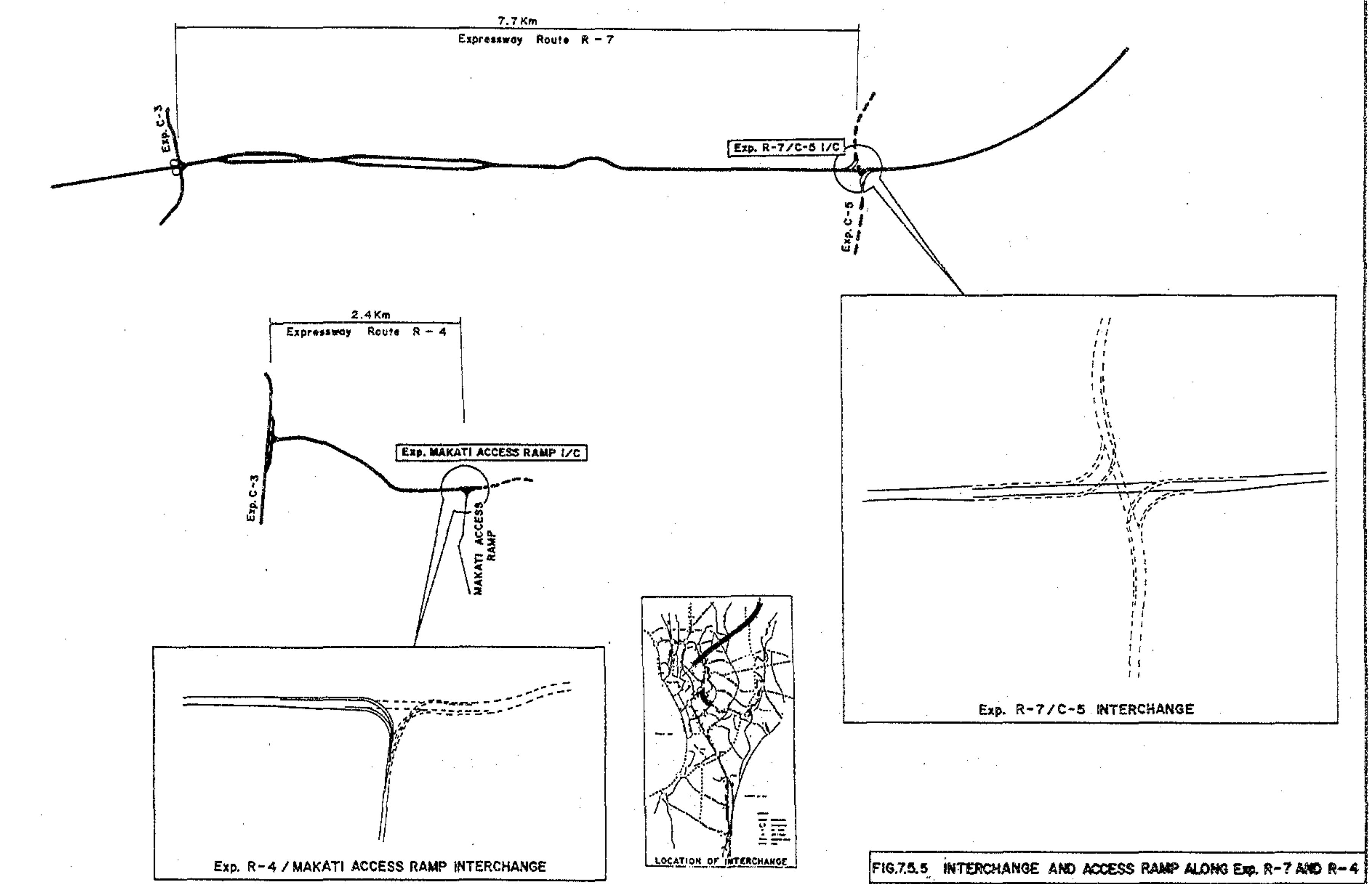


FIG.7.5.5 INTERCHANGE AND ACCESS RAMP ALONG Exp. R-7 AND R-4

FEASIBILITY STUDY ON METRO MANILA URBAN EXPRESSWAY SYSTEM