

13. BUS SERVICE IMPLEMENTATION

(1) Objectives

The bus system is selected as the most suitable public transport system to cope with future traffic demand and socioeconomic activities. It is envisioned to be a great contributor to the vitalization of urban activities and to the improvement of urban environment in the Phnom Penh area.

The project aims to implement such bus services on a proposed short-term bus network in order to establish an efficient operation system, identify effective measures for co-existence of 2-wheel vehicle and observe public acceptability.

(2) Planning Directions for Bus Services Implementation

Necessity of Immediate Action Plan

- The bus operation model to be studied here is that of the “Short-term Plan”. The route network of the Short-term Plan is designed to cover the urbanized area, represented by the Central 4 Districts, and major road connected to the urbanized area to cater the estimated high demand in these areas.
- Therefore, it is practical to propose the immediate action bus route network, transitional between the bus operation experiment network and the short-term bus network, taking into consideration the successful outcome of the bus operation experiment and the smooth implementation of the bus operation in the future. This is intended to avoid a huge initial investment cost.
- The immediate action bus route network is designed to be appropriate to the current land use and road conditions and to make effective use of

existing facilities, such as the terminal area along national roads.

Measures for Passengers Convenience

The most serious demerit of the bus system is the waiting time of passengers at bus stops. Therefore, it is necessary to minimize passenger inconvenience at the bus stops by giving enough information of bus operation and putting up bus shelters at transfer points and bus stops located at near traffic generation facilities, such as markets and schools.

Small Size Bus Fleet

Introducing a large-size bus fleet will not only affect the other modes of transport because the urban area is rather small compared with its population size and the maximum number of lanes along the trunk roads is limited (four lanes) but also disturb the urban scenery, which is composed of historically unique low-level buildings. Therefore, it is necessary to introduce the small-size bus fleet in the bus operation.

Bus Operation System

It is necessary to utilize and revitalize the existing organizations to establish an operationally and financially sustainable bus operation system.

(3) Bus Operation Plan

Based on the planning directions for bus service implementation, the bus operation plan, including proposed bus route networks, is formulated.

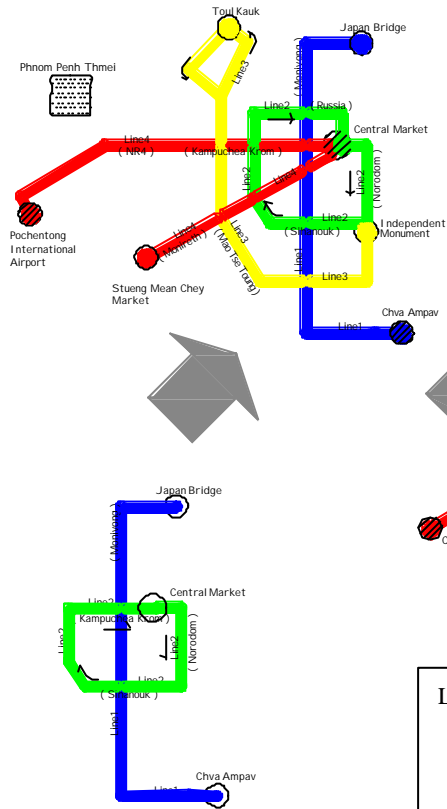
The immediate action bus routes consist of 4 routes (2-circular and 2-radial) and the short-term bus network consists of 9-routes (3-circular and 6-radial).

Bus Operation Plan

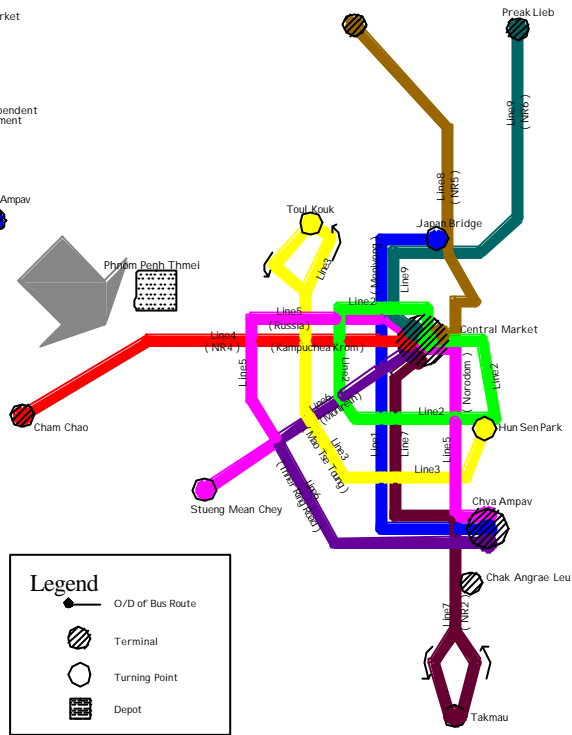
Items		unit	Routes	
			Immediate Action Plan 4 routes	Short-term Plan 9 routes
A	Route length	km	36	92
B	Passenger demand	passenger/day	23,750	49,360
C	Type of bus		Minibus (45 passenger)	
D	Number of bus	unit	64	148
E	Required number of bus	unit	75	175
F	Total number of staff	staff	300	700
G	Number of bus stops	unit	148	325
H	Number of bus shelters	unit	40	90
I	Existing bus terminal in CBD	sq. m	1,430	4,200
J	Existing bus terminal in suburban area	sq. m	1,300	3,400
K	Total area of depot	sq. m	3,680	7,050
L	Total area of office space	sq. m	2,250	5,250

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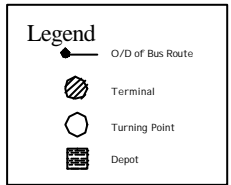
Immediate Action Plan



Bus Operation Experiment Routes



Short-term Plan



Proposed Bus Routes and Facilities

(4) Major Components and Project Cost

The project cost was estimated for the immediate action and short-term plan covering necessary components.

Project Cost

	Immediate Plan	Short-term Plan *	Total *
Basic Design	0.6	-	0.6
Bus Fleet	4.8	6.4	11.2
Bus Facilities	0.9	0.9	1.8
Engineering	-	1.2	1.2
Total	6.3	8.5	14.8

(Unit: US\$ Million)

* The amounts in the column of “Short-term Plan” are the amounts of additional costs for expansion from Immediate Action Plan to Short-term Plan. Thus, the amounts shown in the column of “Total” are the costs for Implementing Short-term Plan.

(5) Economic and Financial Analysis

Assumptions in Economic Analysis

- Project period; 20 years (2005 ~ 2025)
- Discount rate; 12%
- Benefit; saving in travel time and vehicle operating cost.
- Cost; excluding cost of bus fleet, operational general and administration expenses and fuel and depreciation, which were included in traffic cost.

Assumptions in Finalizes Analysis

- Project period: 20 years (2005 ~ 2025)
- Discount rate: 12%
- Benefit: Fare revenue and advertisement fee
- Cost: Cost excluded in the economic analysis were included.

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Economic and Financial Costs

Items	Economic Cost	Financial Cost
Initial Investment	1.561	13.015
Monthly Operating Expenses	0.014	0.265
Monthly General & Administration Expenses	0.046	0.091

(Unit: US\$ Million)

Economic and Financial Evaluation

The results of economic analysis show that the bus service operation is economically feasible with EIRR of 21.9%.

However, the bus operation is not financially viable with the low FIRR of 1.6%.

Benefit Indicators

Items	Economic Indicators	Financial Indicators
Net Present Value (US\$ Million)	4.94	-9.94
B/C	1.46	0.80
EIRR/FIRR (%)	21.9	1.6

(6) Possible Operation System

Because of the low FIRR as a project, the comparative study on six (6) operational options was made to find out a system and entity, which can operate the proposed bus services with a minimum expense in view of the government and the maximum interest of public.

- Option A: Direct operation by public sector
- Option B: Indirect operation by public sector through public corporation
- Option C: Contract-out to private sector under public sector management
- Option D: Operation by third sector
- Option E: Operation by BOT basis
- Option F: Operation by private sector

Cost Ratio of Operational Options

Items	A) Gov't Direct	B) Gov't Indirect	C) Contract Out	D) 3 rd Sector	E) BOT	F) Private
Initial Investment	13,015	265	13,015	11,494	13,044	13,044
Revenue (1)	295	295	295	295	295	295
Operational Expenses	263	263	227	265	265	265
General & Adm. Expenses	72	28	72	101	172	172
Total Expenses (2)	334	290	299	366	437	437
Profit - Loss (1) - (2)	-39	5	-3	-70	-142	-142
Cost Ratio (%) (2)/(1)	113.1%	98.2%	101.2%	123.9%	148.0%	148.0%

(Unit: US\$1,000/month)

The study results indicate that only option B is acceptable in term of cost ratio of 98.2%.

Precondition for Possible Operation System

It is, however, noted that option B stands on the following assumptions.

- (i) Purchase of bus fleet by the government
- (ii) Preparation of land for bus facilities by the government
- (iii) Operational expenses, general and administrative expenses by a public corporation.
- (iv) Self-reliance management and operation by a public corporation.

(7) Implementation Plan

Precondition for Project Realization

- Implementation Agency
 - The Government, preferably MPP
- Operating corporation
 - Phnom Penh Transport Agency (PPTA), under the supervision of DPWT
- MPP responsibility
 - Purchase of bus fleet
 - Preparation of land for bus facilities
- PPTA responsibility
 - Self-reliance management and operation
 - All operation and managerial expenses

Implementation Schedule and Fund

1st Phase: one year pilot bus operation in 2004 as the immediate action plan for 22,960 passenger demand on 4 routes with 75 buses. As for the fund required for the plan, it is suggested that bus fleet be supplied through the grant aid base to the government and the bus facilities be prepared with the local fund by MPP. Design shall include the short-term plan.

2nd Phase: short-term plan starting from 2005 with additional 100 (total 175) buses for 49,500 passengers demand on 9 routes. For this fund sources, the combination of local funds, grant aid and loans from international and bilateral institutions shall be sought.

(8) Profit and Loss Flow

Under the precondition for project realization, a cash flow analysis was made for the both cases; the immediate action plan and short term plan, assuming the durable life of bus of 10 years.

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The analysis reveals that the immediate action plan is profitable after 2nd year and the short-term plan after 7th year following the start of bus operation.

Year	Immediate Action Plan				Short-term Plan			
	Reve-nue	Ex-pense	Bal-ance	Acc. Bal	Reve-nue	Ex-pense	Bal-ance	Acc. Bal
2003	0	0	0	0	0	0	0	0
2004	1,060	1,364	-304	-304	1,060	1,386	-326	-326
2005	1,535	1,364	171	-133	3,189	3,185	4	-322
2006	1,587	1,449	138	5	3,299	3,682	-383	-705
2007	1,642	1,541	101	106	3,412	3,900	-488	-1,193
2008	1,698	1,643	55	161	3,529	4,136	-607	-1,800
2009	1,757	1,790	-33	128	3,650	4,392	-742	-2,542
2010	2,596	1,954	642	770	5,393	4,670	723	-1,819
2011	2,674	2,071	603	1,373	5,555	4,913	642	-1,177
2012	2,754	2,198	556	1,929	5,722	5,173	549	-628
2013	2,837	2,460	377	2,306	5,894	5,894	0	-628
2014	2,922	2,840	82	2,388	6,599	6,532	67	-561
Total	23,062	20,674	2,388		47,302	47,863	-628	
E/R rate (%)				90				101

(9) Conclusion

The bus service operation, especially the immediate action plan, is recommendable under the precondition for project realization, in consideration of the

minimum government expense and maximum public interest. It is, therefore, recommended that the plan shall be implemented at the soonest possible time.

In implementing the bus operation, the following matters needs to be considered.

- 1 A mechanism to feed back the profit accrued from the bus operation to supplement the initial investment should be studied and adopted.
- 2 Personnel of the private firms in the relevant business field, such as bus operation and advertisement, needs to be employed by PPTA to utilize the know-hows possessed by these private firms.
- 3 PPTA should make every effort to raise additional revenue such as development of bus terminals and advertisement. Further, PPTA should always make effort to reduce operation cost to maintain a healthy financial condition.

Stage Implementation Schedule and Fund Requirement

Category	Item	2002	2003	2004	2005	2006
Phase	Type			Immediate Action	Short-term Plan	
	Bus Passenger Demand			22,900/day	49,500/day	
	No. of Route			4	9	
	No. of Bus			75	175	
Schedule	Basic or Detailed Design	[Timeline]				
	Tender		[Timeline]			
	Procurement		[Timeline]	[Timeline]		
	Operation				[Timeline]	[Timeline]
Annual Fund Allocation	Basic Design	400	150	50		
	Procurement & Facility Improvement	0	4,800	6,400		
	Administrative & Bus Operator Consultings	0	893	913		
	Operation/maintenance	0	300	600	300	
	Total Project Cost (in US dollars in million)					
	Item	First Phase		Second Phase	Total	
	Basic or Detailed Design	0.60		0	0.60	
	Procurement & Facility Improvement	4.80		6.40	11.20	
	Management Consultings	0.90		0.90	1.80	
	Operation & Maintenance	0		1.20	1.20	
	Total	6.30		8.50	14.80	
Related Activities	Develop laws/regulations	[Timeline]				
	Conduct training program	[Timeline]		[Timeline]	[Timeline]	
	Execute organization reform	[Timeline]		[Timeline]	[Timeline]	[Timeline]

Source: The Study Team

Remarks: [Timeline] is for Immediate Action (Plan).

[Timeline] is for Full-scale Operation

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14. TRAFFIC CONTROL SYSTEM

(1) Objectives

The major objectives are to achieve efficient utilization of the existing road facilities by improving the traffic flow situation and increasing the traffic handling capacity at major intersections along the major arterial road.

(2) Formulation of Traffic Control System

Proposed Intersections to be improved

Intersection satisfying the following criteria shall be signalized:

- The functions of the intersecting streets:
 - A major street and a major street
 - A major street and a collector street
- Observation and Discussion with DPWT:
 - Good road surface conditions
 - Traffic congestion in peak hours

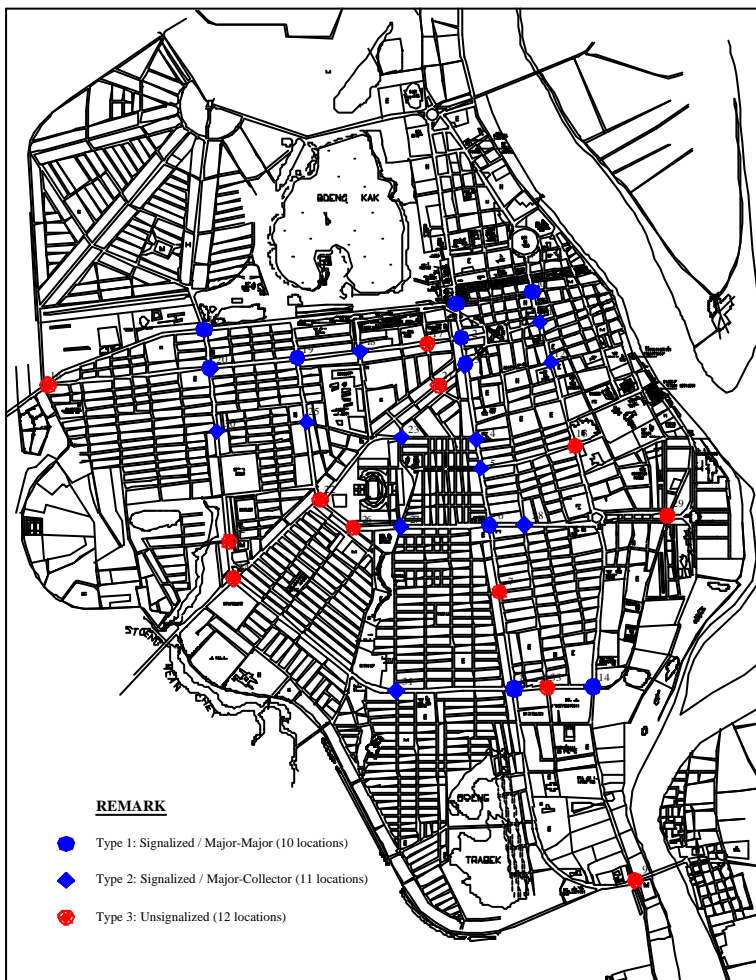
- Traffic volumes of the intersecting streets:
 - Intersections with traffic volumes exceeding estimated critical value

The 33 locations to be improved and/or installed traffic signals are indicated in the figure below.

The basic intersection improvement measures are traffic channelization, traffic control and operation improvements, as well as the installation and/or improvement of traffic signals as a means to strengthen the traffic control facilities.

Major Items of Improvement

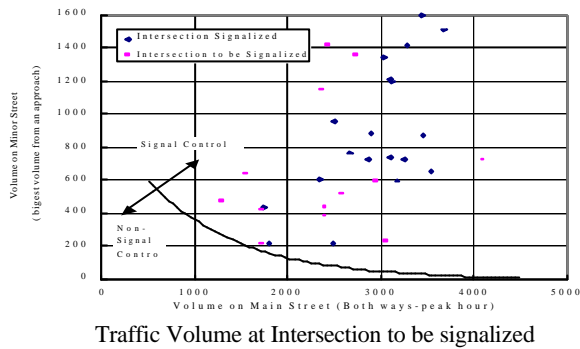
Type	Major Items of Improvement
1: Major-Major	<ul style="list-style-type: none"> • Installation of left-turn lane • Install/improve of signal (left-turn phase)
2: Major-Collector	<ul style="list-style-type: none"> • Installation of left-turn lane (include. partial widening of carriageway) • Install/improve of signal (left-turn phase)
3: Unsignalized Intersection	<ul style="list-style-type: none"> • One-way regulation on minor road • Install/improve signal • Install left-turn lane



No.	Type of Improvement
1	1
2	1
3	1
4	2
5	2
6	1
7	3
8	1
9	3
10	1
11	2
12	2
13	3
14	1
15	1
16	3
17	3
18	2
19	1
20	1
21	3
22	3
23	2
24	3
25	2
26	3
27	2
28	2
29	3
30	2
31	2
32	3
33	3

Proposed Intersections to be signalized

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Required Functions on Signalization

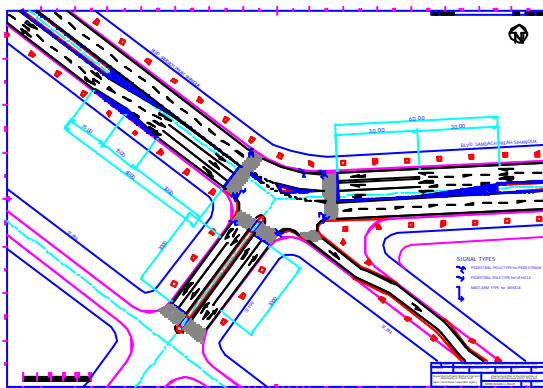
- To display exclusive left turn signal
- To adjust signal timings to the traffic demand fluctuations
- To coordinate with adjoining signals
- To display all red phase
- To enable a manual control function.

(3) Standard Design and Control Operation at Intersections

The three typical intersections are selected to develop standard intersection improvement designs. As an example, the existing feature and standard design of a typical intersection are shown in the picture and the figure, below.



Intersection of Sihanouk Blvd with St.199
(Existing Feature)



Intersection of Sihanouk Blvd with St.199
(Standard Design)

(4) Expected Benefits

The improvements will bring about orderly and smooth traffic flow, and as a consequence,

- Decreasing travel times, saving on fuel consumption and decreasing wear and tear on the vehicle and tires.
- Reduction in traffic accidents
- Reduction in output of noxious gases such as CO, CO₂, NO and NO_x, and also noise and vibration.

(5) Project Cost

The project requires a total of US\$2.8 millions for the implementation of traffic control system at the proposed 33 intersections.

(6) Economic Evaluation

Assumptions: Project Period: 15 years, Discount Rate: 12%, Benefit: Time Saving / Fuel Consumption Saving, Cost: Signal Improvement & Installation / Engineering / Maintenance Costs

Intersection	EIRR %	B/C	NPV
33 proposed intersections	44.9	3.4	6,500

(Unit of NPV: Thousand US\$)

(7) Implementation Schedule

After sufficient funding is secured for the project, an implementation schedule of approximately 18 months will be required to operate the system.

(8) Implementation Agency and Organization

The Department of Public Works and Transport of MPP should undertake the implementation of the project. A traffic management division other than the road construction division in DPWT should be established to directly oversee the overall traffic management operations.

(9) Conclusions

The project is proposed to apply appropriate improvement measures to the selected intersections. Main measures are to provide signalization, exclusive left turning lane and adequate markings and signs.

It is concluded that the project is urgent and feasible and therefore should be implemented as soon as possible. Moreover the implementation cost is relatively low and the construction period is shorter than other measures.

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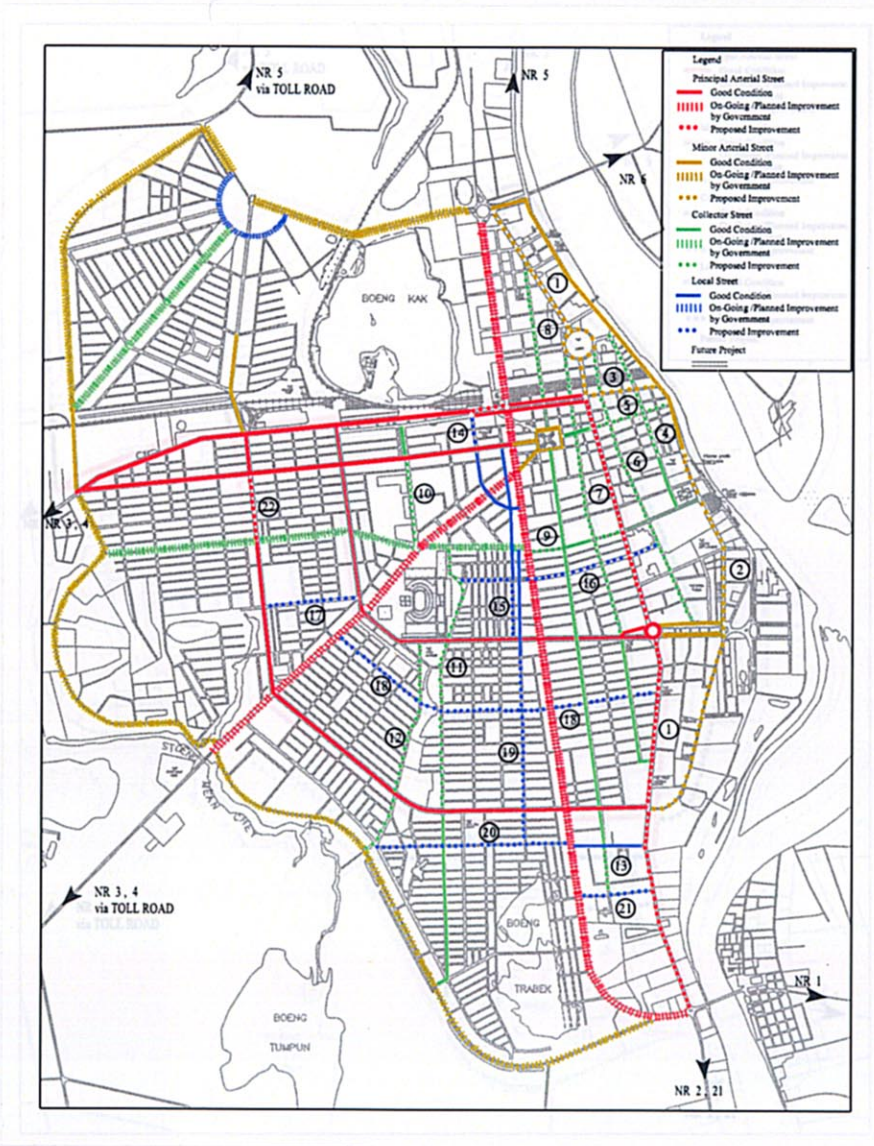
15. URBAN STREET IMPROVEMENT

(1) Objectives

Major objectives of the project are traffic cost savings, improvement of driving comfort, improvement of roadside environment, reducing dust, proper distribution of local traffic, acceleration of the bus favored policy, promotion of tourism industry, enhancement of community development, etc.

(2) Prioritization Criteria

The factors for evaluation of the implementation priority are ① the engineering requirement (necessity/urgency), ② traffic requirement (traffic volume), ③ functional requirement (role of the road as a component of the road network), ④ developmental requirement (tourism industry, community development) and ⑤ environmental requirement (unnecessary of additional ROW, dust prevention effect).



Proposed Roads to be improved

No.	Evaluation Factors				
	①	②	③	④	⑤
1	○	○	○	○	○
2	○	○	○	○	○
3	○	○	○	○	○
4	○	○	○	○	○
5	○	○	○	○	○
6	○	○	○	○	○
7	○	○	○	○	○
8	○	○	○	○	○
9	○	○	○	○	○
10	○	○	○	○	○
11	○	○	○	○	○
12	○	○	○	○	○
13	○	○	○	○	○
14	○	○	○	○	○
15	○	○	○	○	○
16	○	○	○	○	○
17	○	○	○	○	○
18	○	○	○	○	○
19	○	○	○	○	○
20	○	○	○	○	○
21	○	○	○	○	○
22	○	○	○	○	○

Evaluation Factors

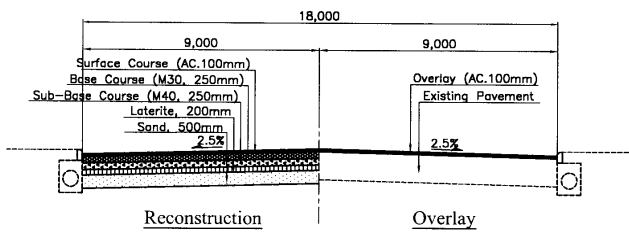
- ① Engineering requirement
- ② Traffic requirement
- ③ Functional requirement
- ④ Developmental requirement
- ⑤ Environmental requirement

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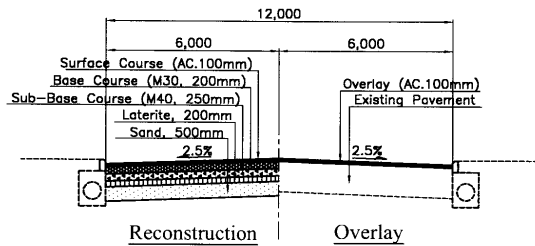
(3) Pavement Design

Either reconstruction or overlay is selected depending on the existing pavement condition.

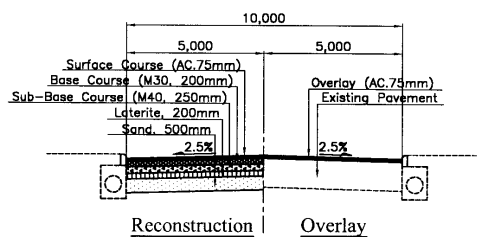
Design performance period (the duration between initial pavement construction and its rehabilitation) is set at 12 years for both reconstruction and overlay. The roadbed soil is designed to be replaced with sand (50cm thick) and laterite (20cm thick) in case of reconstruction.



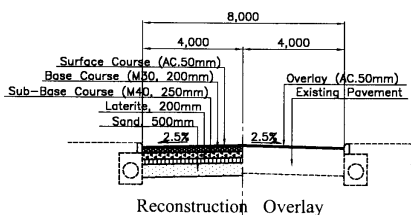
Principal Arterials



Minor Arterials



Collectors



Local Street

(4) Length and Cost of the Project

		Recon- struction	Overlay	Total
Length (km)	Principal Arterials	0.4	4.8	5.2
	Minor Arterials	1.0	4.6	5.6
	Collectors	12.3	-	12.3
	Local Streets	8.7	-	8.7
	Total	22.4	9.4	31.8
Project Cost (M\$)	Construction Cost			
	Principal Arterials	0.33	2.24	2.57
	Minor Arterials	0.68	1.58	2.26
	Collectors	4.92	-	4.92
	Local Streets	2.94	-	2.94
	Total	8.87	3.82	12.69
	Detailed Design			0.63
Construction Supervision			0.89	
Post-const. Engineering	0.30			
Total				14.51

(5) Implementation Schedule

	Cost	Year				
		2001	2002	2003	2004	2010
1. Ongoing/Planned Project by Government		[Timeline bar]				
2. Proposed Project		[Timeline bar]				
Detailed Design	0.63		[Bar]			
Construction Supervision	0.89			[Bar]		
Construction	12.69			[Bar]		
Post-construction Engineering Services	0.30				[Bar]	
3. Future Projects						[Timeline bar]

(Unit of Cost: US\$ Million)

The post-construction engineering services are proposed to be included as a component of the project for technology transfer for traffic management and safety and road maintenance, in order to encourage and sustain the effect of the project.

(6) Economic Evaluation

Assumptions: Project Period: 25 years, Discount Rate: 12%, Benefit: Reduction of Operation/Time/Fixed Cost, Cost: Project Cost, except Tax and Residual Value at the end of Project Period

	Principal Arterials	Minor Arterials	Collectors	Local Streets	Total
NPV	1.71	0.21	-0.04	-0.17	1.71
B/C Ratio	1.38	1.07	0.99	0.94	1.05
EIRR (%)	18.0	12.9	11.9	11.3	12.9

(Unit for NPV: US\$ Million)

(7) Conclusion

The effects of the project are broad ranging: traffic cost savings, proper distribution of local traffic resulting in mitigation of traffic congestion on the arterials, improvement of roadside environment, promotion of tourism industry, etc, which are supported by the results of the public experiment. It is concluded that the project is urgently needed and feasible from technical, economical, social and environmental aspects.