DEPARTMENT OD ROADS
MINISTRY OF PHYSICAL PLANNING AND WORKS
HIS MAJESTY'S GOVERNMENT OF NEPAL

STUDY REPORT
ON
THE PROJECT FOR IMPROVEMENT
OF
INTERSECTIONS IN KATHMANDU CITY
IN THE KINGDOM OF NEPAL

January 2000

JAPAN INTERNATIONAL COOPERATION AGENCY

NIPPON KOEI CO., LTD.

PREFACE

In response to a request from His Majesty's Government of Nepal, the Government of Japan decided to conduct a basic design study on the Project for Improvement of Intersections in Kathmandu City in the Kingdom of Nepal and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Nepal a study team from May 29, 2000 to September 23, 2000.

The team held discussions with the officials concerned of His Majesty's Government of Nepal, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Nepal in order to discuss a draft basic design, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of Nepal for their close cooperation extended to the teams.

January 2001

Kunihiko Saito
President
Japan International Cooperation Agency

January 2001

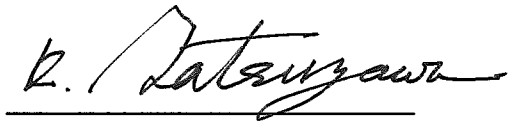
LETTER OF TRANSMITTAL

We are pleased to submit to you the basic design study report on the Project for Improvement of Intersections in Kathmandu City in the Kingdom of Nepal.

This study was conducted by Nippon Koei Co., Ltd., under a contract to JICA, during the period from May 19, 2000 to January 10, 2001. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Nepal and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,



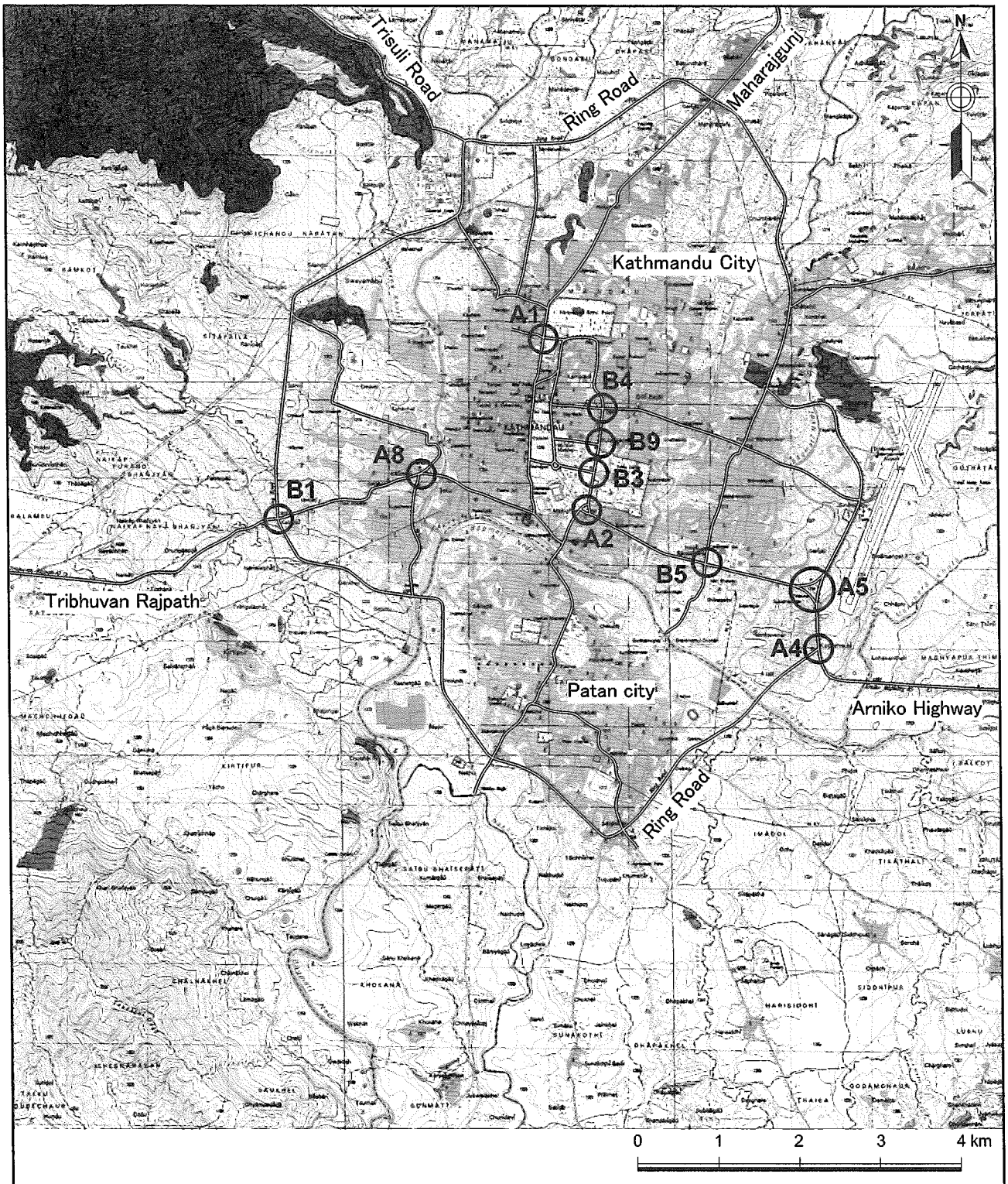
Katsufumi Matsuzawa

Project Manager

Basic design study team on the Project for Improvement of Intersections in Kathmandu City in the Kingdom of Nepal

Nippon Koei Co., Ltd.

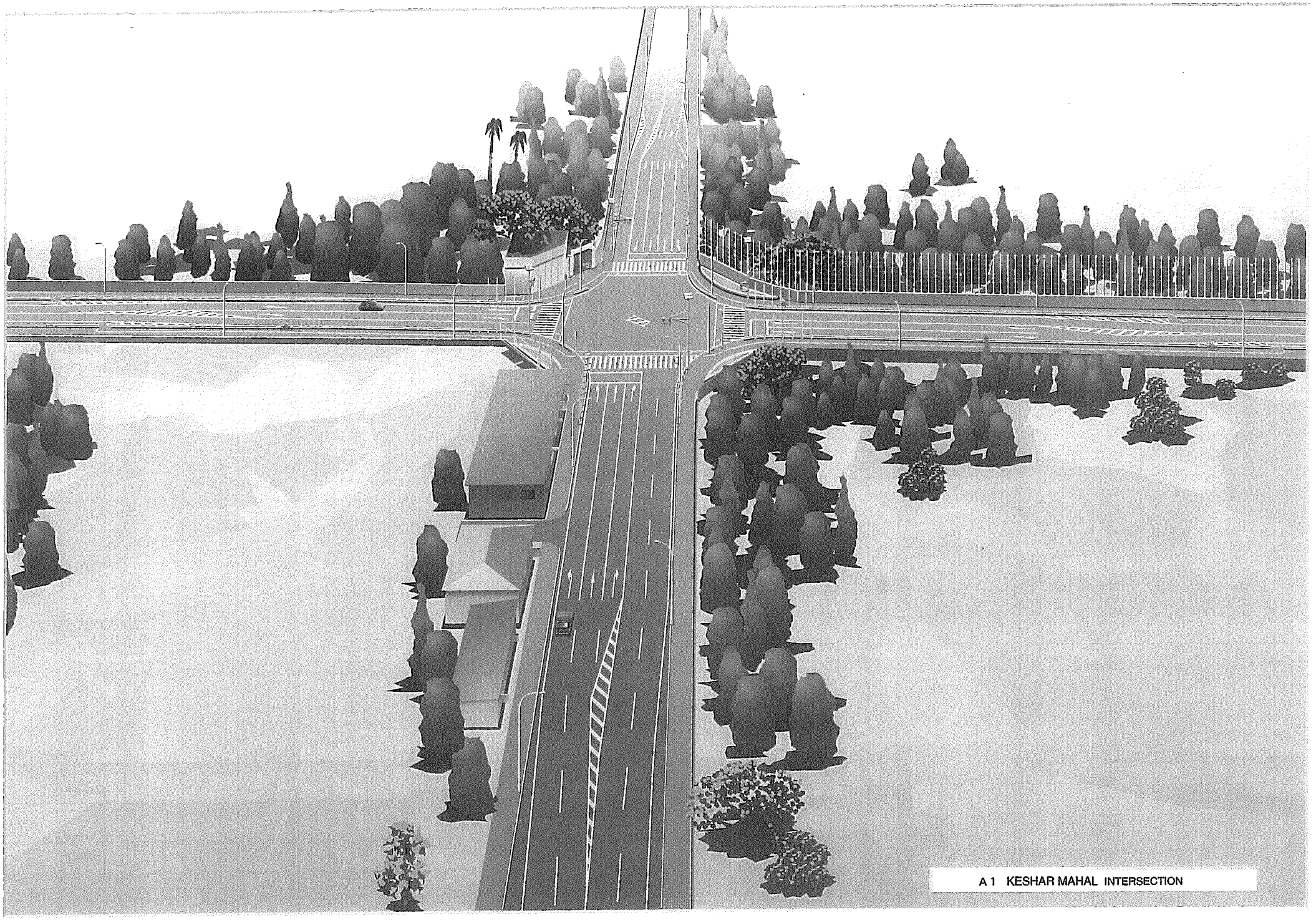
FRONTICEPIECE



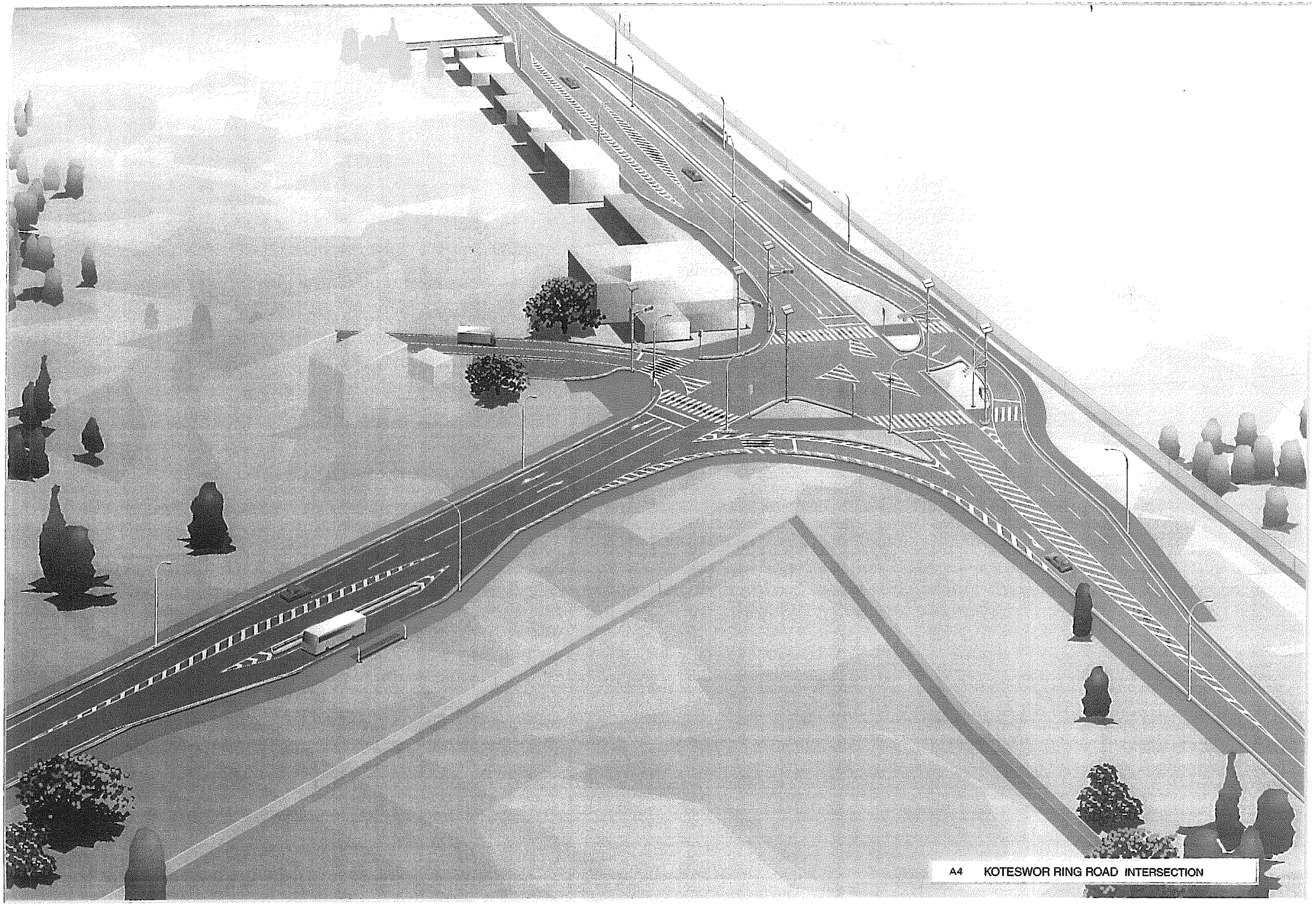
Name of Intersection subject to study

A1	Kesharmahal	B1	Kalanki-Chowk
A2	Maitighar	B3	Singha Durbar
A4	Koteswor Ring Road	B4	Ramshaha Path-Dilli Bazar
A5	Koteswor Tinkune	B5	Naya Baneshwar
A8	Kalimati	B9	Padmodaya Turning

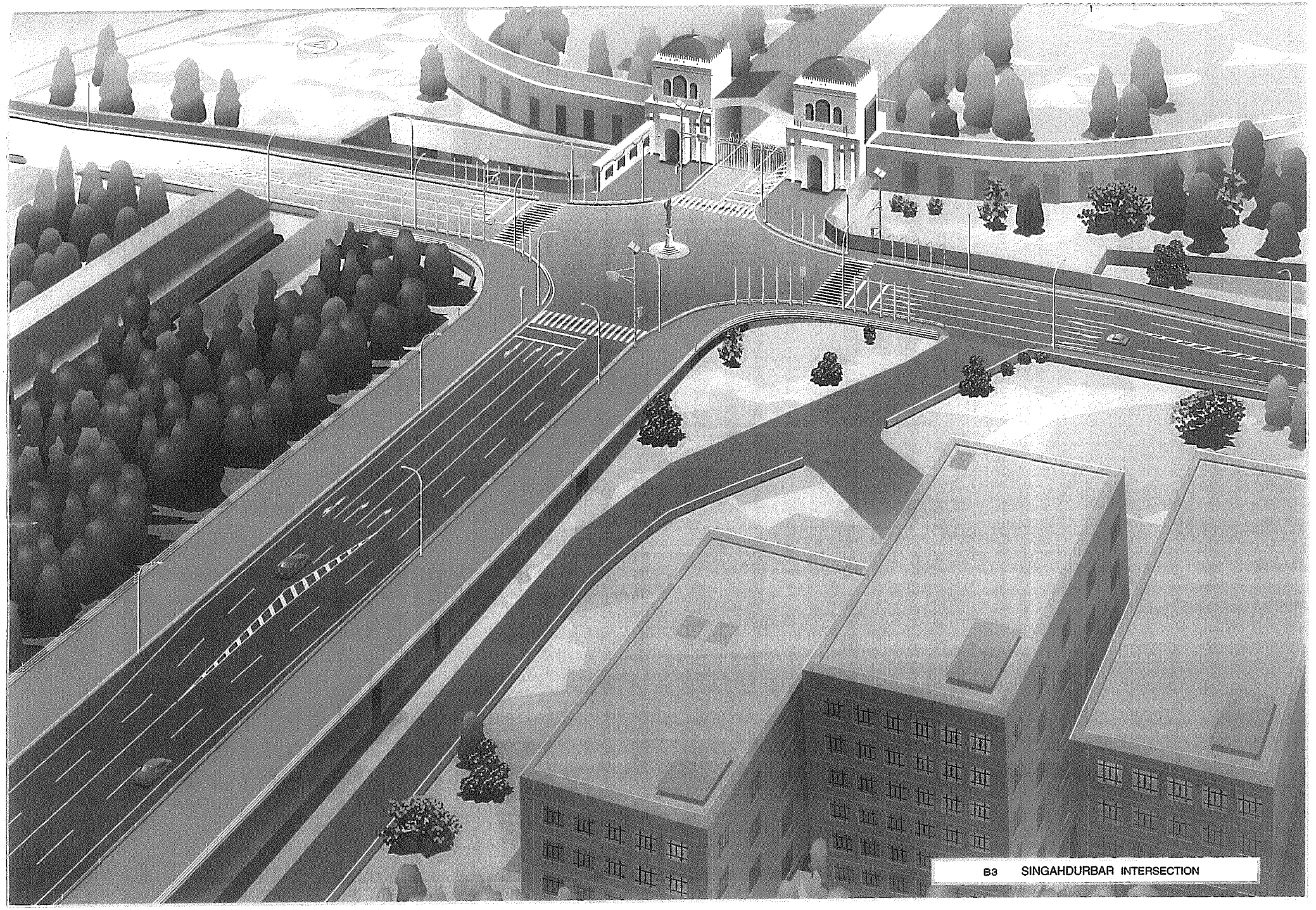
LOCATION MAP



A 1 KESHAR MAHAL INTERSECTION



A4 KOTESWOR RING ROAD INTERSECTION



B3 SINGAHDURBAR INTERSECTION

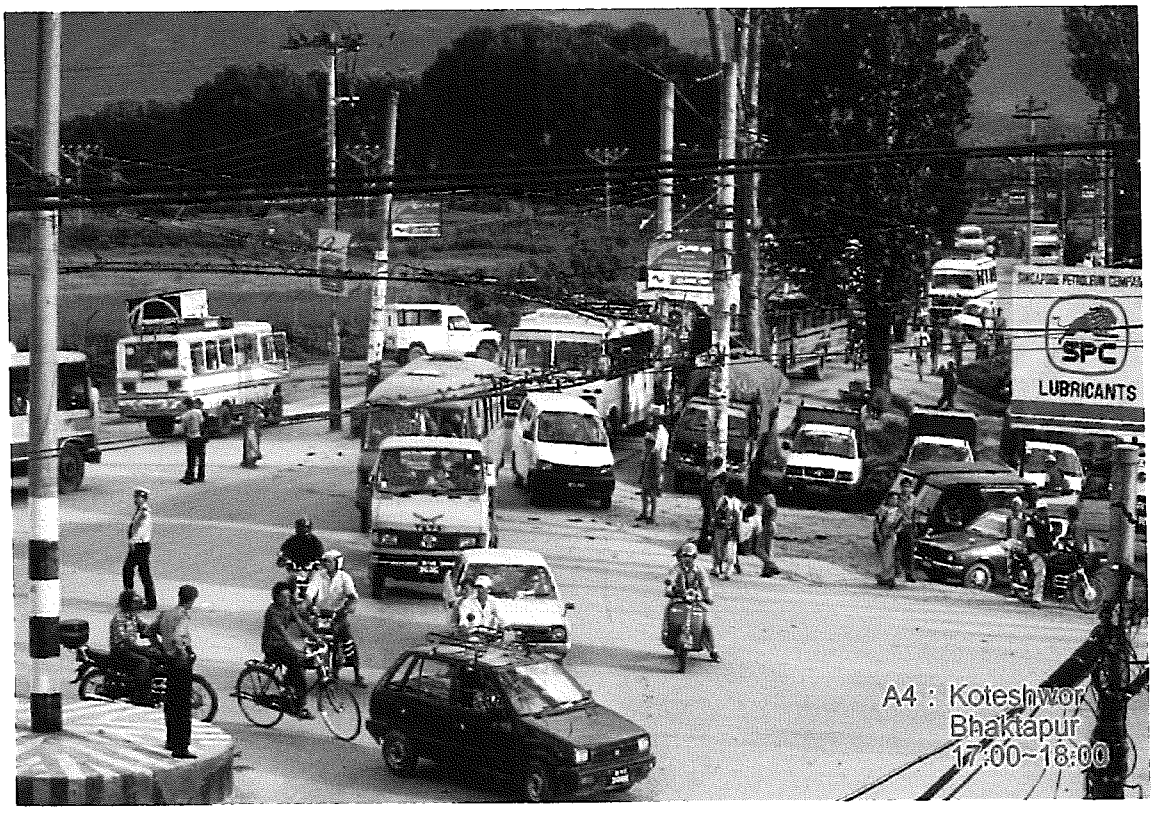
A 1　Kesharmahal

A 1　Kesharmahal

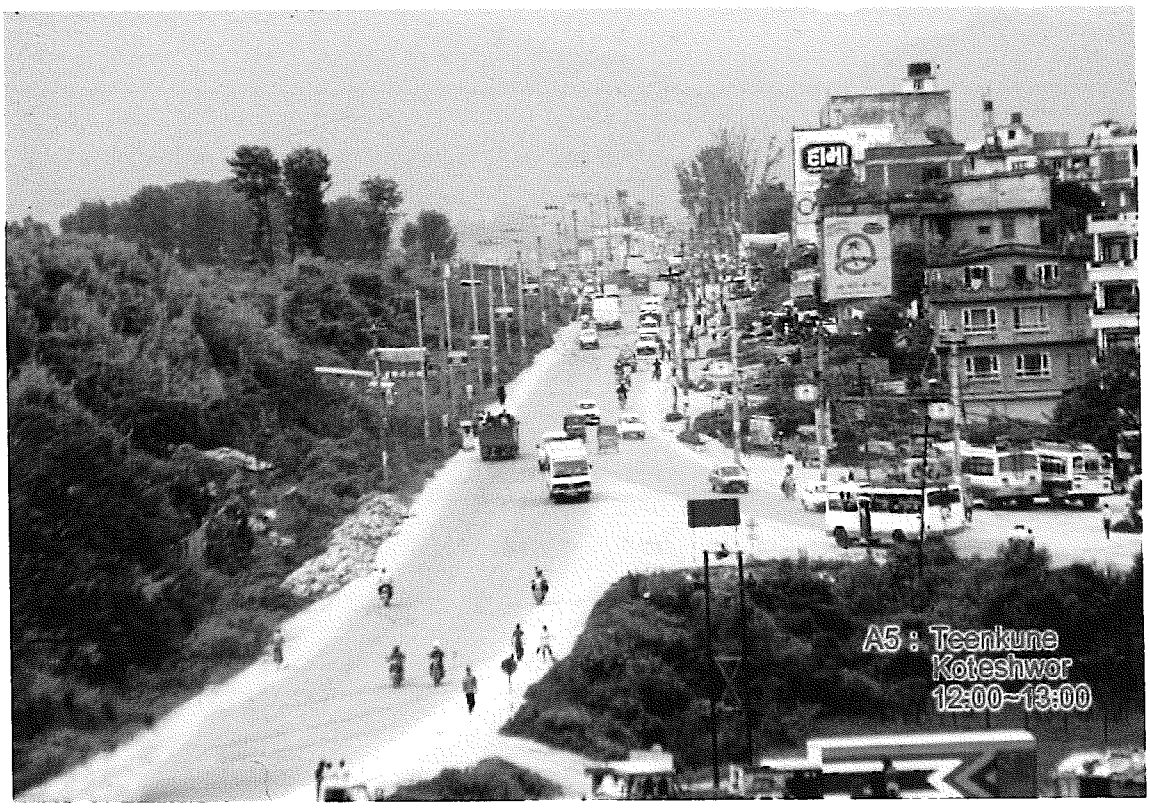
A 2　Maitighar

A 2　Maitighar

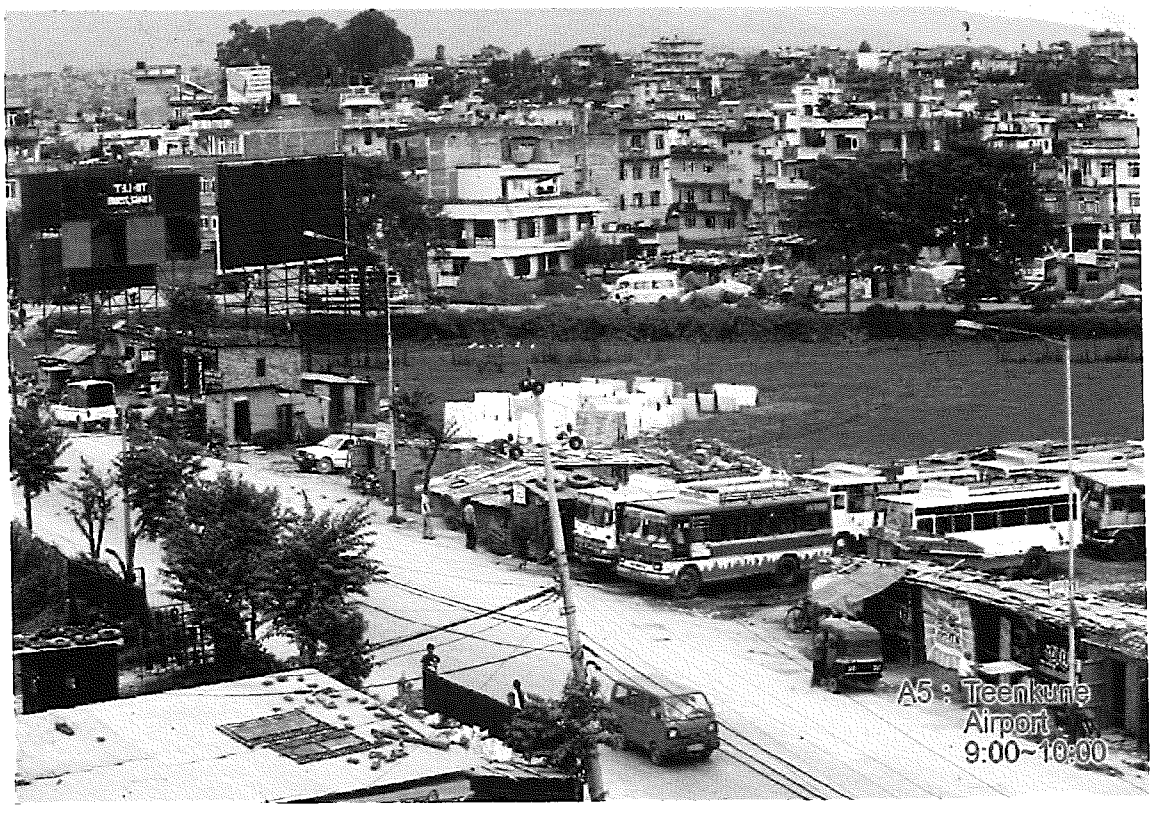
A 4　Koteswor Ring Road



A 4　Koteswor Ring Road

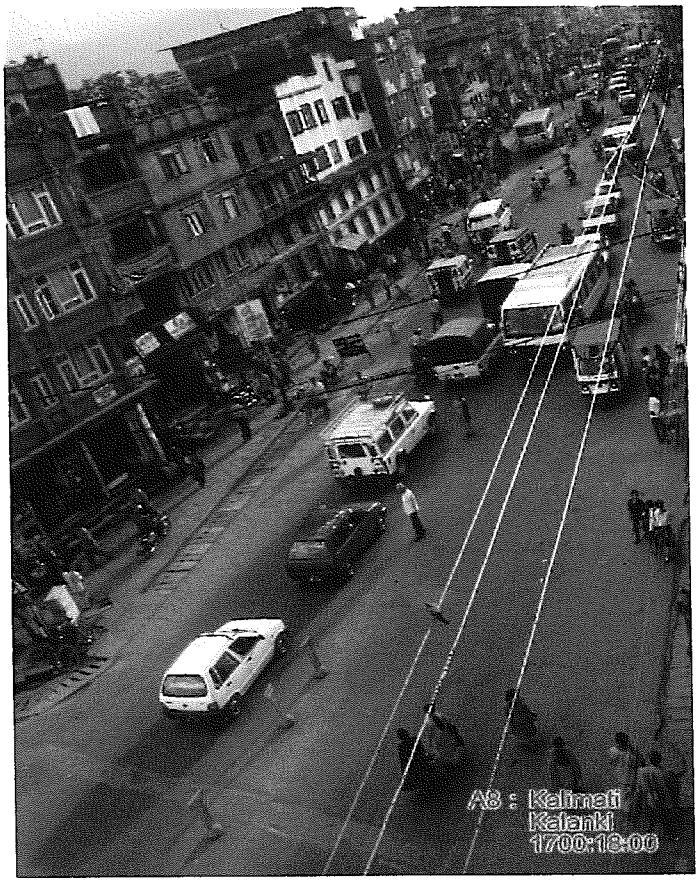


A 5　Koteswor Tinkune

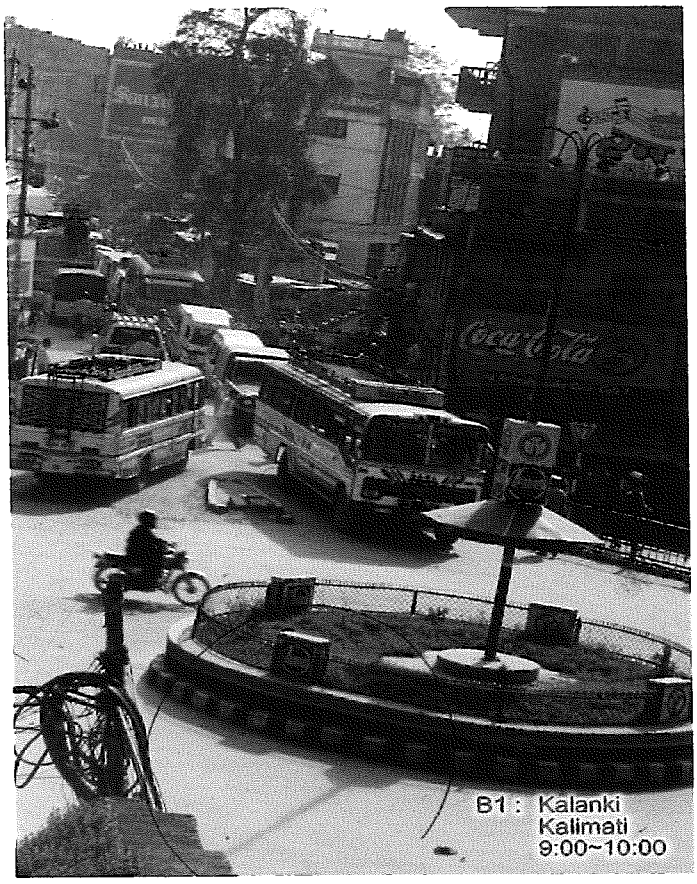


A 5　Koteswor Tinkune

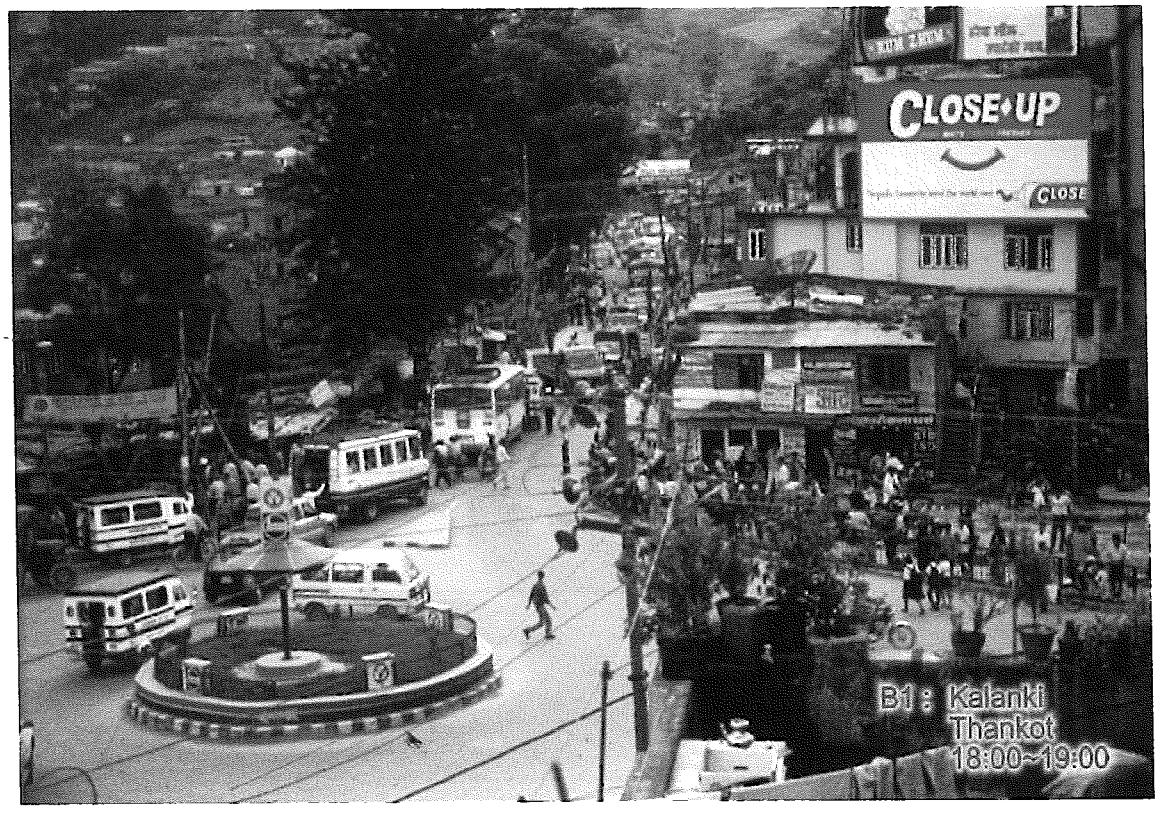
A 8　Kalimati



A 8　Kalimati



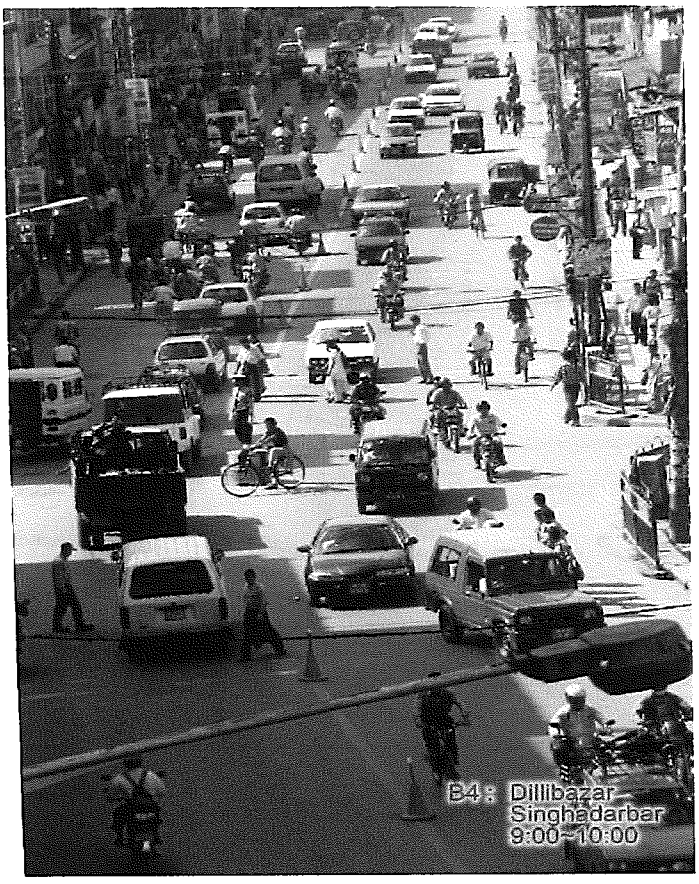
B1　Kalanki-Chowk



B1　Kalanki-Chowk

B 3　Singha Durbar

B 3　Singha Durbar



B 4　Ramshaha Path-DilliBazar

B 4　Ramshaha Path-DilliBazar

B 5　Naya Baneshwar

B 5　Naya Baneshwar

B 9　Padmodaya Turning

B 9　Padmodaya Turning

TABLE OF CONTENTS

FRONTICEPIECE: Location Map
FRONTICEPIECE: Perspective View (3 Sheets)

CHAPTER 1 BACKGROUND OF THE PROJECT ····· 1
CHAPTER 2 CONTENTS OF THE PROJECT ····· 2
2.1 Objectives of the Project ····· 2
2.2 The Basic Concept of the Project ····· 2
2.2.1 Description of the Project ····· 2
2.2.2 Basic Concept of the Improvement Plan ····· 3
2.3 Basic Design ····· 3
2.3.1 Design Policy and Applicable Design Standards ····· 3
2.3.2 Basic Plan ····· 4
(1) Type of Intersection and Pedestrian Crossing Facility ····· 4
(2) Traffic Control Methods and Effect of Improvement Works ····· 7
(3) Intersection Improvement Design ····· 10
2.3.3 Facilities of the Basic Design ····· 18
(1) Summary Sheet of Facilities ····· 18
(2) Contents of the Improvement Works at Each Intersection ····· 20
2.4 Project Implementation Agency ····· 44
2.4.1 Organization ····· 44
2.4.2 Budget ····· 46
2.4.3 Staff and Engineering Competency ····· 46

CHAPTER 3 IMPLEMENTATION PLAN
3.1 Implementation Plan ····· 48
3.1.1 Implementation Concept ····· 48
3.1.2 Implementation Conditions ····· 49
3.1.3 Scope of Work ····· 50
3.1.4 Consulting Services ····· 51
3.1.5 Basic Construction Plan ····· 53
3.1.6 Procurement Plan ····· 54
3.1.7 Implementation Schedule ····· 56
3.1.8 Obligations of Recipient Country ····· 58

3.2 Soft Component Assistance ····· 59
3.2.1 Background Information to Soft Component ····· 59
3.2.2 Purpose of Soft Component ····· 60
3.2.3 Expected Direct Benefit from Soft Component ····· 60
3.2.4 Activities under Soft Component ····· 60
3.2.5 Inputs of Japan's Grant ····· 61

CHAPTER 4 PROJECT EVALUATION AND RECOMMENDATION
4.1 Project Effect ····· 64
4.2 Need for Technical Cooperation ····· 64
4.3 Recommendation ····· 65

APPENDICES

APPENDIX I: Member List
APPENDIC II: Itinerary of Study Team
APPENDIX III: List of Party Concerned in the Recipient Country
APPENDIX IV: Minutes of Discussions dated June, 2000
APPENDIX V: Minutes of Discussions dated October, 2000
APPENDIX VI: Drawings other than Main Report

CHAPTER 1 BACKGROUND OF THE PROJECT

The city of Kathmandu, the capital of Nepal, is located in a valley surrounded by the Himalayas and the Mahabarat mountains, and is the center of economic, political, and industrial activities in Nepal. Recent economic development in the valley has brought benefits as well as negative impacts to the city particularly to the road traffic. The road traffic in Kathmandu valley is suffering from congestion mainly due to rapid increase of population, haphazard urban sprawl, and inadequate urban infrastructures.

Urban traffic condition in the city is deteriorating and congestion of roads and public transport takes place even in the off-peak hours. Especially, the traffic at the intersections and the area in those vicinity are getting serious and hampering daily activities of the citizens. Problems at bottleneck intersections and nearby areas include severe traffic congestion, increasing traffic accidents, emission of substantial amount of exhaust by the vehicles during standstill, degradation of urban amenities, etc.

The Government of Nepal recognized the importance of improvement of traffic conditions in the valley. However, no effective and substantial measures to solve the problems have been initiated yet despite several proposals to resolve the problems that have been prepared in such studies as “Kathmandu Valley Urban Road Development”, conducted by JICA during 1991 to 1993.

In March 1999, the Government of Nepal made a request to the Government of Japan for conducting the intersection improvement in Kathmandu City. The Government of Japan, having made the decision to examine the viability of the requested intersection improvement, entrusted a Basic Design Study to the Japan International Cooperation Agency (JICA).

CHAPTER 2 CONTENTS OF THE PROJECT

2.1 Objectives of the Project

The road traffic in Kathmandu valley is suffering from congestion mainly due to rapid increase of population, haphazard urban sprawl, and inadequate urban infrastructures. Urban traffic condition in the city is deteriorating and congestion of roads and public transport takes place even in the off-peak hours. Problems at bottleneck intersections and nearby areas include severe traffic congestion, increasing traffic accidents, emission of substantial amount of exhaust by the vehicles during standstill, degradation of urban amenities, etc.

The Project aims to upgrade 10 of the most congested intersections. In addition, traffic safety campaign and training a soft component program will be incorporated in parallel to the facility construction.

2.2 The Basic Concept of the Project

2.2.1 Description of the Project

In March 1999, the Government of Nepal requested for an official assistance to the Government of Japan to conduct a basic design study to select and determine intersections that requires immediate improvement among 28 intersections, of which 9 intersections were identified in the Master Plan Study (Kathmandu Valley Urban Road Development) conducted by JICA and 19 intersections (B1 ~ B16 and BB-1 ~ BB-3) additionally requested for improvement. The Government of Japan dispatched a preliminary study team to the site between November to December 1999 to determine 10 intersections that are designated to be improved under the Grant Aid scheme. The ten intersections designated as priority projects are as follows:

Table 2.2.1 Intersections to be improved

ID No.	Location	Intersecting Roads
A1	Kesharmahal	Tridevi road, Kanti road
A2	Maitighar	Thapathali road, Ramshaha road, Arniko road, Bhadrakali road, etc
A4	Koteswor Ring Road	Arniko road, Ring road
A5	Koteswor Tinkune	Arniko road, Ring road, Airport access road
A8	Kalimati	Tribhuvan road, Kuleshwar road, etc

B1	Kalanki-Chowk	Tribhuvan road, Ring road
B3	Singha Durbar	Ramshaha road, Prithvi road
B4	Ramshaha Path-DilliBazar	Ramshaha road, DilliBazar road, BagBazaar road
B5	Naya Baneshwor	Arniko road, Baneswar road, Sankhumal road
B9	Padmodaya Turning	Ramshaha road, Anam Nagar road

2.2.2 The Basic Concept of the Improvement Plan

- The size of the intersection is to be contained within the right-of-way of DOR, and additional land acquisition and resettlement is repressed.
- The design of the intersection is not only aimed to improve the capacity of the traffic but also the safety of the traffic.
- The area (or length) for improvement works for the intersection is limited to those area where it is technically required.
- If the CBR ratio of the existing pavement at the intersection road is found to be sufficient, these area will be improved by overlay works.
- Improvement of the pedestrian path and curbs will be carried out to improve the amenity of the uses as well as to reduce the number of traffic accidents by segregating the pedestrians from the traffic.
- Installation of signals will be provided to improve the traffic capacity and to increase the safety of the pedestrian.
- Bus stop lanes will be provided at existing bus stops to reduce the number of traffic accidents and alleviate traffic congestion.

2.3 Basic Design

2.3.1 Design Policy and Applicable Design Standards

(1) Considerations made for basic design

- The basic design will adhere to each elements of the basic concept of the improvement plan and will be carried out adjusted according to the natural condition, traffic conditions, land usage, etc., of each intersection designated for improvement.
- The limits for the improvement of the intersection is confined within the right-of-way of DOR, and the alignment and roadway width will be set to avoid any additional land acquisition and resettlement.
- Signals for traffic and pedestrians will be set to increase the capacity of the traffic as

3.2 Soft Component Assistance ····· 59
3.2.1 Background Information to Soft Component ····· 59
3.2.2 Purpose of Soft Component ····· 60
3.2.3 Expected Direct Benefit from Soft Component ····· 60
3.2.4 Activities under Soft Component ····· 60
3.2.5 Inputs of Japan's Grant ····· 61

CHAPTER 4 PROJECT EVALUATION AND RECOMMENDATION
4.1 Project Effect ····· 64
4.2 Need for Technical Cooperation ····· 64
4.3 Recommendation ····· 65

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- The area (or length) for improvement works for the intersection is limited to those area where it is technically required.
- If the CBR ratio of the existing pavement at the intersection road is found to be sufficient, these area will be improved by overlay works.
- Improvement of the pedestrian path and curbs will be carried out to improve the amenity of the uses as well as to reduce the number of traffic accidents by segregating the pedestrians from the traffic.
- Installation of signals will be provided to improve the traffic capacity and to increase the safety of the pedestrian.
- Bus stop lanes will be provided at existing bus stops to reduce the number of traffic accidents and alleviate traffic congestion.

2.3 Basic Design

2.3.1 Design Policy and Applicable Design Standards

(1) Considerations made for basic design

- The basic design will adhere to each elements of the basic concept of the improvement plan and will be carried out adjusted according to the natural condition, traffic conditions, land usage, etc., of each intersection designated for improvement.
- The limits for the improvement of the intersection is confined within the right-of-way of DOR, and the alignment and roadway width will be set to avoid any additional land acquisition and resettlement.
- Signals for traffic and pedestrians will be set to increase the capacity of the traffic as

well as to increase the safety of the pedestrians. Road lighting will be planned to improve the safety of the pedestrians during the night.

- Overlay works are planned for those locations where widening of intersections is not required. On the other hand, if widening works are considered to be necessary, the subgrade of the new construction is planned to be improved to prevent the cracking of the pavement at the boundary of the existing and new pavement.
- In order to reduce, alleviate the traffic congestion and for the reduction of traffic accidents, pedestrian paths and curbs will be improved and handrails will be provided segregating pedestrians and the vehicles.
- Bus stopping lanes will be provided at locations where demand by bus users are present to reduce the traffic congestion and traffic accidents.

(2) Applicable Design Standards

The following standards will be applied for the traffic analysis, signal design, traffic sign, and geometrical structural design:

Table 2.3.1 Design Standards to be applied

Road Structure Ordinance – Clarification and Practice	Japan Road Association
Planning and Designing of Intersections (Basics) Revised Edition	Japan Society of Traffic Engineers
Planning and Designing of Intersections (Practice) Revised Edition	Japan Society of Traffic Engineers
Guidelines for Setting Road Marking	Japan Society of Traffic Engineers
Traffic Signs Manual, August 1997	TESU Design Branch, DOR, Ministry of Works & Transport, HMG of Nepal

2.3.2 Basic Plan

(1) Type of Intersection and Pedestrian Crossing Facility

1) Comparative Examination of Intersection Type (Kalanki-Chowk intersection, Koteswor Ring Road intersection)

A rotary type of intersection was requested by the DOR to be examined for application for the design of Kalanki-Chowk intersection, Koteswor Ring Road intersection. As per the request, the Study Team has conducted a comparative analysis between the rotary type and the signal controlled intersection type on the basis of required land and traffic capacity. The Study Team has concluded the examination by recommending the signal controlled type intersection.

The result of the comparative analysis is presented in the following pages.

Table 2.3.2 Comparative Analysis Intersection Type for Kalanki-Chowk Intersection

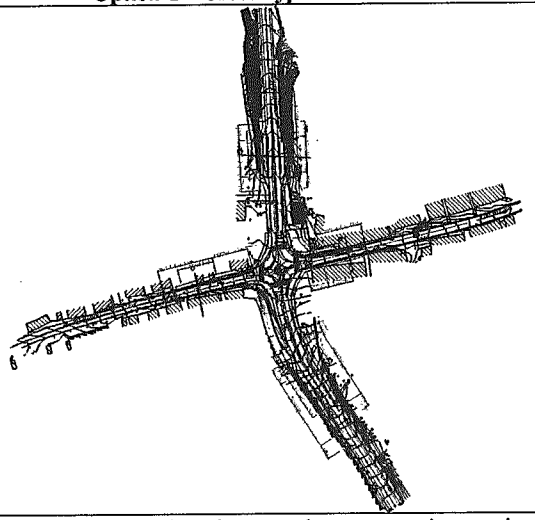
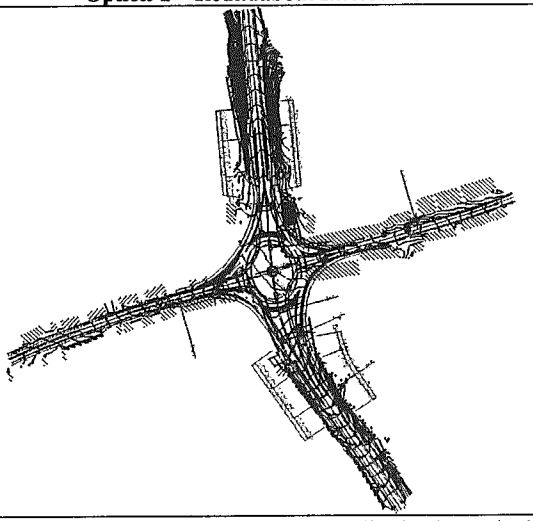
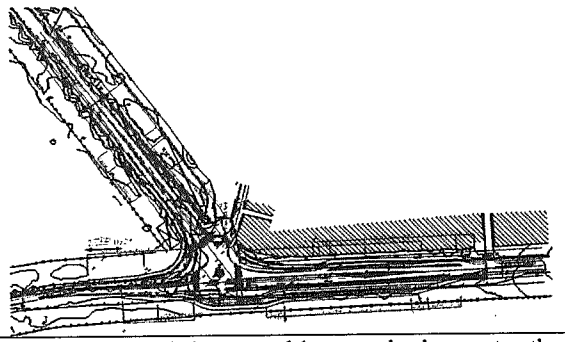
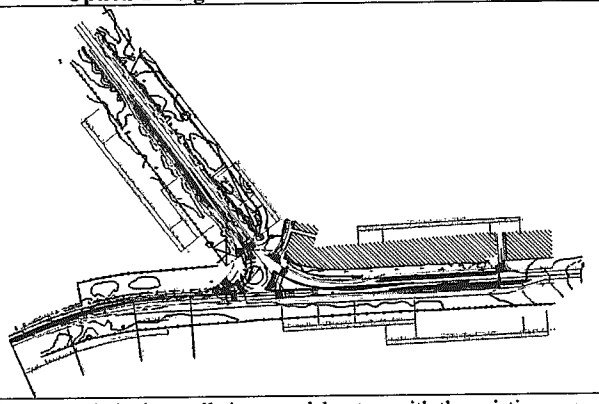
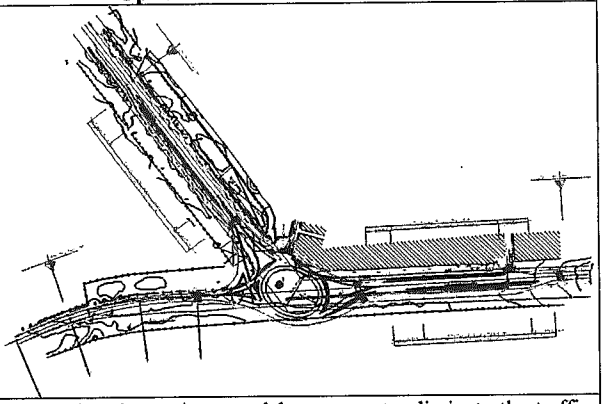
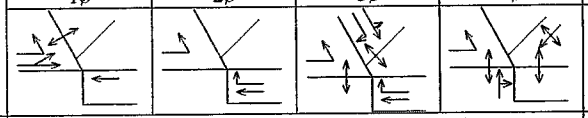
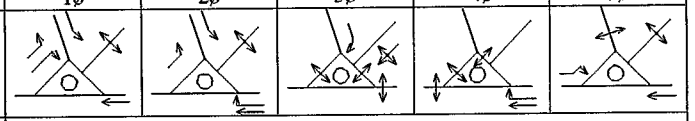
	Option-1 Cross Type Intersections	Option-2 Roundabout Intersection
Plan		
Design Outlin	- Remove the existing roundabout and then change to the cross type intersection.	- Enlarge the size of the roundabout to the extent that no signalization is required.
Saturation Degree	Signal Phase:  (1ø, 2ø, 3ø, 4ø) Cycle Time: Morning Peak: 0.63, Evening Peak: 0.62 Morning Peak: 60 sec., Evening Peak: 70 sec.	
Remarks	1. Saturation degree after improvement will be 0.63 with cycle time of 60 to 70 seconds, and therefore smooth traffic flow will be maintained by signalization. 2. As the auto-rickishow depot is relocated apart from the intersection, traffic congestion being caused by show speed vehicles will decrease. 3. Demolishing of 2 buildings is required.	1. Vehicle travelling time to pass the intersection is much longer than Option-1. 2. Demolishing of 2 buildings is required. 3. The intersection is located on the top of hill, and differential height between the road surface and ground surface beside the road is remarkably large. Therefore, retaining walls and embankment works are required, which increase the construction cost. 4. As all the incoming traffic lanes are single lane, serious traffic congestion will take place even when one direction traffic is saturated.
Evaluation	**Recommended**	

Table 2.3.3 Comparative Analysis Intersection Type for Koteswor-Ring Road Intersection

	Option-1 T Intersection	Option-2 Signalized Roundabout Intersection	Option-3 Roundabout Intersection
Plan			
Design Outline	1. Remove the existing roundabout and change to the T Intersection. 2. Increase the traffic lanes of primary road to augment the traffic capacity of primary traffic flow. 3. Maintain the single phase (4ø) required for trolley bus turning.	1. Apply a relatively small size roundabout as with the existing one. 2. Install traffic signals in addition to the roundabout since the storage length seems to be longer. 3. Locate a bus layby toward the airport side much more than Option-1 in order to facilitate the trolley bus turning in the same zone of the vehicles.	1. Apply a large size roundabout so as to eliminate the traffic signals. 2. Local a bus lay-by toward the airport side much more than Option-1 in order to facilitate the trolley bus turning in the same zone of the vehicles. 3. Apply 30m-radius and 15m-radius in the Ring Road direction and transverse direction respectively. 4. Maintain the major traffics on the Ring Road to pass the outer circumference of the roundabout.
Saturation Degree – Signal Phase	1ø, 2ø, 3ø, 4ø 	1ø, 2ø, 3ø, 4ø, 5ø 	
Saturation Degree – Saturation Degree	Morning Peak: 0.58, Evening Peak: 0.43		
Saturation Degree – Cycle Type	Morning Peak: 140 sec., Evening Peak: 90 sec.		
Remarks	- Saturation degree after improvement will be less than 1.0 in both morning and evening peak hours. - As the intersection area is too large, appropriate traffic lane marking should be provided in order to eliminate indiscriminate traffic movement.	- Saturation degree after improvement will be more than 1.0, and therefore smooth traffic flow will not be achieved unless auxiliary lanes are provided. - As the radius of the roundabout is very small and weaving distance is insufficient, smooth traffic flow control will be very difficult.	- Land acquisition is required. - Smooth traffic flow control seems difficult - As the inflow traffic capacity is same as the present even the size of the roundabout is bigger, it seems difficult to achieve smooth traffic control.
Evaluation	**Recommended**		

2) Selection of Elevated Pedestrian Crossing Facilities

Despite the application of the signal, mounted type elevated pedestrian crossing facilities was not recommended in the preliminary study for Kalanki-Chowk, Naya Baneshwor, and Singha Durbar intersections, an examination and selection of the type applicable for the elevated pedestrian crossing facilities was conducted on the far a signal mounted type. The analysis took into consideration the result of the traffic survey and the number of pedestrians. It was concluded that Kalanki-Chowk, Naya Baneshwor, and Singha Durbar intersections do not require elevated type pedestrian crossing facility and due to the fact that it was revealed that a pedestrian crossing is sufficient for all intersections (degree of saturation is 0.9 or less).

	AM Peak	**PM Peak**
①Kalanki-Chowk	0.59	0.68
②Naya Baneshwor	0.74	0.72
③Singha Durbar	0.75	0.88

(2) Traffic Control Methods and Effect of Improvement Works

1) Selection of Traffic Control Methods

The following aspects were taken into consideration for the selection of traffic control methods and the reason is provided for problems inherent in the signal-less control method.

a) Amenity and safety aspects regarding vehicle maneuver

- Merging of inflow vehicles from minor roadway into major roadway is difficult and dangerous under signal-less control method. (Continuity of major roadway flow)
- Absorption of increase in traffic demand is difficult and is not expected to have effectiveness in easing traffic congestion.

b) Convenience and Safety to Pedestrians

- Under signal-less control method, road crossing of pedestrians is difficult and may induce traffic accidents due to large influx of traffic.

The relation of main and minor roadway traffic volume under signal-less control method is depicted in Figure 2.3.1 superimposed together with the traffic volume data of the intersections subject to Study. The conclusion is that the traffic volume at all intersections exceeds the limit calculated under the condition of stop control method, and adoption of signal control method has been recommended.

Figure 2.3.1 Traffic Volume at Stop Control Intersections

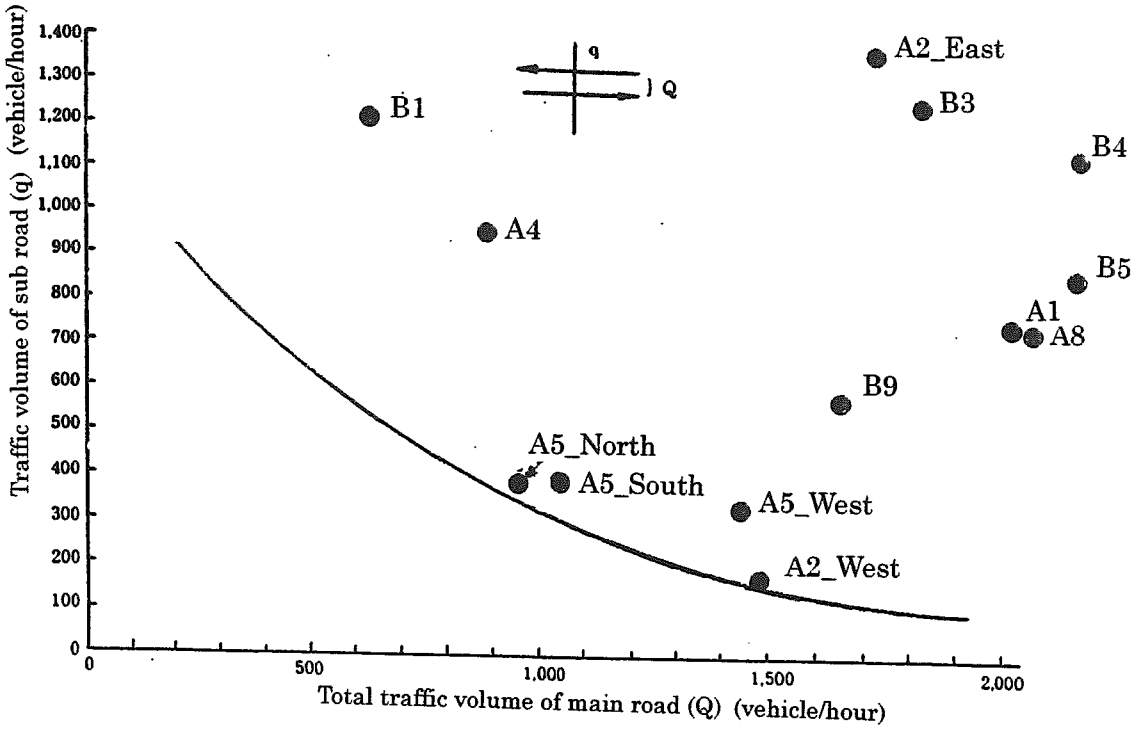


Table 2.3.4 Result of Traffic Count Survey

Intersection	Peak Hour Traffic Volume (Vehicles/hr)			12Hour Traffic (Vehicles/12hrs)
	Morning	Afternoon	Evening	
A1_Kesharmahal	6,383	—	7,435	67,425
A2_Maitighar	8,039	—	9,134	85,463
B3_Singha Durbar	5,400	—	5,902	60,600
B9_Padmodaya Turning	—	5,819	5,891	63,004
B4_Ramshaha Path-Dilli Bazar	5,963	—	5,759	59,776
B5_Naya Baneshwor	6,773	—	5,749	59,035
A8_Kalimati	6,897	—	6,018	66,652
A5_Koteswor Tinkune	3,895	—	4,158	40,195
A4_Koteswor Ring Road	3,122	—	3,661	34,401
B1_Kalanki-Chowk	2,020	—	1,869	25,273

2) Examination of Effectiveness of Intersection Improvement by Signal Control

The level of saturation at the intersections increases in proportion to the sum of minimum duration of green aspect at each signal. Thus, if the level of saturation exceeds 1.0, the intersection is considered to be over saturated and not sufficient to handle the design traffic volume. This translates directly to the deterioration of service level provided at the intersection. The calculation result of the level of saturation at each intersection upon the completion of the improvement works is presented in Table 2.3.5.

Table 2.3.5 Calculation Result of the Level of Saturation at Each Intersection

Intersection	Level of Saturation		
	Morning	Afternoon	Evening
A1_Kesharmahal	0.89	-	0.98
A2_Maitighar North	0.53	-	0.64
ditto East	0.85	-	0.92
ditto West	0.65	-	0.83
B3_Singha Durbar	0.75	-	0.88
B9_Padmodaya Turning North	-	0.77	0.75
ditto South	-	0.76	0.49
B4_Ramshaha Path-DilliBazar	0.64	-	0.63
B5_Naya Baneshwor	0.74	-	0.72
A8_Kalimati East	0.61	-	0.61
ditto West	0.64	-	0.68
A5_Koteswor Tinkune North	0.39	-	0.54
ditto South	0.55	-	0.75
ditto West	0.46	-	0.58
A4_Koteswor Ring Road	0.66	-	0.92
B1_Kalanki-Chowk	0.59	-	0.68

(3) Intersection Improvement Design

1) Design Conditions

In principle, the design speed of the roads subject to the Study is set at 60km/hr for the Ring Road, 50km/hr at trunk roads, and 30km/hr at subsidiary roads, following the same condition of the existing roads. However the design speed at the intersections is planned to be reduced by 10 to 20 km/hr, as per page 130 of the “Road Structure Ordinance”, considering the safety and the traffic volume. As per the basic policy, the utilization of the existing roads will be maximized and is set to be at least 2.75 meters. As a principle, the lane width for direct, direct and left-turn, and left turn is set at least 3.0 meters.

The design condition was set for major roadway and minor roadway at each intersection. The summary table for the design conditions is presented in the following page.

Table 2.3.6 Summary Table of Design Conditions

IDNo.	Intersection	Crossing Roads	Design Speed	Number of Lanes		Lane Width(m)		Pedest-rian Path	Bus Stop	Signal	Remark
				Existing	Plan	Major	Right Turn Lane				
A1	Kesharmahal(Cross intersection)	Kanti Road (Major)	V=50km/h (30km/h)	2	4	3.00	2.75 (South side only)	○	—	○	Remove rotary.
		Tridevi Road (Minor)	V=50km/h (30km/h)	2	2	3.00	—	○	—	○	Improve existing rotary.
A2	Maitighar(Rotary)	Ram Shah Road (Major)	V=50km/h (30km/h)	4	4	3.00	—	○	—	○	Reduce size of existing rotary.
		Airport Road (Major)	V=50km/h (40km/h)	4	4	3.00	—	○	—	○	
		Bhadrakali Road (Minor)	V=30km/h (20km/h)	2	2	2.75	—	—	—	○	
		Singha Durbar Circular Artery (Minor)	V=30km/h (20km/h)	2	2	3.00	2.75	—	—	○	
B3	Singha Durbar(Cross Intersection)	Ram Shah Road (Major)	V=50km/h (30km/h)	4	4	3.00	2.75	○	—	○	
		Prithvi Road (major)	V=50km/h (30km/h)	4	4	3.00	2.75	○	—	○	
		Access to Singha Durbar Road (Minor)	V=30km/h (20km/h)	2	2	5.50	—	○	—	○	
B9	Padmodaya Turning(Crank)	Ram Shah Road (major)	V=50km/h (30km/h)	4	4	3.00	—	○	—	○	
		Bhrikutimandap Road (minor)	V=50km/h (30km/h)	2	2	3.00	2.75	○	—	○	
		Singha Durbar Circular Artery (minor)	V=30km/h (20km/h)	2	2	3.00	2.75	○	—	○	
B4	Ramshaha Path-DilliBazar(Cross Intersection)	Ram Shah Road (major)	V=50km/h (30km/h)	1 direction 4	4	3.00	—	○	—	○	
		Dilli Bazaar Road (minor)	V=30km/h (20km/h)	1 direction 2	2	2.75	—	○	—	○	
		Bagh Bazaar Road (minor)	V=30km/h (20km/h)	2	2	2.75	—	○	—	○	
B5	Naya Baneshwor(Cross Intersection)	Airport Road (major)	V=50km/h (30km/h)	4	4	3.00	2.75	○	○	○	Provide parking lot.
		Baneswar Road (minor)	V=50km/h (30km/h)	4	2	3.00	2.75	○	—	○	
		Sankhumal Road (minor)	V=30km/h (20km/h)	1	2	3.00	—	○	—	○	
A8	Kalimati(Crank)	Tripureshwar Road (major)	V=50km/h (30km/h)	4	4	3.00	—	○	—	○	Remove rotary.
		Kuleshwar Road (minor)	V=50km/h (30km/h)	4	4	3.00	—	○	○	○	
		Hyumat Road (minor)	V=30km/h (20km/h)	2	2	3.00	2.75	○	—	○	
A5	Koteswor Tinkune(Y-type Intersection 3nos)	Arniko Road (major)	V=50km/h (30km/h)	2	2	3.00	2.75	○	—	○	Widening of Arniko Road as 2 lane standard.
		Ring Road (major ～minor)	V=60km/h (40km/h)	2	2	3.00	3.00	○	—	○	
		Airport Road (minor)	V=50km/h (30km/h)	2	2	3.00	2.75	○	—	○	
A4	Koteswor Ring Roadring(T Intersection)	Ring Road (major)	V=60km/h (40km/h)	2	2	3.25	3.00	○	○	○	Removal of rotary.
		Arniko Road (major)	V=60km/h (40km/h)	2	2	3.00	—	○	○	○	
		Koteswor Road (minor)	V=30km/h (20km/h)	2	2	3.00	—	○	○	○	
B1	Kalanki-Chowk(Cross Intersection)	Ring Road (major)	V=60km/h (40km/h)	2	2	3.25	3.00	○	○	○	Removal of rotary. Provide parking lot.
		Tribhuvan Road (minor)	V=60km/h (40km/h)	2	2	3.00	2.75	○	—	○	
		Tripureshwar Road (minor)	V=50km/h (30km/h)	2	2	3.00	2.75	○	—	○	

Remarks：Figures in brackets will be applied for the design of the intersections.

2) Area for Intersection Improvement

The area for the improvement works will be determined by one of the following three, whichever becomes the greater.

① Length of right turn lane is limited to the sum of storage length, deceleration length, and the main line shift length.

② If the sum of above is extended due to provision of a bus stop, the limit is up to the beginning point of the taper.

③ For areas not having a right turn, the limit is the distance from the halt line to the sight distance and the visibility distance stipulated in Clause 5.3.3 of the Road Structure Ordinance (page 319 to 320).

i) If the design speed at the intersection is 30 km/hr,

$L = Vt / 3.6 + (1/2\ \alpha)(V/3.6)^2 = 50.0$ meters

ii) If the design speed at the intersection is 30 km/hr,

$L = Vt / 3.6 + (1/2\ \alpha)(V/3.6)^2 = 35.0$ meters,

Where,

V: Design speed at the intersection (Km/hr)

t : Total response time after visualizing the signal, 6 seconds (urban condition)

α : Deceleration (m/s^2) disregarded.

3) Auxiliary Road Facilities

a) Auxiliary Road Facilities (Drainage facility, bus stops)

① Drainage facility

In this Study, the road surface is set as the design catchment area required for the design of the drainage facility. The site survey concluded that the improvement works for the drainage facility is recommended to be carried out on all area subject to the design.

Also, the site survey concluded that the adjacent existing catch basin and trench is adequate for the discharge of the drainage. Since the existing Koteswor Tinkune intersection has a concave formation, an apron consisting of a gabion mat is designed to be set in the center of the intersection to function as an outlet for the surface water.

i) Structural type of drainage

The majority of existing drainage on the roadside is currently filled with litter due to inflow of household waste. To alleviate these problems and considering the damage of the lids, the improved design for the drainage is conceived to be an L type or a LO type.

An L type drainage is conceived to be applied for improved drainage if the existing drainage is not a U type or a LU type. An LO type drainage is conceived to be applied for others.

ii) Setting distance of catch basins

As a principle, catch basins are designed to be set at 20 meter intervals.

② Bus Stop

Existing bus stops at Maitighar, Naya Baneshwor, Koteswor Ring Road, and B1 Kalanki-Chowk intersections is planned to be improved. In principle, the location for the improved bus stop is planned to be set adjacent to the existing bus stop, and is planned to be at least 30 meters away from the intersection to avoid the traffic flow. In principle, the size of the bus stop is determined from the following values:

1. bus traffic volume confirmed from the traffic count survey , and
2. time required per bus at each stop, which is calculated from the time required per passenger for boarding/disembarking at each stop

b) Traffic Safety Facility (traffic sign, channelizing island, road marking, hand rail, signal, lighting facilities)

① Traffic sign

In accordance to the existing traffic sign in place, the design of the new traffic signs will conform to the “Traffic Signal Manual – HMGN - August 1997” and relevant traffic rules set by the Government of Nepal.

② Channelizing island

The design of channelizing island and road marking will conform to the “Guidelines for Setting Road Marking” established by the Japan Society of Traffic Engineers.

A bicycle lane was conceived in the design at Kesharmahal

Intersection which is expected to absorb the rent-a-cycle traffic flow from Thamel area towards the street on the west-side of the Royal Palace.

③ Handrail

Handrails were provided at each intersections along the boundaries between the pedestrian path and the vehicle traffic to prevent uncontrolled crossing and to increase the safety of the pedestrians.

④ Pedestrian signals/lighting

Pedestrian signals will be provided at cross walk of each intersection to safely guide the pedestrians. Road lighting facilities will be installed to improve the visibility of the pedestrians for the drivers at night.

4) Pavement Design

a) Design of Asphalt Pavement Structure

The overlay thickness for the existing roads and the areas subject to improvement will conform to the stipulations set in the "Manual for Asphalt Pavement – June 1998" published by Japan Road Association. The planned traffic volume is calculated under the assumption of a 10 year design period with a converted wheel number (wheel per direction) of 50,000 tons. The design CBR value at each intersections was determined by calibrating the in-situ CBR value (by k=0.6), obtained by the penetration test using the TRL dynamic cone penetrometer. The design CBR of the subgrade is determined as per the Manual for Asphalt Pavement table. (Please refer to Table 2.3.6 Study Result of Subbase).

The design thickness of the overlay for the existing road will be determined by incorporating the measured data of the existing pavement structure of two test pits at each intersection as well as conforming to the structure design and repair design stipulations, as is covered in the "Manual for Asphalt Pavement". In principle, overlay is planned on existing roads except for areas where catch basins are newly installed at the shoulders of the road, and where widening is planned for addition of lanes.

The pavement thickness is determined by careful examination and evaluation of the existing pavement and deducing the "residual equivalent thickness of the existing pavement (T_{A0})", while the thickness of the overlay is determined by deducing the "target equivalent thickness of the existing

pavement (T_A). The required "overlay thickness (t)" can be calculated by subtracting T_{A0} from $T_{A.}$

Table 2.3.7 Study Result of Subbase

Intersection	CBRValue		
	Examination Point 1	Examination Point 2	Examination Point 3
A1_Kesharmahal	4	3(4)	—
A2_Maitighar	4	2(3)	—
B3_Singha Durbar	2	2	6(8)
B9_Padmodaya Turning	3	4	—
B4_Ramshaha Path-DilliBazar	3	2	—
B5_Naya Baneshwor	4	4	—
A8_Kalimati	4	8	4
A5_Koteswor Tinkune	8	8	6
A4_Koteswor Ring Road	2(6)	4	6
B1_Kalanki-Chowk	2(6)	2(6)	—

b) Design of the Cement Concrete Pavement Structure at the Bus Stop

Bus stops are located at Maitighar, Naya Baneshwor, Koteswor Ring Road, and Kalanki-Chowk intersections. The bus stop at Maitighar and Naya Baneshwor intersection are cement concrete structure. The Study Team recommends the cement concrete pavement at bus stop locations since it is effective in resisting oil erosion. Since all bus stops are designated to be relocated due to the intersection improvement works, all existing pavement at the bus stops will be reconstructed. The design of the cement concrete pavement will conform to the stipulations given in the "Manual for Cement Concrete Pavement – February 1984" established by the Japan Road Association.

c) Pavement Design of the Pedestrian Path

The design of the pedestrian path will conform to "Manual for Asphalt Pavement – June 1998" established by the Japan Road Association, and as well as to "Manual for Interlocking Block Pavement Design and Construction – July 2000" established by the Interlocking Block Pavement Technical Association of Japan. Since it was confirmed that interlocking blocks are manufactured in Kathmandu Valley and that there are several experiences in the past of actually constructing pedestrian path using interlocking blocks, it is recommended to apply this pavement type in this Project. However, due to economical and construction reasons, the

pedestrian path at Koteswor Tinkune intersection (west, south, and north intersection) is recommended to be a flat type path and asphalt concrete pavement be applied.

5) Signalling system

Taking into consideration the existing traffic conditions of the Study area and the maintenance capacity of the Nepalese road authority, the policy for selecting the traffic control method of the intersections and the signal system is set as follows:

a) All 10 intersections subject to this Study are recommended to be equipped with signals. The site survey concluded that all 10 intersections would not function without signals.

b) The signal lamp is recommended to be a light emitting diode (LED) type. The maintenance is much easier and the power consumption is lower compared to the bulb type. (Please refer to Table 2.3.7)

c) Considering the current power supply conditions and the traffic demand, solar panel is recommended to be installed for those locations that satisfy the following three conditions:

Number of black-outs: Once in three days on average.

Number of power cables available: Less than two cables.

Traffic demand: Traffic volume more than 30,000 vehicles per 12 hour period (the traffic volume at Koteswor Tinkune intersection is counted as one-third of the raw data since it comprises three smaller intersections)

d) An offset is recommended to be provided for the four intersections between Ramshaha Path-DilliBazar to Maitighar and be link-controlled. The maximum distance between the intersections being approximately 500 meters apart, relatively a short distance, a link-controlled signalling system is recommended to be applied to avoid unnecessary stalling of the traffic flow.

e) A large capacity condenser is recommended to be installed to prevent sudden black-out of the signal in the event of disruption to the power supply and also prevent confusion during the event. The provision of a large capacity condenser would provide temporary power to the signals in the event of power cut until the signals are supplied with auxiliary power.

Table 2.3.8 Comparison of Specifications of LED Lamp and Bulb Lamp

	LED Lamp	Bulb Lamp
Power Supply (per lamp)	・20 W	・100 W
Visibility	・No delusion under back light conditions (※1) ・A sharp contrast between on and off.	・Delusive under back light conditions ・No sharp condition
Average life	・20 years ・Minimal effect to life due to flashing control. (※2)	・4000 hours ・Flashing control shortens the life of the bulb.
Lamp replacement	・Unnecessary	・Annual full replacement ・28 units / standard intersection 10 intersections x 20 years = 5600 units/life ・High platform works are dangerous
Conditions during lamp failure	・The lamp comprised of numerous LEDs, the lamp could still function as a signal.	・Complete lamp failure. (Regular full replacements are carried out for all bulbs prior to average life.)
Utilization in Japan	・Used at more than 10 locations and is increasing.	・Used across the nation
Cost of signal (Ratio) [Sum of material + direct construction cost + transportation cost for a typical intersection]	・Yen 21,170,000 (1.3)	・Yen 16,230,000 (1.0)
Total maintenance cost for 20 years for a typical intersection	Power cost Yen 391,000 Total Yen 391,000 (Annual maintenance cost) Yen 20,000	Bulb Yen 420,000 Replacement cost Yen 210,000 Power cost Yen 1,642,000 Total Yen 2,272,000 (Annual maintenance cost) Yen 113,000
Total Cost (Ratio)	Yen 21,561,000 (1.17)	Yen 18,502,000 (1.0)

(※1)Delusion: When the signal lamp is exposed to sunlight, such as low angle sunset rays, the lamp occasionally seem to be lit on despite it is not.

(※2)Flashing control: Blinking operation of the signal during night. Yellow blink (to slow down) and red blink (to stop before the signal)

2.3.3 Facilities of the Basic Design

(1) Summary sheet of the facilities

Table 2.3.8 presents the contents of the facilities for the intersection improvement works.

Table 2.3.8 Summary Sheet of Facilities of the Intersection Improvement Works

Items \ Intersection	A1	A2	B3	B9	B4	B5	A8	A5	A4	B1
	Keshamahal	Maitighar	Singha Durbar	Padmodaya Turning	Rameshaha Path – Dilli Bazar	Naya Baneshwar	Kalimati	Koteshwar – Tinkune	Koteshwar – Ring Rd	Kalanki Chowk
Proposed Intersection Type	Cross	Roundabout	Cross	a @ Y-Type (Fork)	Cross	Cross	2 @ Y-Type (Fork)	Y-Type (Fork)	Y-Type (Fork)	Cross
Future Use of the Present Roundabout	Remove	Maintain	Reduce the size of roundabout	NA	NA	NA	Relocate the statue	NA	Remove	Remove
Carriageway Width	Widen the Kanti Path on the southern side	Same as present	Enlarge	Same as present	Same as present	Enlarge	Same as present	Widen the Arniko Highway.	Enlarge	Enlarge
Pavement	Reconstruct and overlay	Overlay	Reconstruct and overlay	Overlay	Overlay	Overlay	Overlay	Reconstruct and overlay	Reconstruct and overlay	Reconstruct and overlay
Side Ditchs and Cross Drainage	Reconstruct	Reconstruct	Reconstruct	Reconstruct	Reconstruct	Reconstruct	Reconstruct	Reconstruct	Reconstruct	Reconstruct
Sidewalk Type (Necesity of icycle lane)	Mound-up (needed)	Mound-up (not needed)	Mound-up (not needed)	Mound-up (not needed)	Mound-up (not needed)	Mound-up (not needed)	Mound-up (not needed)	Flat (not needed)	Mound-up (not needed)	Mound-up (not needed)
Curbs and Pedestrian Paths	Curbs and Tilling	Curbs and Tilling	Curbs and Tilling	Curbs and Tilling	Curbs and Tilling	Curbs and Tilling	Curbs and Tilling	Curbs and Pavement	Curbs and Tilling	Curbs and Tilling
Handrails along Pedestrian Paths	Reconstruct	Reconstruct	Reconstruct	Reconstruct	Reconstruct	Reconstruct	Reconstruct	Nil	Reconstruct	Reconstruct
Signals	Replace by new signals	Install	Replace by new signals	Replace by new signals	Replace by new signals	Install	Install	Install	Install	Install
Road Lighting	Replace by new lighting.	Reuse	Replace by new lighting.	Reuse	Reuse	Reuse	Reuse	Install	Install	Install
Necessity of Flag Pole	Reuse	Reuse	Reuse	Reuse	Not required	Ruse	Reuse	Reuse	Not required	Not required
Pedestrian Crossings	Zebra Type	Zebra Type	Zebra Type	Zebra Type	Zebra Type	Scrambled Type	Zebra Type	Zebra Type	Zebra Type	Zebra Type
Provision of Lay-by for Buses	Not required	Not required	Not required	Not required	Not required	Not required	Required	Not required	Required	Required
Land Acquisition and Resettlement	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	No land acquisition is required but resettlement of encroachment would have to be solved.	At least 2 houses would have to be acquired. And resettlement of encroachment should be settled.
Others						Parking lot is required.				

(2) Contents of the Improvement Works at Each Intersection

i) A1 Kesharmahal Intersection

The intersection is located in front of the Royal Palace and is roundabout type with four legs (cross type). Since the intersection is located at the entrance of the Tamel district the intersection is of significant importance. The existing intersection is equipped with out-of-date type of signals which have limited function and requires the assistance and guidance of a traffic policeman to expedite the traffic flow.

Currently, the degree of saturation at peak hours exceeds 1.0. The Study Team's observation has confirmed three to four stalls of the traffic during the peak hours at the rotary. The Study Team believes that the effect of this phenomenon is one of the major cause of the congestion. The Team also sees the diameter of the rotary (approximately 17.5 meters) being too small and is another cause for the congestion. Right turning and left turning vehicles circulating the rotary cross each other and intersecting lane changing vehicles also are believed to be the cause of the jam.

The following are recommended improvements to be made.

a) Remove the rotary, and remove the old signals and replace them with LED type signals.

b) Construct a new right turning lane to the Tridevi Road which is currently an opposing double lane road having, a width of 10.5 meters. If we construct a right turning lane on the four lane Kanti Street at the north of the intersection, additional land needs to be acquired from the Royal Palace. Thus, it is recommended to modify all lanes into a combined right turning lane and direct through lane, and shrink the width of the pedestrian path at the southern side of the intersection approximately 40 centimeter to make room for the new right turning lane.

c) Introduce a new bicycle lane inside the pedestrian path along the Tridevi road.

d) Provisions of signals and road marking to guide the large number of pedestrians.

e) In principle, the pavement improvement works will be planned as overlay works, and pedestrian paths will be provided.

f) Provide drainage facilities.

g) Remove all existing signals and replace them with LED type signals

for vehicles and for pedestrian. Solar panel will be fixed to signal poles to allow the signal system to operate on dual system, i.e., solar and existing low voltage power supply.

h) Replacement of road lighting will be limited to area where civil works are carried out. Existing lighting will be removed and replaced with new one.

KESHAR MAHAL - INTER SECTION

A1

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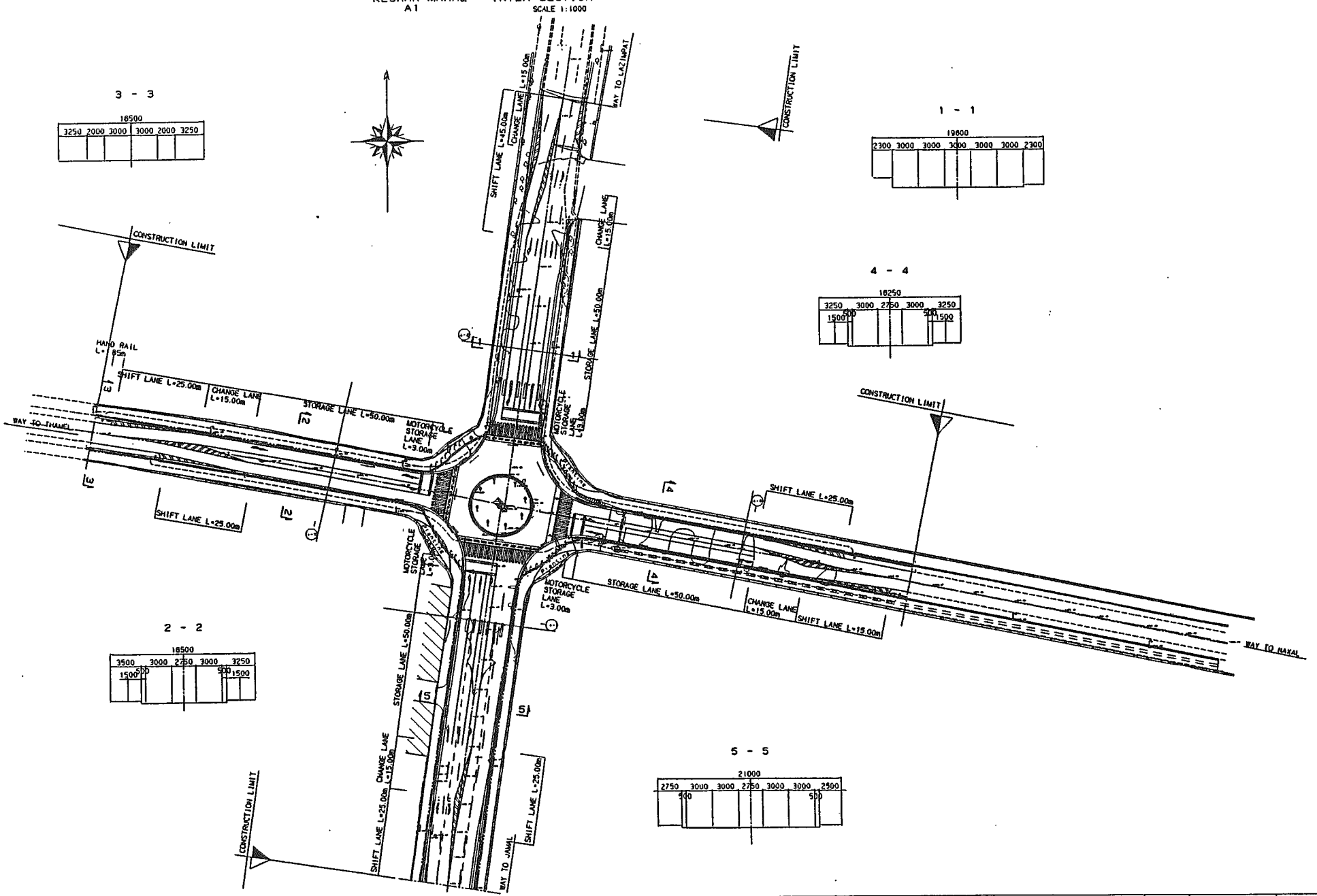


THE KINGDOM OF NEPAL MINISTRY OF PHYSICAL PLANNING AND WORKS	BASIC DESIGN STUDY ON THE PROJECT FOR IMPROVEMENT OF INTERSECTIONS IN KATHMANDU CITY IN THE KINGDOM OF NEPAL	JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE	SCALE	DATE	SHEET NO.
			A1:KESHAR MAHAL INTER SECTION	1:1000	DEC.2000	

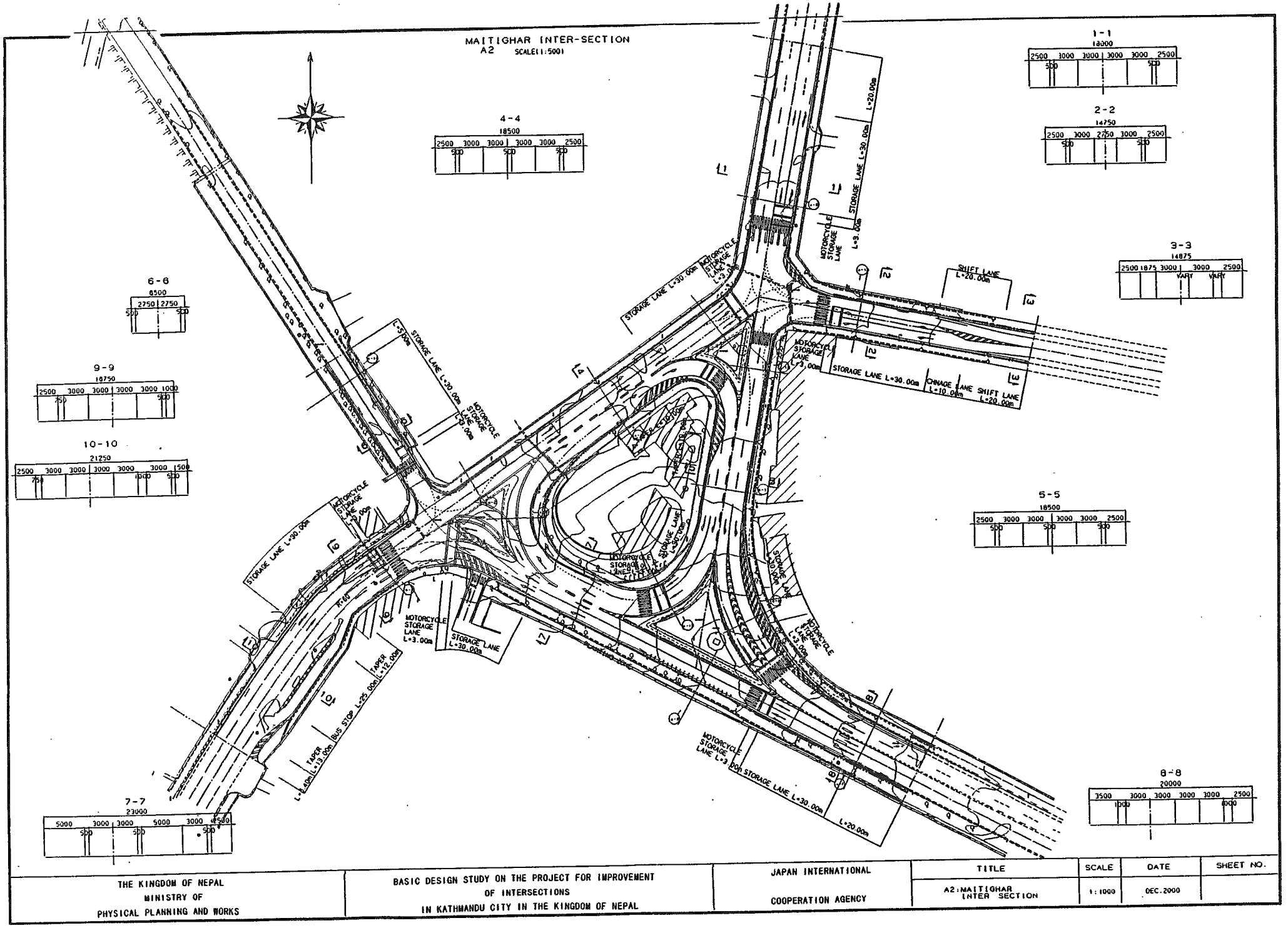
ii) A2 Maitighar Intersection

The intersection can be categorized as a large triangular shaped rotary type intersection. The traffic flow is complex due to three weaving points, its unique shape, and the large traffic flow.

Currently, there are no signals and the chronically congested traffic is expedited by the traffic police. The intersection is located adjacent to Thapathali intersection. In the morning peak hours vehicles traffic from Thapathali intersection, B-5 Naya Baneshwor intersection, and B-3 Singha Durbar intersection flow into this intersection creating severe congestion.

Recommendations for improvement are presented below.

a) Installation of signals based on the traffic analysis. Installation of signals at each intersections and, if necessary, installation of supplementary signals before weavings.
b) Arrangement of coordinated control signals at A2 Maitighar intersection with the B-3 Singha Durbar intersection located 450 meters north.
c) Provisions of signals and road marking to guide the large number of pedestrians.
d) Improvement of the road width of the rotary.
e) In principle, the pavement improvement works will be planned as overlay works, and pedestrian paths will be provided.
f) Provide drainage facilities. Provision of outlet facilities for locations where inundation occurs during rainfall.
g) Remove all existing signals and replace them with LED type signals for vehicles and for pedestrian.
h) Replacement of road lighting will be limited to area where civil works are carried out. Existing lighting will be removed and replaced with new one.



THE KINGDOM OF NEPAL MINISTRY OF PHYSICAL PLANNING AND WORKS	BASIC DESIGN STUDY ON THE PROJECT FOR IMPROVEMENT OF INTERSECTIONS IN KATHMANDU CITY IN THE KINGDOM OF NEPAL	JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE	SCALE	DATE / SHEET NO.
			A2:MAITIGHAR INTER SECTION	1:1000	DEC.2000

iii) B3 Singha Durbar Intersection

The intersection is situated in the neighborhood of government offices and former resident building of the Prime Minister. The intersection has a right angle configuration of four legs and is equipped with out-of-date signals. A statue dedicated to Prithivi Narayan, the founder of Nepal, stands in the center of the small rotary (approximate diameter of 6.0 meters). At present, signals and traffic police manage the traffic of the intersection.

The existing configuration of the intersection is arranged for vehicles heading north from Maitighar intersection to head towards Bhadrakali intersection by a fully-access controlled left-turn lane, and the other lane as a straight through lane heading towards the Royal Palace. It was observed that the left turning lane traffic on weekdays is relatively smooth, however, 15 to 20 vehicles on the straight through lane heading towards the north were stalled at the red light.

On the other hand, for the traffic from Bhadrakali intersection, one lane is dedicated for right-turn lane towards Maitighar intersection, and the other lane dedicated for left-turn traffic heading the Royal Palace. It was observed that the left-turn traffic was smooth but 15 to 20 vehicles were stalled on weekdays for the right-turn lane.

The traffic lane within the rotary is a bottleneck for the south bound traffic (towards Maitighar intersection) from the Royal Palace and the west bound traffic (towards Bhadrakali intersection). Inflow traffic from Bhadrakali intersection also interfere with the traffic and amplify the congestion.

Recommendations for improvement are presented below.

a) Provision of right-turn lane for each traffic lane and replace all out-of-date signals.
b) Arrangement of two lanes, each 3.0 meters wide, for the south bound traffic towards Maitighar intersection from the Royal Palace. For this configuration, additional land is required on the Prime Ministry Office side, however, DOR has confirmed that the acquisition can be arranged.
c) Reduction of the diameter of the rotary to 3.0 meters. No relocation of the statue.
d) A-2 Maitighar intersection, B-3 Singha Durbar intersection, B-9 Padmodaya Turning intersection, and B-4 Ramshaha Path-DilliBazar intersection are continuous intersections along Ram Shah Street. Since Ram Shah Street has a heavy traffic and since the distance between

intersections are short, the improvement works will be planned in a manner have conformity. All four intersections mentioned above are recommended to have coordinated control to improve the efficiency of the traffic flow.

e) Provisions of signals and road marking to guide the large number of pedestrians.

f) In principle, the pavement improvement works will be planned as overlay works, and pedestrian paths will be provided.

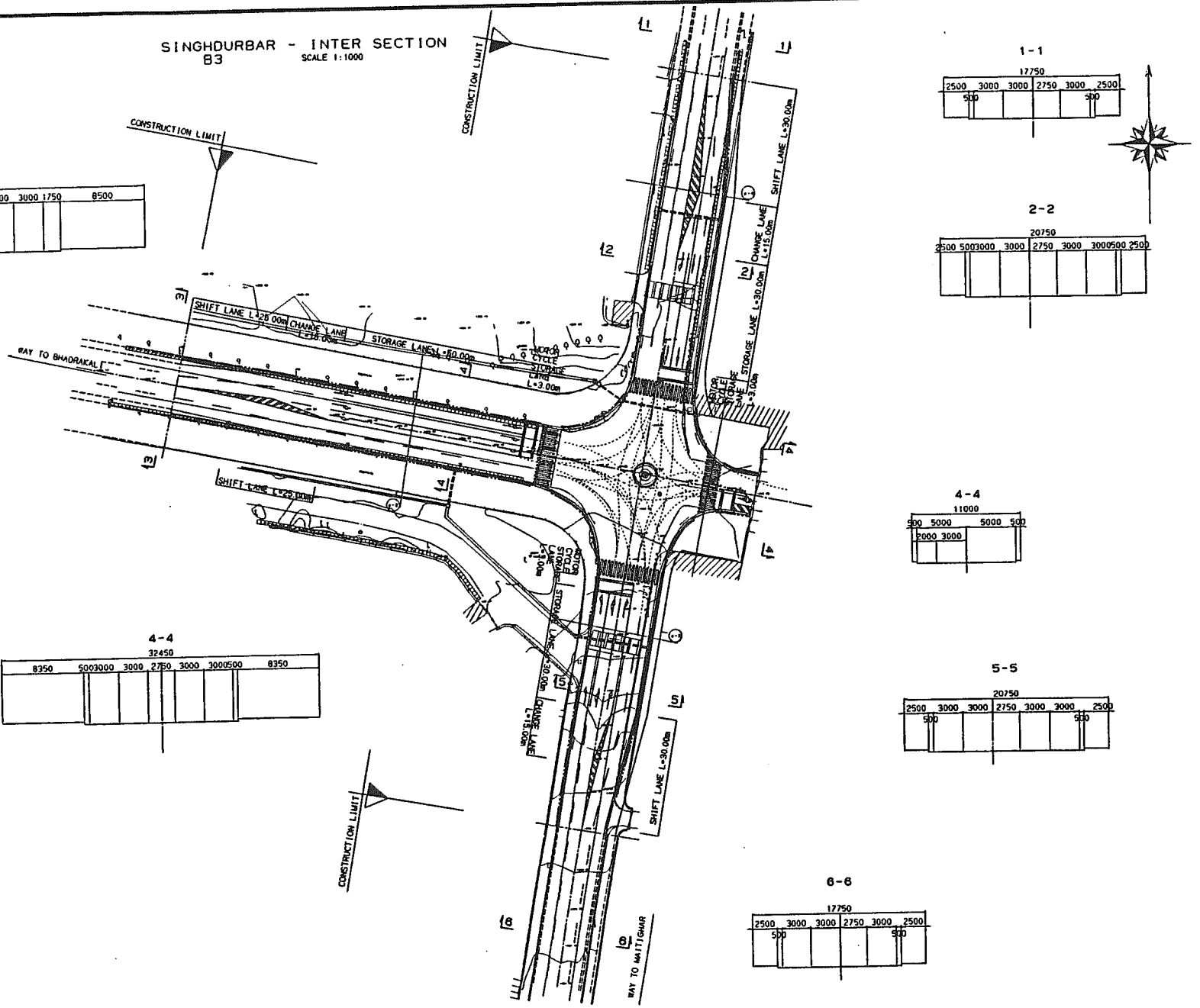
g) Provide drainage facilities.

h) Remove all existing signals and replace them with LED type signals for vehicles and for pedestrian. Provision of offsets at each intersections from Maitighar intersection to Ramshaha Path-DilliBazar intersection of Ram Shah Street and introduce a cable link control. Solar panel will be fixed to signal poles to allow the signal system to operate on dual system, i.e., solar and existing low voltage power supply.

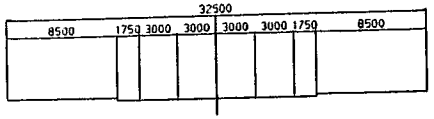
i) Replacement of road lighting will be limited to area where civil works are carried out. Existing lighting will be removed and replaced with new one.

SINGHDURBAR - INTER SECTION
83

SCALE 1:1000



3-3



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4-4

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THE KINGDOM OF NEPAL MINISTRY OF PHYSICAL PLANNING AND WORKS	BASIC DESIGN STUDY ON THE PROJECT FOR IMPROVEMENT OF INTERSECTIONS IN KATHMANDU CITY IN THE KINGDOM OF NEPAL	JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE	SCALE	DATE / SHEET NO.
			83:SINGHDURBAR INTER SECTION	1:1000	DEC.2000

iv) B9 Padmodaya Turning Intersection

This intersection has a cranked configuration located 300 to 350 meters north of B-3 Singha Durbar intersection. The intersection is equipped with out-of-date signals and the traffic is also managed by traffic police.

The widening of the intersection is difficult due to the densely inhabited buildings.

Recommendations for improvement are presented below.

a) Similar to Singha Durbar intersection of above, presented in the recommendation d), coordinated control of the signals along Ram Shah Street is recommended to be provided (B-3 Singha Durbar intersection, B-9 Padmodaya Turning intersection, B-4 Ramshaha Path-DilliBazar intersection).

b) Since the Bhrikutimandap Road (minor roadway) and the existing road width of West-side Road (Singha Durbar Circular Artery) is wide enough, part of road will be used as a right-turn lane. Since the widening of Ram Shah Street (major roadway) is difficult, a right-turn lane will not be provided.

c) Provisions of signals and road marking to guide the large number of pedestrians.

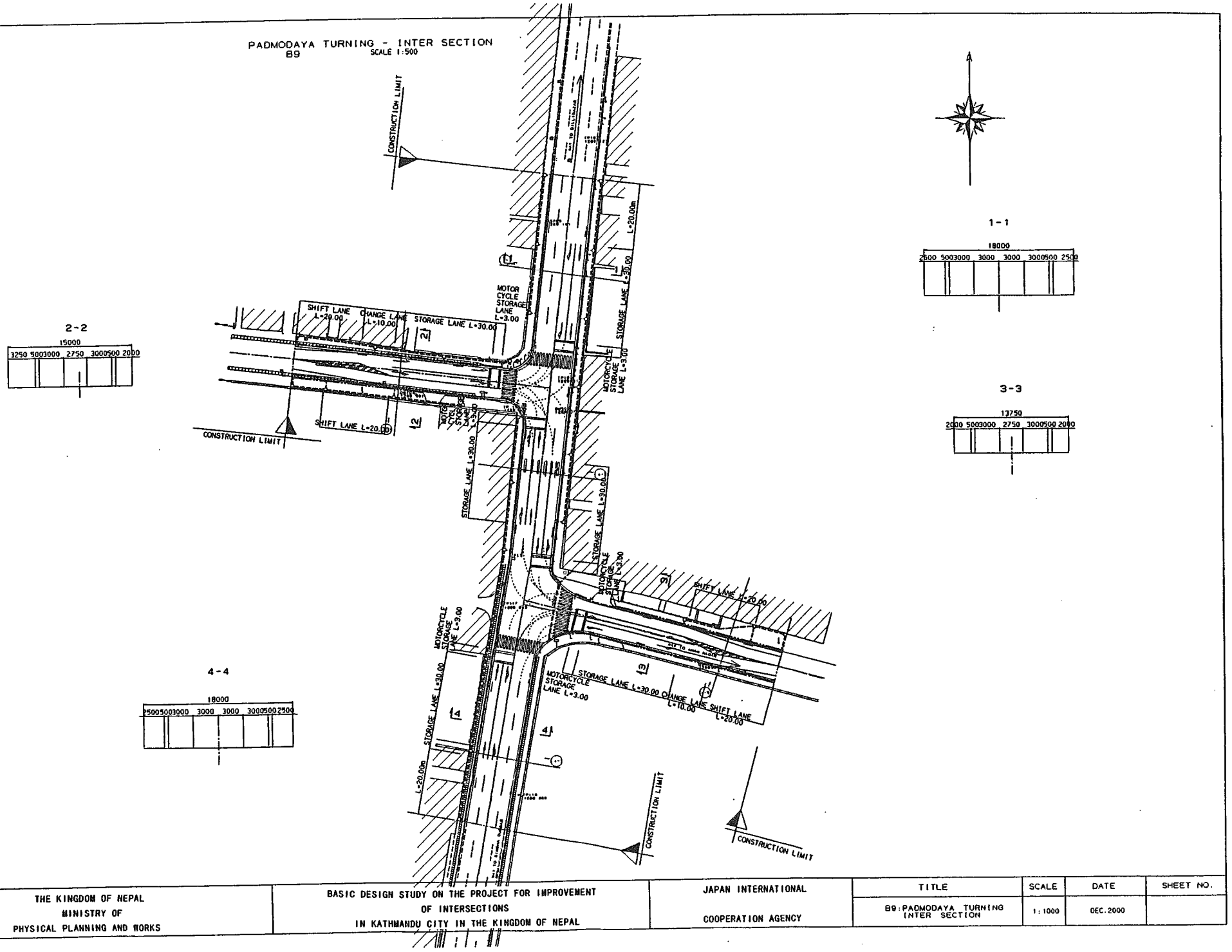
d) In principle, the pavement improvement works will be planned as overlay works, and pedestrian paths will be provided.

e) Provide drainage facilities.

f) Remove all existing signals and replace them with LED type signals for vehicles and for pedestrian. Provision of offsets at each intersections from Maitigal intersection to Dilli Bazar intersection of Ramshaha Path and introduce a cable link control. Solar panel will be fixed to signal poles to allow the signal system to operate on dual system, i.e., solar and existing low voltage power supply.

g) Replacement of road lighting will be limited to area where civil works are carried out. Existing lighting will be removed and replaced with new one.

PADMODAYA TURNING - INTER SECTION
89
SCALE 1:500



THE KINGDOM OF NEPAL MINISTRY OF PHYSICAL PLANNING AND WORKS	BASIC DESIGN STUDY ON THE PROJECT FOR IMPROVEMENT OF INTERSECTIONS IN KATHMANDU CITY IN THE KINGDOM OF NEPAL	JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE	SCALE	DATE	SHEET NO.
			89:PADMODAYA TURNING INTER SECTION	1:1000	DEC.2000	

v) B4 Ramshaha Path-Dilli Bazar Intersection

This intersection has a right-angled configuration and is located approximately 450 meters north of B-9 Padmodaya Turning intersection. The main roadway is the north-south direction Ram Shah Street, and the intersecting east-west minor roadway is a two lane road. The minor roadway is a one-way street that merges into the intersection from east and west direction and flows towards the south (towards Maitighar intersection) and towards the north (towards the Royal Palace). The intersection is equipped with out-of-date signals and the traffic is also managed by traffic police.

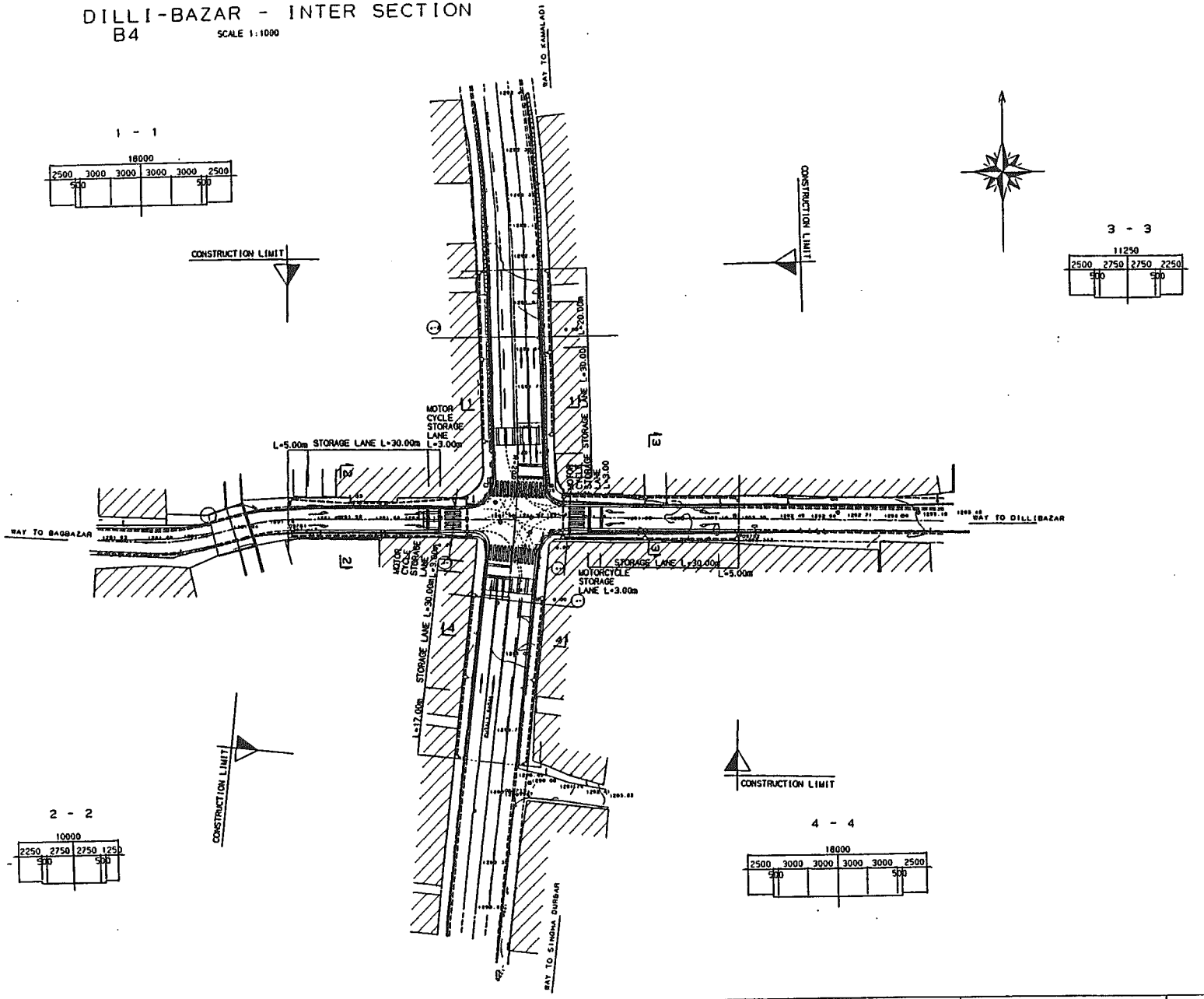
Shops occupy both roadsides, thus widening is perceived to be difficult to carry out.

Recommendations for improvement are presented below.

a) Provision of new signals. Coordinated link-control should be arranged with B-3 Singha Durbar intersection and B-9 Padmodaya Turning intersection.
b) Provisions of signals and road marking to guide the large number of pedestrians.
c) In principle, the pavement improvement works will be planned as overlay works, and pedestrian paths will be provided.
d) Provide drainage facilities.
e) No provision is made for right-turning on either main and minor roadway due to the difficulty of widening.
f) Remove all existing signals and replace them with LED type signals for vehicles and for pedestrians. Provision of offsets at each intersection between Padmodaya Turning intersection to this intersection and introduce a cable link control.
g) No replacement of road lighting will be made, existing lighting will be used.

DILLI-BAZAR - INTER SECTION

B4 SCALE 1:1000



THE KINGDOM OF NEPAL MINISTRY OF PHYSICAL PLANNING AND WORKS	BASIC DESIGN STUDY ON THE PROJECT FOR IMPROVEMENT OF INTERSECTIONS IN KATHMANDU CITY IN THE KINGDOM OF NEPAL	JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE	SCALE	DATE	SHEET NO.
			B4:DILLIBAZAR INTER SECTION	1:1000	DEC. 2000	

vi) B5 Naya Baneshwor Intersection

This intersection has a right-angled configuration with no signals and is situated on the west of the International Conference Hall. Traffic police manage the traffic of the intersection.

Many shops selling vegetables and fruit are established in the vicinity of it and many people come here to do their shopping in the late afternoon. Many passengers were observed to disembark the bus there. DOR has constructed an island for passengers to take refuge before they cross the road. According to DOR, the island has substantially relieved the congestion of the traffic due to the mass. Still, the one-meter width island was observed to be insufficient in absorbing the numerous pedestrians crossing. The main cause of the congestion is concluded to be due to the number of pedestrians.

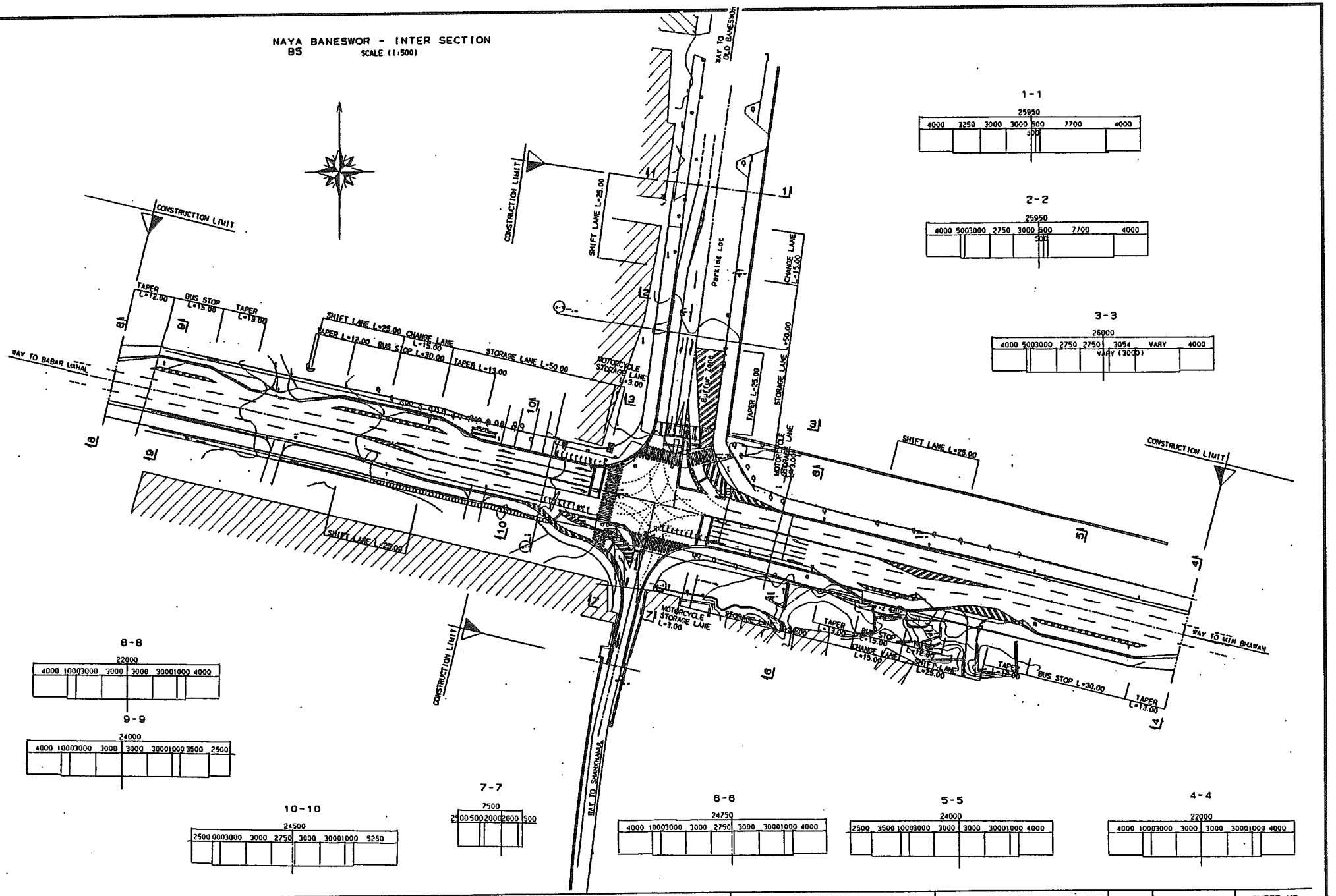
Recommendations for improvement are presented below.

a) Installation of right-turn lane with signals along the airport road (major roadway).
b) Installation of pedestrian signals and adequate road markings.
c) In principle, the pavement improvement works will be planned as overlay works, and pedestrian paths will be provided.
d) Provide drainage facilities.

The installation of the following facilities need to be studied further but still constitute as an option.

e) Installation of LED type signals for pedestrians and vehicles. Power can be drawn from the existing low voltage power network.
f) Existing road lighting will be kept in place.

NAYA BANESWOR - INTER SECTION
B5
SCALE (1:500)



THE KINGDOM OF NEPAL MINISTRY OF PHYSICAL PLANNING AND WORKS	BASIC DESIGN STUDY ON THE PROJECT FOR IMPROVEMENT OF INTERSECTIONS IN KATHMANDU CITY IN THE KINGDOM OF NEPAL	JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE	SCALE	DATE	SHEET NO.
			B5 : NAYA BANESWOR INTER SECTION	1 : 1000	DEC. 2000	

vii) A8 Kalimati Intersection

The intersection is situated approximately 150 to 250 meters west of the Vishnumati River Bridge, and the Tripureshwar Road which stretches from Kalanki-Chowk Intersection to Tribhuvan Highway, is the major roadway.

The intersection has a cranked configuration and is not equipped with signals. The traffic police manages the expedition of the traffic. The Study Team has concluded that the congestion of the traffic at present is due to insufficient numbers of traffic lanes combined with the obscure width of the lanes.

Also, a wholesale vegetable market was observed sitting in front of one of the crank and the existence of small vehicle traffic. The area is a commercial district where pedestrian, bus, and taxi traffic occupy the area. A comprehensive city planning may be the appropriate approach for a holistic resolution.

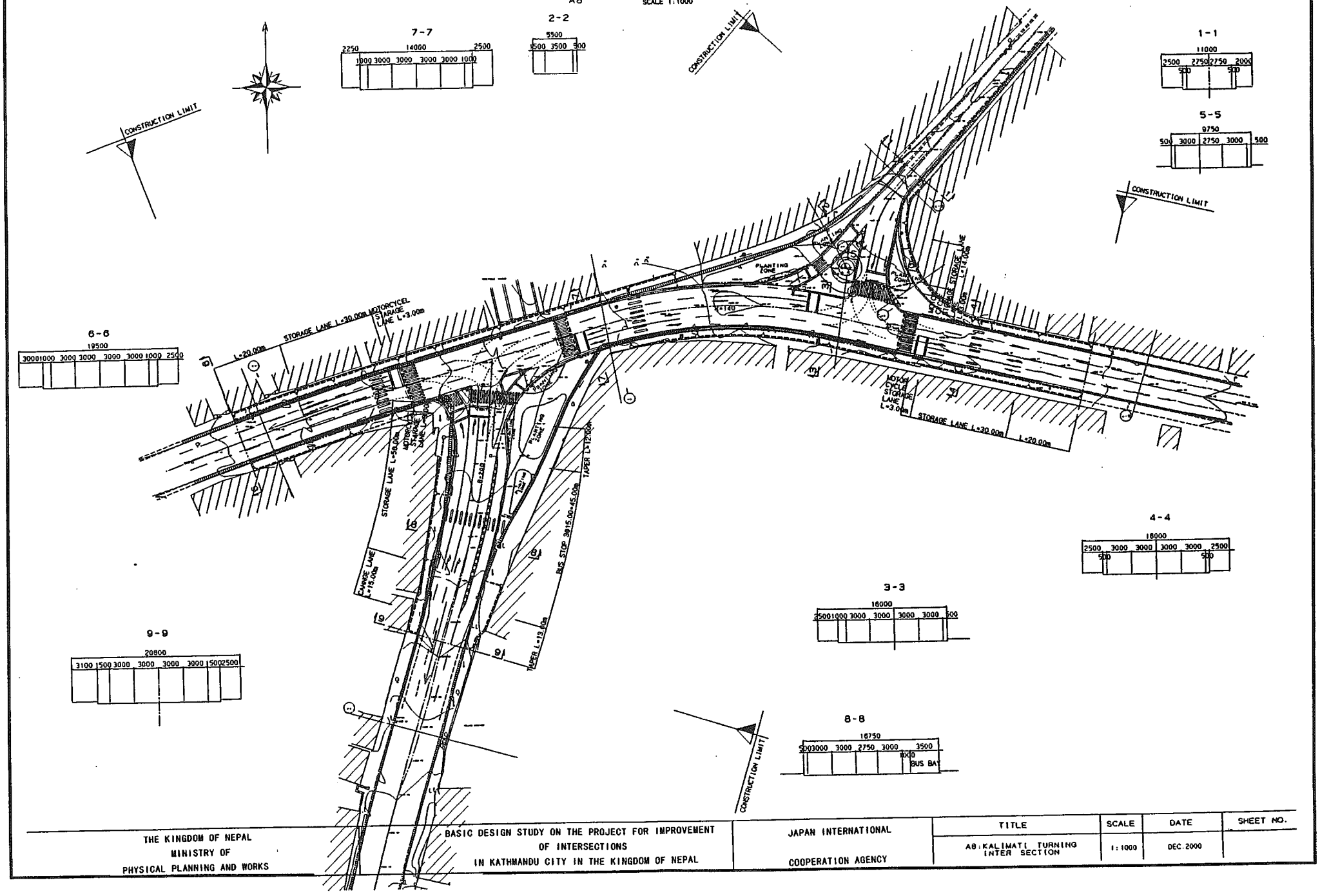
Recommendations for improvement are presented below.

a) Define and improve the lanes, the major roadway of Tripureswor Road , and install a right turning lane for the minor roadway of north and south road.
b) Remove the rotary of the west–side intersection.
c) Install time delayed signals on the two intersections.
d) Improve the bus stop.
e) Installation of pedestrian signals and adequate road markings.
f) In principle, the pavement improvement works will be planned as overlay works, and pedestrian paths will be provided.
g) Provide drainage facilities.
h) Installation of LED type signals for pedestrians and vehicles. Power can be drawn from the existing low voltage power network.
i) Existing road lighting will be kept in place.

KALIMATI TURNING - INTER SECTION

A8

SCALE 1:1000



THE KINGDOM OF NEPAL MINISTRY OF PHYSICAL PLANNING AND WORKS	BASIC DESIGN STUDY ON THE PROJECT FOR IMPROVEMENT OF INTERSECTIONS IN KATHMANDU CITY IN THE KINGDOM OF NEPAL	JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE	SCALE	DATE	SHEET NO.
			A8 : KALIMATI TURNING INTER SECTION	1:1000	DEC. 2000	

viii) A5 Koteswor Tinkune Intersection

This intersection is a Y-shaped intersection where the Airport Road, the Ring Road, and the Arniko Highway converge. One side of this triangular rotary is approximately 350 meters. Because of the shear size, and because of the sharp turn at the pinnacle of the triangle, the intersection is not perceived as a rotary by the drivers entering the intersection by either a right or a left turn. Unfortunately, currently, the intersection is not functioning as a rotary but as a opposing two lane road. No stalling of vehicles was apparent during the Study Team's observation.

At each pinnacle of the triangular intersection, the right-turning vehicles and the straight through vehicles intersects each other. Since the rotary is situated in the entrance of the suburbs and since the road is a trunk road, the speed of the vehicles is relatively high, thus a high potential of accident exists. In the 1993 JICA report, the intersection was recommended to be modified into a large circular rotary, however, according to the DOR, the land right issues in the middle of the rotary is currently under dispute and the acquisition is difficult. Also, failed attempts had been made to utilize the intersection as a one way rotary by positioning traffic police.

Recommendations for improvement are presented below.

a) Modify all three pinnacles of the intersection by adding a right turn lane and converting it into a Y-shaped intersection and installing traffic lights at each intersection. Major roadway will be set to Arniko Highway and the Ring Road.
b) Provisions of signals and road marking to guide the large number of pedestrians.
c) In principle, the pavement improvement works will be planned as overlay works, and pedestrian paths will be provided.
d) Provide drainage facilities.
e) As per the request from DOR, a 2.5 meter wide pedestrian path will be constructed to the triangular strip land of the Airport Road (left side). Also, the existing road width (approximately 6 to 10 meters) of the Arniko Highway is planned to be converted into a roadway with pedestrian path on one side having a total width of 10.75 meters (1.75m + 3.00m x 2 + 0.5m + 2.5m).
f) Newly install LED type signals for the roadway and for the pedestrians

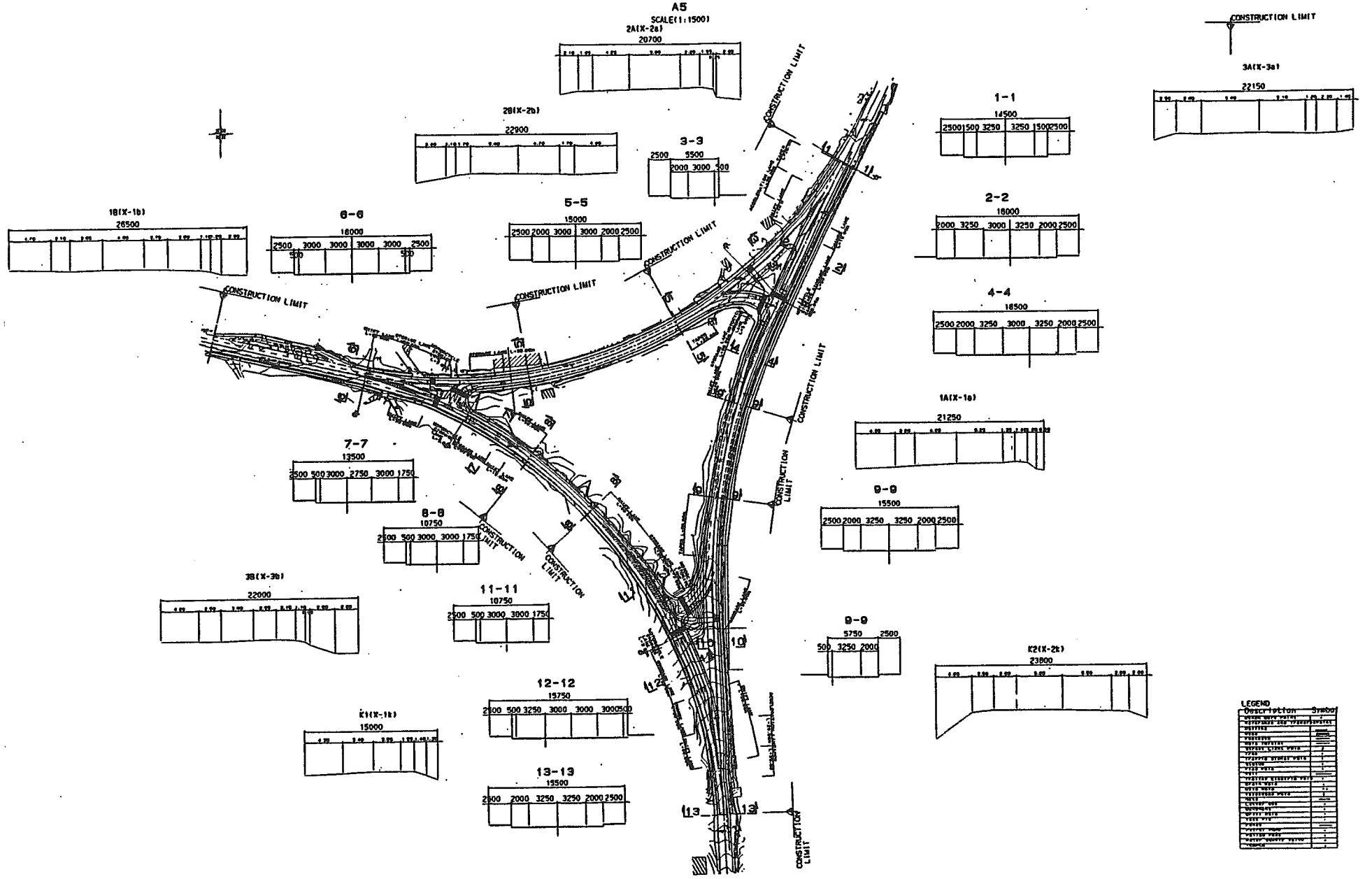
at all three intersections. Existing low power supply will be utilized.

g) Newly install road lighting in the premises of the three intersections.

KOTESWOR-TINKUNE-INTER SECTION

A5

SCALE(1:1500)



THE KINGDOM OF NEPAL MINISTRY OF PHYSICAL PLANNING AND WORKS	BASIC DESIGN STUDY ON THE PROJECT FOR IMPROVEMENT OF INTERSECTIONS IN KATHMANDU CITY IN THE KINGDOM OF NEPAL	JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE	SCALE	DATE	SHEET NO.
			A5 : KOTESWOR-TINKUNE INTER SECTION	1 : 3000	DEC. 2000	

ix) A4 Koteswor Ring Road Intersection

This intersection has a T-shaped configuration and is a diverging point of the Ring Road and the Arniko Highway. Many street vendor tents and their customers as well as the bus stops and passengers were observed. The combination with the numerous pedestrians is the major cause of the congestion of the traffic. Traffic police stationed at the police box were observed to regulate the traffic particularly in the peak hours.

The Arniko Highway, stretching towards the east from Kathmandu, serves a vital role as an artery national road. Its traffic is forecasted to increase continuously and since the improvement works of the Ring Road is already scheduled to be implemented by the Asian Development Bank, the A4 Koteswor Ring Road Intersection is required to be widened to a 4-lane road.

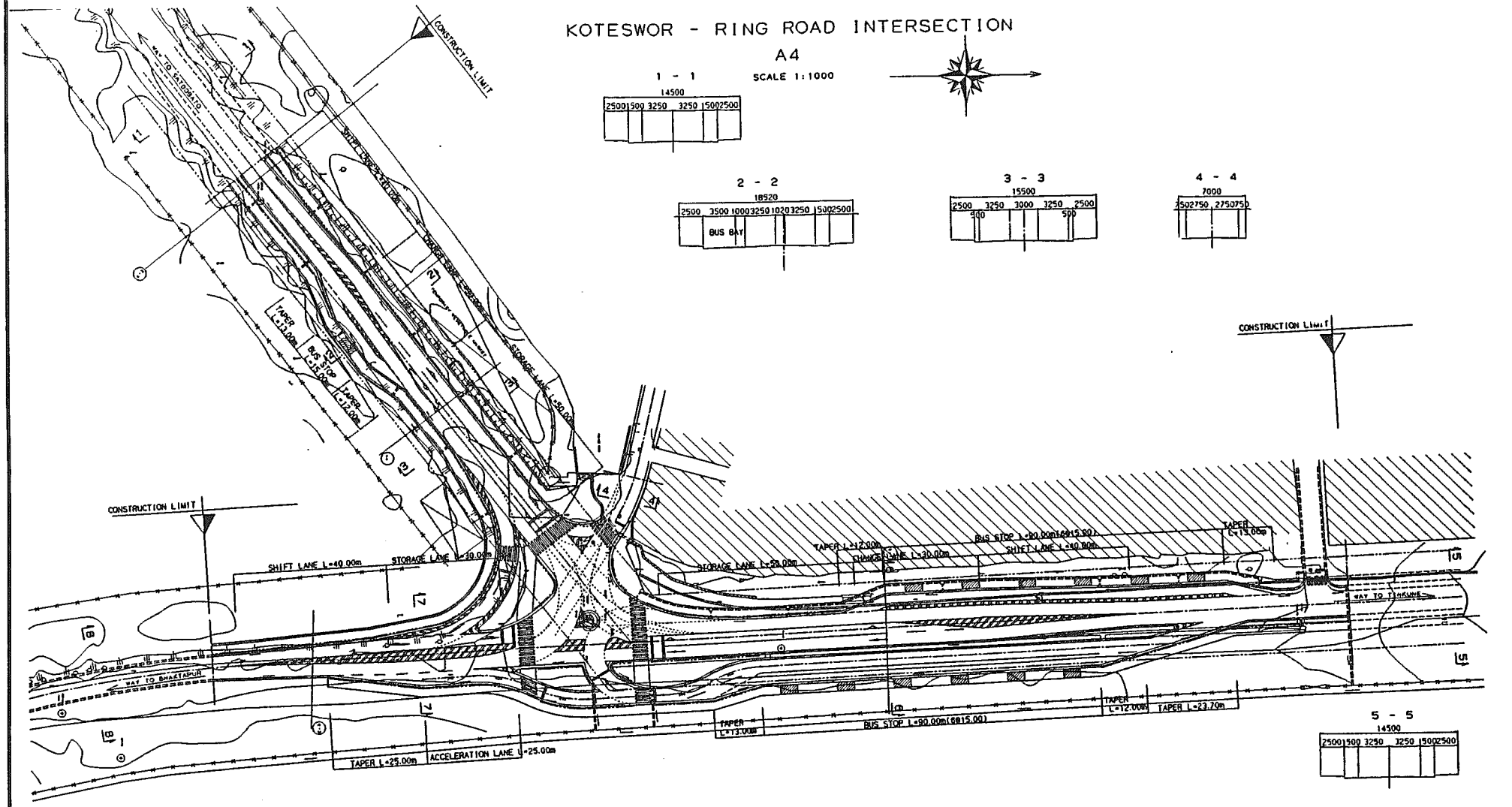
Recommendations for improvement are presented below.

a) The design speed of the Ring Road is set at 60km/hr, accommodating four-lane traffic and the Arniko Highway will be designed to accommodate opposing two lane traffic with a design speed of 60km/hr. (However the design speed in the premises of the intersection will be reduced 10 to 20 km/hr as per the stipulations of the Road Structure Ordinance)
b) Remove the rotary and reconfigure the intersection as a at grade T intersection and install signals.
c) Construct a new bus stop on the unoccupied land beside the intersection.
d) Provisions of signals and adequate pedestrian crossing to guide the large number of pedestrians.
e) Pavement improvement works by overlay works and construction of pedestrian path.
f) Provide drainage facilities.
g) Installation of LED type signals for pedestrians and vehicles. Solar panel will be fixed to signal poles to allow the signal system to operate on dual system, i.e., solar and existing low voltage power supply.
h) New road lighting will be installed and existing aerial cables (power and telephone lines) will be relocated underground.

KOTESWOR - RING ROAD INTERSECTION

A4

SCALE 1:1000



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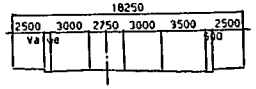
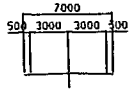


8 - 8



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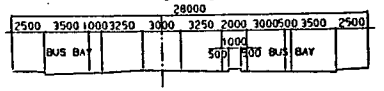


THE KINGDOM OF NEPAL MINISTRY OF PHYSICAL PLANNING AND WORKS	BASIC DESIGN STUDY ON THE PROJECT FOR IMPROVEMENT OF INTERSECTIONS IN KATHMANDU CITY IN THE KINGDOM OF NEPAL	JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE	SCALE	DATE / SHEET NO.
			A4:KOTESWOR RING ROAD INTERSECTION	1:1000	DEC.2000

x) B1 Kalanki-Chowk Intersection

The intersection is the vital merging point of the Tripureshwar Road, the Tribhuvan Highway, and the Ring Road. In the center of the intersection lies a rotary approximately 9.0 meters in diameter and connects to four legs, each having aisland structure. Pedestrians were observed walking along the roadway despite the pedestrian path which is equipped with a handrail. The intersection has no signals and the traffic police was observed to regulate the chronic congestion of traffic. Particularly during the peak hours, traffic from the Tripureshwar Road and traffic from the Tribhuvan Highway concentrates at this intersection.

The traffic count survey conducted in the Basic Design Study confirmed the traffic of the main direction being 2,340 pcu/hr, and site survey also found heavy congestion. The small unoccupied land, just enough for 3 to 5 buses, located 50 meters west from the intersection is occupied by the bus passengers and is presumed to be cause of the congestion that extends to the intersection. The inappropriate arrangement of the bus stops is believed to be the main cause of the traffic jam.

The traffic flow was interrupted by the pedestrian crossing. The installation of a pedestrian bridge and relocation of the bus bay to an appropriate location beside the intersection is believed to resolve the present congested traffic.

The pavement of Tripureshwar Road, which intersects with the Ring Road, and Tribhuvan Highway was observed as being damaged and is perceived to be putting a limit to the speed as well as contributing to the congestion.

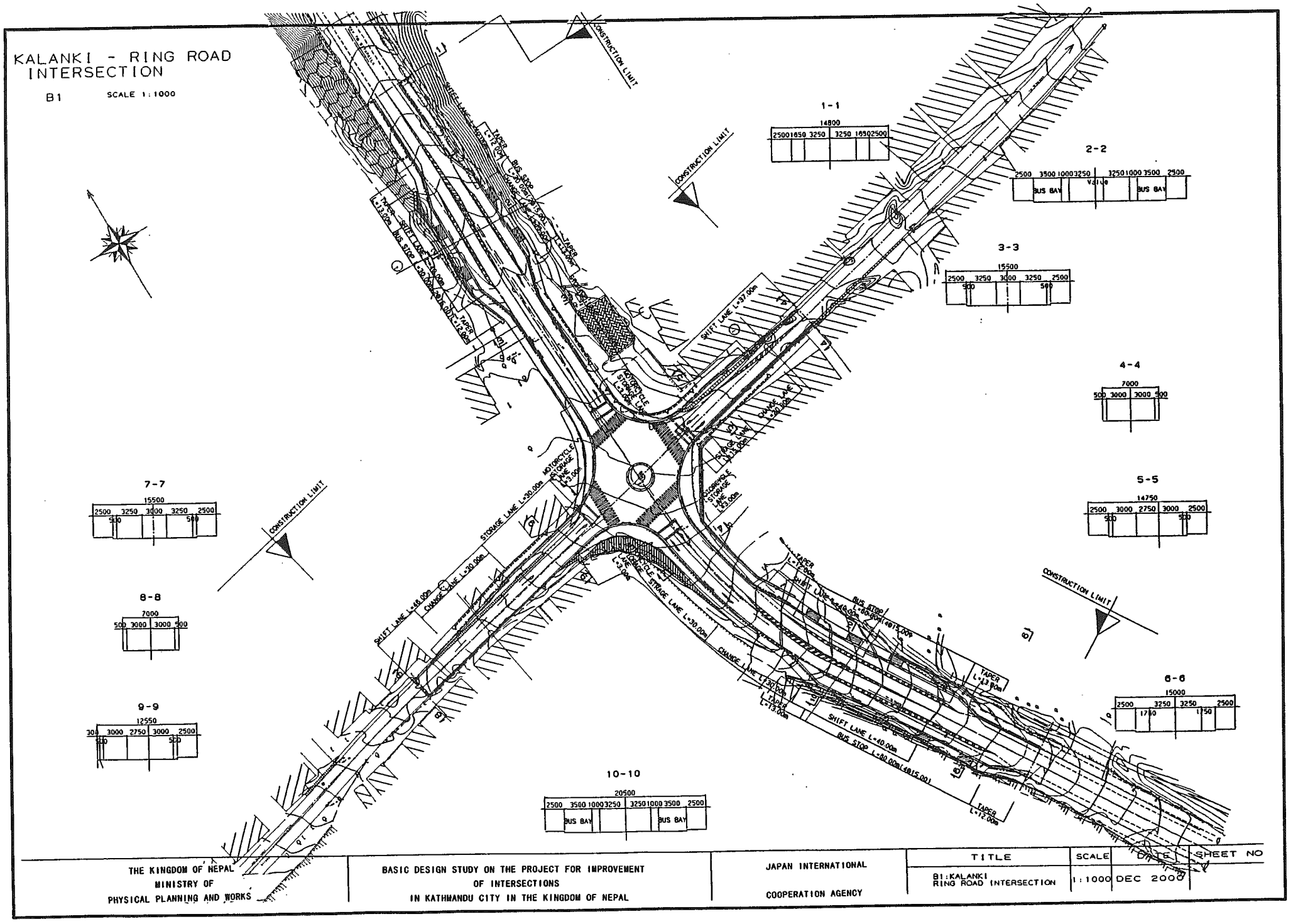
The Tribhuvan Highway, stretching towards the west from Kathmandu, serves a vital role as an artery national road. Its traffic is forecasted to increase continuously and since the improvement works jointly with the Ring Road is already scheduled to be implemented by Asian Development Bank, the A4 Koteswor Ring Road Intersection is be required to be widened to a 4-lane road.

Recommendations for improvement are presented below.

a) The design speed and the configuration of the traffic lane for the Ring Road, Tribhuvan Road, and the Tripureshwar Road are set at 60km/hr and four –lane, 60km/hr and opposing two lane traffic, and 40km/hr and opposing two lane traffic, respectively. (However the design speed in

the premises of the intersection will be reduced 10 to 20 km/hr as per the stipulations of the Road Structure Ordinance)

b) Remove the rotary and reconfigure the intersection as a at grade cross intersection and installing signals.
c) Construct a new bus stop along the open space of Ring Road.
d) Provisions of signals and adequate pedestrian crossing to guide the large number of pedestrians.
e) Pavement improvement works by overlay works and partial reconstruction, as well as the construction of pedestrian path.
f) Provide drainage facilities.
g) Installation of LED type signals for pedestrians and vehicles. Replacement of road lighting will be limited to area where civil works are carried out.


KALANKI - RING ROAD
INTERSECTION
B1
SCALE 1:1000
CONSTRUCTION LIMIT
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14800
2500 1650 3250 3250 1650 2500
2-2
2500 3500 1000 3250 3250 1000 3500 2500
BUS BAY
BUS BAY
3-3
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2500 3250 3000 3250 2500
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BUS BAY
BUS BAY
SHIFT LANE L=37.00m
SHIFT LANE L=40.00m
CHANGE LANE L=30.00m
STORAGE LANE L=30.00m
MOTORCYCLE STORAGE LANE L=3.00m
BUS STOP L=20.00m
TAPER L=13.00m
THE KINGDOM OF NEPAL
MINISTRY OF
PHYSICAL PLANNING AND WORKS
BASIC DESIGN STUDY ON THE PROJECT FOR IMPROVEMENT
OF INTERSECTIONS
IN KATHMANDU CITY IN THE KINGDOM OF NEPAL
JAPAN INTERNATIONAL
COOPERATION AGENCY
TITLE
B1:KALANKI
RING ROAD INTERSECTION
SCALE
1:1000
DATE
DEC 2000
SHEET NO

2.4 Project Implementing Agency

2.4.1 Organization

1) Organization Structure of the Department of Roads

The Department of Roads (DOR) of the Ministry of Physical Planning and Works is the agency responsible for implementing the Project for Improvement of Intersections in Kathmandu City (the Project) and is also the responsible organization for administering the road construction of the Kingdom of Nepal. Figure 2.4.1 presents the organization chart of the DOR.

The Project for Improvement of Intersections in Kathmandu City will be managed by the Design Department of the DOR and the sub organization, Traffic Engineering and Safety Unit (TESU) will be supervising the implementation of Project.

2) Project Implementation Agency

The Project office will be established within the TESU. The Project Management Organization will be managed and operated by a Project Manager, assigned from the Unit Chief of TESU, 2 Engineers from the TESU, 6 Engineers from the Kathmandu Branch Office, one administrator, totaling 10 persons.

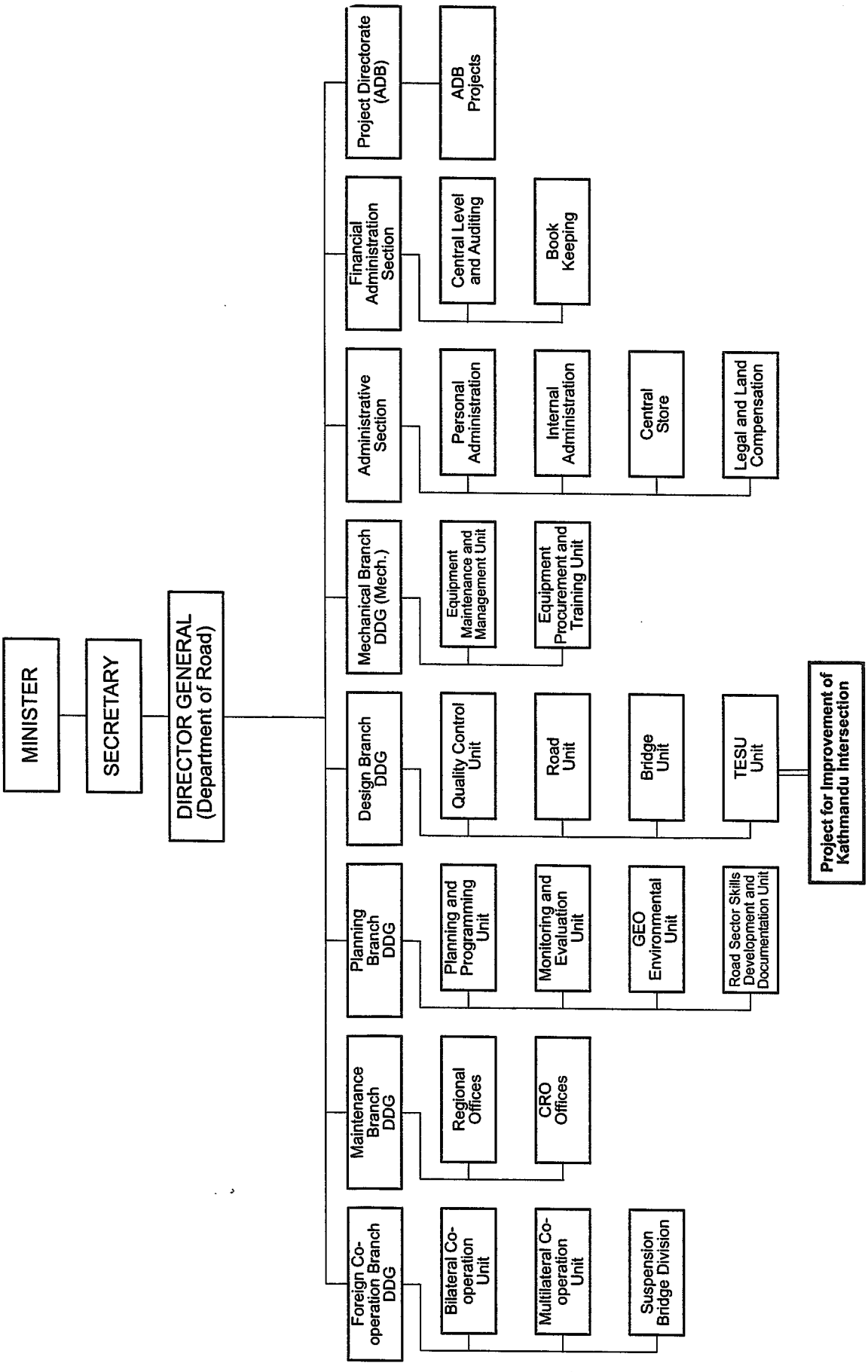


Figure 2.4.1 Organization Chart of DOR

2.4.2 Budget

Table 2.4.1 summarizes the budget allocation to the road sector of the past four years.

Table 2.4.1 Budget Allocation to the Road Sector for the of Four Years

（Million Nepal Rupih）

Fiscal Year	96/97		97/98		98/99		99/00	
National Budget	**50,723.7**	**(100.0%)**	**57,707.2**	**(100.0%)**	**69,693.3**	**(100.0%)**	**77,230.0**	**(100.0%)**
Road Budget	**4,698.0**	**(9.3%)**	**4,774.0**	**(8.3%)**	**5,298.0**	**(7.6%)**	**5,350.0**	**(6.9%)**
Source of Funds	**4,698.0**	**<100.0%>**	**4,774.0**	**<100.0%>**	**5,298.0**	**<100.0%>**	**5,350.0**	**<100%>**
Domestic Funds	1,663.0	(35.4%)	1,667.0	(34.9%)	1,703.0	(32.1%)	1,980.0	(37.0)
Foreign Source	3,035.0	(64.6%)	3,107.0	(65.1%)	3,595.0	(67.9%)	3,370.0	(63.0)
Development Budget	**4,547.0**	**<96.8%>**	**4,618.0**	**<96.7%>**	**5,137.0**	**<97.0%>**	**5,188.0**	**<96.1%>**
Highway	325.0	(6.9%)	364.0	(7.6%)	390.0	(7.4%)	595.0	(11.1%)
Feeder Road	397.0	(8.5%)	404.0	(8.5%)	387.0	(7.3%)	1,009.0	(18.9%)
Road Improvement, Reparation	1,903.0	(40.5%)	2,151.0	(45.1%)	2,729.0	(51.5%)	2,657.0	(49.7%)
Others	737.0	(15.7%)	445.0	(9.3%)	542.0	(10.2%)	127.0	(2.4%)
Periodical Maintenance	653.0	(13.9%)	647.0	(13.6%)	599.0	(11.3%)	-	
Bridge Construction	442.0	(9.4%)	535.0	(11.2%)	429.0	(8.1%)	720.0	(13.5%)
Urban Road	90.0	(1.9%)	720.0	(15.1%)	60.0	(1.1%)	80.0	(1.5%)
General Budget	**151.0**	**<3.2%.>**	**156.0**	**<3.3%>**	**161.0**	**<3.0%>**	**162.0**	**<3.1%>**
Maintenance	40.0	(0.9%)	40.0	(0.8%)	40.0	(0.8%)	85.0	(1.6%)
DOR Expense	111.0	(2.4%)	116.0	(2.4%)	121.0	(2.3%)	77.0	(1.5%)

As is clear from Table 2.4.2, more than 60% of the budget of the road sector is funded from international organizations, and from official assistance, and more than 95% of the budget is allocated to development sector thus leaving limited source of funds to daily maintenance activities.

The Government of Nepal is planning to initiate the following four initiatives to secure funds domestically, which would amount to approximately 1 billion Nepal Rupih for the fiscal year of 2000/2001:

1) Increase of diesel and oil products
2) Increase of toll fee of toll road
3) Increase of license fee for heavy vehicles
4) Introduction of taxes for international transit vehicles

2.4.3 Staff and Engineering Competency

The DOR consists of approximately 650 engineers and a total staff of approximately 3000 persons and is one of the organizations that has a long history within the Government of Nepal. In the past the organization has made successful

achievements in administering and implementing land acquisitions and resettlement administrations for Grant Aid Projects sponsored by the Government of Japan such as Bridge Reconstruction Project of Kathmandu (Phase I & II), Bagmati Bridge Reconstruction Project, and the Sindhuli Road Construction Project.

Particular noteworthy is the resemblance of the Thapathali Intersection improvement works, which was part of the Bagmati Bridge Reconstruction Project, to the Project for Improvement of Intersections in Kathmandu City. DOR has sufficient experiences and achievements in implementing the Project.

CHAPTER 3 IMPLEMENTATION PLAN

3.1 Implementation Plan

3.1.1 Implementation Concept

(1) General

After signing an Exchange of Notes (E/N) between both Governments, the implementation of the Project will commence under the Grant Aid Scheme from the Government of Japan. For the implementation of the Project, two contracts for consulting services, which consist of detailed design and construction supervision, will be concluded between the Department of Roads (DOR), Ministry of Physical Planning and Works (MPPW), His Majesty's Government of Nepal (HMG/N) and a Japanese consulting firm (the Consultant). Afterwards, a contract for construction works will be concluded between DOR and a Japanese construction firm (the Contractor). Each contract will be effective after verification by the Government of Japan.

DOR is responsible for the implementation of the Project. Hence, DOR would have to manage coordination, preparation and administration matters in connection with agreements in E/N.

The Japanese consulting firm has to carry out the following services as the Consultant on behalf of HMG/N.

[Detailed Design]

- Detailed engineering design including preparation of pre-qualification and tender documents.

[Construction Supervision]

- Pre-construction activities ranging from pre-qualification announcement to tender evaluation assistance.
- Construction Supervision

The Japanese construction firm has to undertake the construction as the Contractor in accordance with the work program and schedule of the Project.

(2) Implementation Method

An implementation plan has been studied assuming that the Project will be executed under the grant aid from the Japanese Government and has been made taking the following conditions into consideration:

- Considering job opportunity, transfer of technology and enhancement of economy development in the region, the labor forces as well as materials and equipment available in Kathmandu Valley

would have to be used as much as possible.

- An appropriate communication channel would have to be established among the Nepalese Government, Consultant, and Contractor so as to execute the Project smoothly during the construction stage.
- An appropriate implementation plan would have to be established based on the rainfall patterns, suitable procurement of equipment and materials, reliable construction methods, etc.
- Construction time-table would have to be planned to eliminate any traffic disruption and disturbance during the construction stage.
- An appropriate program for transfer of knowledge and technology, which includes technology training and soft components, would have to be prepared.

3.1.2 Implementation Conditions

To implement the Project, the following factors, which concern the coordination of the work areas, construction methods, procurement of materials and equipment, and so on would have to be considered:

(1) Applicable Labor Laws

The Contractor should properly manage the Project execution to eliminate any disputes with labors in accordance with the present laws of Nepal.

(2) Protective Measure of Environments

In order to protect the environments, the Construction works should be carried out to mitigate even normal construction hazards like dusts and water pollution in such works as borrow pit excavation, embankment, soil disposal, and pavement. （Environment Protection Act-2053、Environment Protection Regulation-2054 (First Revision-2055)、Environmental Assessment in the Road Sector of Nepal、Standards for pollution control or abatement as effective in Nepal、Roads Act-2031、Transportation Act-2049、Historical Monuments Conservation Act-2029.）

(3) Securing Safety of Working Areas

Construction works will be executed even at midnight since most of the specific sites of the intersections are located in the central business districts in the Kathmandu City. Considering such peculiar situation of the Project, the Nepalese Government should take security measures for the working areas.

(4) Customs Clearance and Inland Transportation

The Nepalese Government should ensure prompt unloading, tax exemption, customs clearance at the Calcutta Port in India and prompt inland transportation of the materials and equipment for the Project.

(5) Packages by Terms

The detailed design and construction of the Project, which consists of 10 intersections, will be implemented in 2 terms, in 2 Japanese fiscal years. Packaging of intersections has to be considered effectively for the respective terms.

(6) Technology Transfer through Construction Works

For the sake of technology transfer on suitable operation and maintenance, counterparts from the Nepalese Government and other concerned personnel will participate in the training program.

3.1.3 Scope of Work

The scope of work for which Japanese and Nepalese Governments are responsible is described as follows:

(1) Services and Facilities to be provided by the Japanese Side

i) Consulting Services by Japan's Grant

a) Detailed Engineering Design

- Supplementary topographic survey and subsoil exploration
- Detailed design of 10 intersections
- Preparation of pre-qualification and tender documents
- Cost estimation

b) Construction Supervision

- Assistance to DOR for pre-qualification and tender evaluation during pre-construction stage
- Construction supervision of 10 intersections
- Defect liability inspection

ii) Construction by Japan's Grant

- Construction of 10 intersections, each of which includes the following:
  - Drainage
  - Pavement
  - Traffic safety facilities such as traffic signals, road lighting, traffic sign boards, traffic marking
- Maintenance of facilities for defect liability period

iii) Transfer knowledge through Soft Component Assistance

The following will be conducted through "Soft Components Assistance" to facilitate effective use of the completed facilities by the Japan's Grant.

- Preparation of materials for traffic safety campaign
- Traffic safety training
- O/M training for new signals

(2) Undertakings to be provided by the Nepalese Side

- To relocate the existing facilities such as poles and cables of electricity line, trolley bus, telephone lines, as well as water pipes and buildings.
- To secure land necessary for the execution of the Project, such as land for intersections and roads, temporary offices, working areas, storage areas and others.
- To bear commissions to a Japanese bank for its banking services based upon the Banking Arrangement.
- To ensure prompt unloading, tax exemption, customs clearance at the port of disembarkation in India and prompt transportation of materials and equipment to the sites of the Project.
- To ensure Japanese nationals engaged in the Project are exempted from customs duties, internal taxes and other fiscal levies which may be imposed in Nepal with respect to the supply of the products and services under the verified contracts.
- To safeguard the working areas and surroundings thereof.
- To execute the traffic safety campaign in the Kathmandu Valley as well as the training of traffic safety and O/M (operation & maintenance) in collaboration with the Soft Components Assistance.

3.1.4 Consulting Services

(1) Schedule of Consulting Services

1) Detailed Engineering Design Stage

Immediately after signing the Exchange of Notes (E/N) regarding the detailed engineering design of the Project by both governments, the contract for the detailed engineering design should be signed. The services will cover the detailed design of 10 intersections, cost

estimation, preparation of pre-qualification and tender/contract documents.

2) Pre-construction and Construction Supervision Stage

As with the detailed engineering design, the contract for the consulting services, which includes the pre-construction and construction supervision stage, should be signed soon after signing the Exchange of Notes.

During the pre-construction stage, the services will cover the assistance to DOR for pre-qualification notice, pre-qualification evaluation, distribution of tender documents, and tender evaluation.

3) Soft Components

Details are discussed in the subsequent subsection 3.2.

(2) Staffing for Consulting Services

1) Detailed Engineering Design Stage

Table 3.1.1 Staffing for Detailed Engineering Design

Position	Responsible Tasks
Project Manager	Overall management of detailed design, preparation of pre-qualification & tender documents, and check on the cost estimate
Intersection Designer	Design of 10 intersections, preparation of drawings, and quantity calculation
Road Facility Designer	Design of road associated facilities, drawings, and quantity calculation
Signalization Designer	Design of traffic signals and road lighting, drawings, and quantity calculation
Construction Planner/ Cost Estimator	Preparation of construction plan, price analyses, cost estimation
Document Specialist	Preparation of pre-qualification documents, and tender documents.

2) Pre-construction and Construction Supervision Stage

Table 3.1.2 Staffing for Construction Supervision

Position	Responsible Tasks
Project Manager	Assistance to DOR for pre-qualification notice and pre-qualification evaluation. Overall management of construction supervision.
Resident Engineer	Management of construction supervision.
Material Engineer	Supervising of material testing, check on quality control and mix design.
Signalization Engineer	Supervision of installation of signals and subsequent commissioning.

3.1.5 Basic Construction Plan

(1) Temporary Works

1) Temporary Yards

Soon after the verification of the contract for construction works, the Contractor should deploy equipment, materials and staff. Meanwhile, the temporary yards will be developed. The conceivable yards are shown in Figure 3.1.1.

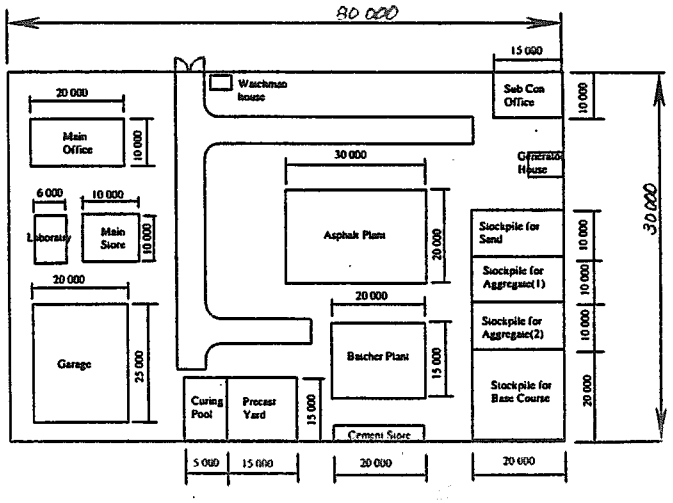


Figure 3.1.1 Layout Plan of Temporary Yard

2) Electricity, Telephone and Potable Water

During construction stage, the Project will require the facilities for distribution of electricity, telephone and water supply and other incidental facilities around the sites and temporary yard.

(2) Intersection Improvement

1) Construction Sequence

It is not practical to close the intersections during the construction stage taking the present traffic and street characteristics into account since the intersections are located in the central business district in the Kathmandu City. The construction method is proposed to maintain the present traffic without detour roads. Accordingly, the construction work will be carried out part by part of road section as shown in Figure 3.1.2. Construction works of the respective part would have to be executed at midnight when the traffic is almost none.

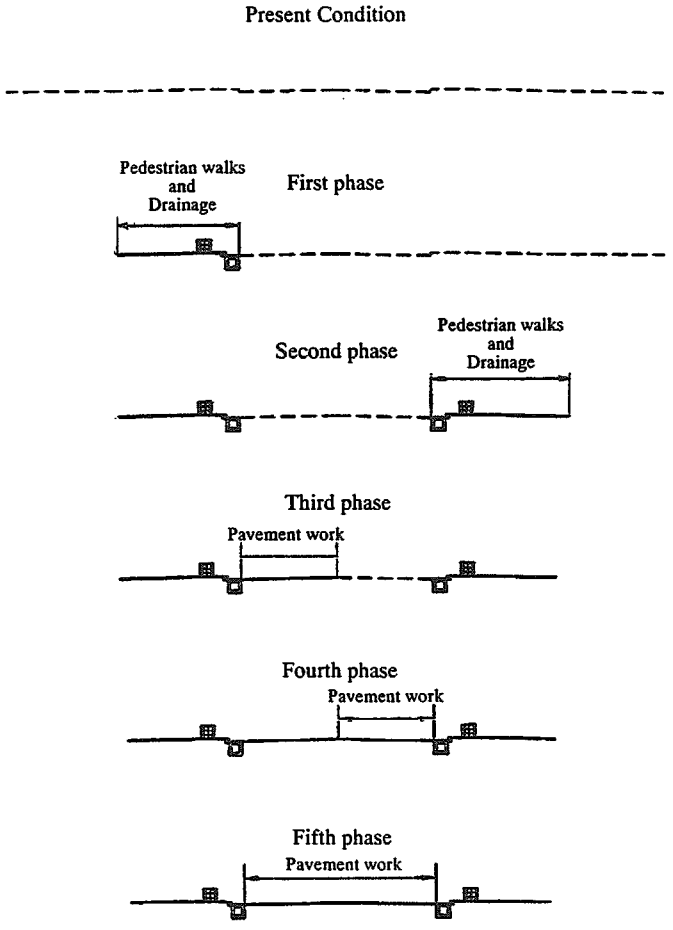


Figure 3.1.2 Construction Sequence

2) Traffic Management during Construction

In order to maintain the traffic safety in daytime, due cooperation with the Traffic Police and Kathmandu Municipality is essential.

3.1.6 Procurement Plan

1) Construction Materials

The construction materials to be used for the Project are mostly available in Nepal except those of traffic signals, road lighting and solar panels. Procurement of major items is summarized in Table 3.1.3

Table 3.1.3 Procurement of Construction Materials

Items	Procured in Nepal	Procured in Japan	Procured from third country other than Nepal and Japan
Cement	○		
Concrete Admixture	○		
Reinforcing Bar	○		
Plywood for Formwork	○		
Timber	○		
Asphalt, Asphalt Emulsion	○		
Heavy Oil	○		
Light Oil	○		
Gasoline	○		
Coarse Aggregate	○		
Fine Aggregate	○		
Paint for traffic marking		○	
Delineator (Chatter Bar)		○	
Road Lighting		○	
Traffic Signals		○	
Solar Panel		○	

(2) Construction Equipment

As for construction machinery, the procurement schedule is shown in Table 3.1.4. All the equipment would have to be procured from outside of Nepal since no lease system is developed in the country.

Table 3.1.4 Procurement of Construction Equipment

Items	Specification	Procured in Nepal	Procured in Japan	Procured from third country other than Nepal and Japan
Bulldozer	15 t		○	
Tractor Shovel	1.4 m3		○	
Dump Truck	8.0 t			○
Backhoe	0.6 m3		○	
Vibration Roller	3.0 – 4.0 t		○	
Road Roller	10.0 t		○	
Tire Roller	8 – 20 t		○	
Grader	3.1 m		○	
Prime Coat Distributor	2,000 lit		○	
Concrete Mixer	3.0 m3		○	
Trailer	40.0 t		○	
Traffic Lane Marker	2.0 lit/m3		○	
Asphalt Plant	50.0 t/m3	○		
Asphalt Finisher	2.5 – 5.0 m	○		

3.1.7 Implementation Schedule

An overall time schedule for the project implementation is shown in Figure 3.1.5.

The procedures of Japan's Grant Aid Program is shown in Figure 2.1.6.

(1) Detailed Engineering Design by Japan's Grant

Soon after signing the contract for consulting services regarding the detailed engineering design, the Consultant will start the detailed engineering design. A Detailed engineering design period of 4.0 months will be required.

(2) Construction Works and Construction Supervision by Japan's Grant

1) Pre-construction and Construction Supervision

Soon after signing the contract for consulting services regarding the construction supervision, the Consultant will start the pre-qualification notice on behalf of DOR. Consulting service period of 19.5 months will be required for the pre-qualification, tender, and construction supervision.

2) Construction Works

Approximately after half a month, the Contractor will commence the construction works. Total construction period of 17 months will be required.

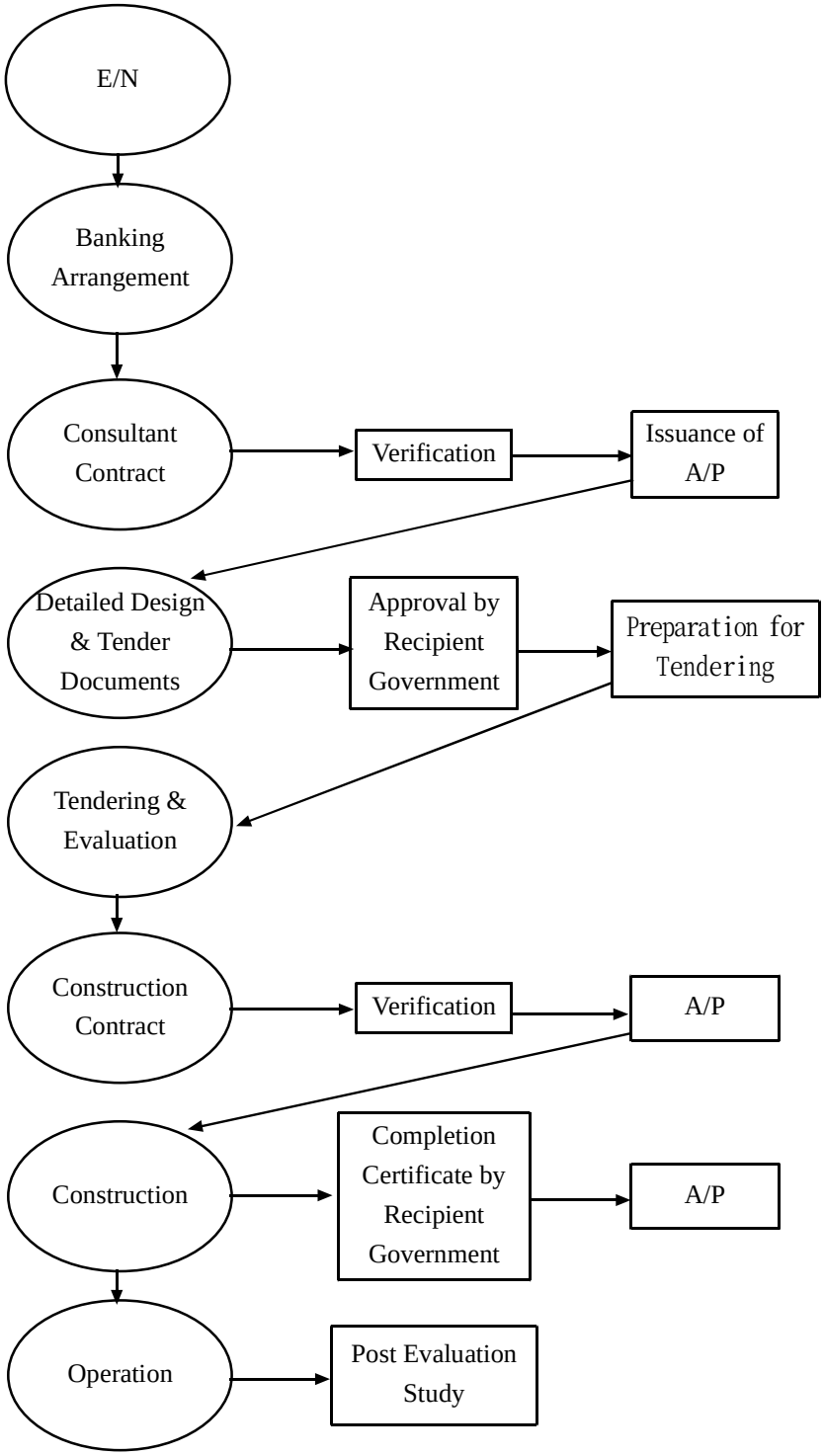
The construction works for 10 intersections will be carried out for 2 Japanese fiscal years, Term-1 and Term-2. Term-1 will cover 4 intersections and Term-2 will cover the rest. Specific intersections by Term are as follows:

[Term-1]

- A2 Maitighar
- A5 Koteswor Tinkune
- A8 Kalimati
- B9 Padmodaya Turning

[Term-2]

- A1 Kesharmahal
- A4 Koteswor Ring Road
- B1 Kalanki-Chowk
- B3 Singha Durbar
- B4 Ramshaha Path-Dilli Bazar
- B5 Naya Baneshwar



Notes: (1) E/N: Exchange Notes
(2) A/P: Authorization to Pay

Figure 3.1.6 Procedures of Japan's Grant Aid Program

(3) Soft Component Assistance

In addition to the Japan's Grant Assistance, a Soft Component Assistance will be carried out to facilitate the smooth traffic management as well as proper operation and maintenance of traffic signals and associated facilities through training programs.

3.1.8 Obligations of Recipient Country

The following necessary measures should be undertaken by HMG/N on condition that the Grant Aid by the Government of Japan is extended to the Project.

(1) Common Items by Japan's Grant Aid

- To furnish data and information necessary for implementing the Project
- To acquire the land and compensate for the buildings to be removed (ROW of roads, working areas, storage areas, etc.)
- To clear the sites
- To bear commission for the banking services based on the Banking Arrangement
- To ensure prompt unloading and tax exemption of customs clearance, and subsequent inland transportation
- To ensure tax exemption for the Consultant and the Contractor engaged in the Project
- To issue visas and other certificates necessary for the execution of the Project to the Consultant and Contractor
- To bear expenses required for the proper and effective operation and maintenance of all the facilities after completion of the Project
- To bear all the expenses necessary for the execution of the Project other than those to be borne by the Grant Aid

(2) Specific Items of the Project

- To allocate the budget related to the compensation of existing two buildings being leveled at B1 Kalanki-Chowk Intersection for the Nepalese fiscal year 2000 or 2001.
- To relocate the existing police box as well as poles and cables of the electric and telephone lines at B5 Naya Baneshwar Intersection by the end of June 2002.
- To relocate the poles and cables of trolley bus at A4 Koteshwar Ring Road Intersection by the end of June 2002.
- To confirm that the road lighting facilities will be transferred from DOR

to the Kathmandu Municipality after the completion of the Project.

- To confirm which organization will bear the electricity charges of traffic signals (DOR) and road lighting (Kathmandu Municipality)
- To confirm which organization will be responsible for the future maintenance work of traffic sign boards.
- To allocate the budgets required for implementation and future operation and maintenance. Indicative costs for these purposes are estimated in the following tables.

Table 3.1.5 Indicative Cost during Implementation

Description	Amount (NRs)
(1) Compensation for 2 buildings	1,599,000
(2) Relocation of trolley bus poles & cables, electricity poles & cables, water pipes.	1,562,500
(3) Other expenses for design & construction stage	125,000
(4) Expenses for Soft Component Program	1,250,000
Total	4,536,500

Table 3.1.6 Indicative Cost for Future O/M

Description	Occurrence	Amount (NRs)
Maintenance of pavement	1/5 years	2,050,000
O/M of road lighting	2/year	850,000
O/M of signals	2/year	190,000
Maintenance of traffic sign boards	2/year	70,000
Maintenance of other road safety facilities	1/year	70,000
Maintenance of drainage	1/year	50,000

3.2 Soft Component Assistance

"Soft Component" means the part of consulting services for enhancing the proper use of the facilities completed under the Japan's Grant. As the Project for Improvement of Intersections in Kathmandu City includes installation of new traffic signals at 10 intersections, traffic safety campaign in connection with the implementation plan of new traffic signal system is very essential for the proper use of the intersection facilities in the future. In this regard, Soft Component Assistance will be included in the consulting services in addition to the Construction Supervision.

A project design matrix (PDM) for the Soft Component Assistance is shown in Table 3.2.1, and an overall time table is shown in Figure 3.2.1.

3.2.1 Background Information to Soft Component

Traffic signals in the Kathmandu City are extremely of old system and not appropriate for smooth traffic management, except those of the Thapatali

Intersection, which was improved through the Project for Construction of the New Baghmati Bridge under the Japan's Grant Aid in 1996.

Ten intersections will be newly improved by using a new signal system if the Project is completed. As for much proper use of the improved intersections, appropriate programs including public notice and training in connection with traffic safety and new signals would have to be conducted through Soft Component Assistance.

3.2.2 Purpose of Soft Component

The purpose of Soft Component Assistance is:

- To announce to the public that new signal system is adopted in the specific 10 intersections in the Kathmandu City.
- To conduct a training program for proper use of the improved intersections.

As such, it is expected to reduce the traffic congestion at the intersections and to enhance the socio-economic activities in the Kathmandu Valley.

3.2.3 Expected Direct Benefit from Soft Component

i) Senior officers from DOR, Kathmandu Municipality and Traffic Police would recognize the significant effects to relieve the traffic congestion and to upgrade the traffic safety.

ii) Officers from Traffic Police and TESU Unit of DOR would understand the mechanism of new signal system and aspect of signals (signalling term or signal phase). Accordingly, proper operation and maintenance (O/M) of new signals would be expected after completion of the Project.

iii) Concerned personnel from electric maintenance firms and TESU Unit in the Kathmandu City would learn how the new signals and associated facilities are to be operated and maintained appropriately.

iv) Kathmandu Traffic Police would able to control and manage traffic and pedestrians at the intersections after understanding the characteristics of new signal system.

v) School boys and girls, driving schools and citizens in the Kathmandu City would follow the traffic safety rule through the training and guidance by the Kathmandu Traffic Police.

3.2.4 Activities under Soft Component

a) Staff from the Consultant and TESU Unit of DOR will prepare the materials for the traffic safety campaign: advertising poster, textbook for traffic safety rule, O/M manual of signals.

b) Staff from TESU Unit of DOR will ensure the coordination with media like TV and newspapers in connection with traffic safety campaign.

c) Staff from the Consultant and TESU Unit of DOR will provide training programs for the concerned personnel from the Government of Nepal, Traffic Police, electric maintenance firms, etc.

d) Traffic Police, who has already completed the training program, will conduct the traffic safety training towards school boys and girls, driving schools, citizens.

e) Staff from the Consultant and TESU Unit of DOR will examine verification indicators for the effects of Soft Component Assistance.

f) Staff from the Consultant and TESU Unit of DOR will prepare an evaluation report regarding the Soft Component Assistance.

3.2.5 Inputs of Japan's Grant

[Term-1]

i) Consulting Staff

- A traffic safety specialist will prepare draft materials for advertisement, traffic safety textbook, signal O/M manual, etc., in English.
- During the commissioning time of 4 intersections, the Consultant will send 3 staff: project manager, 2 traffic safety specialists

ii) Preparation of Materials for Soft Component

- Advertisement poster
- Textbook of traffic safety rule
- O/M manual of signals

iii) Seminar Arrangement

[Term-2]

i) Consulting Staff

- During the commissioning time of 6 intersections, the Consultant will send 3 staff: project manager, 2 traffic safety specialists

ii) Preparation of Materials for Soft Component

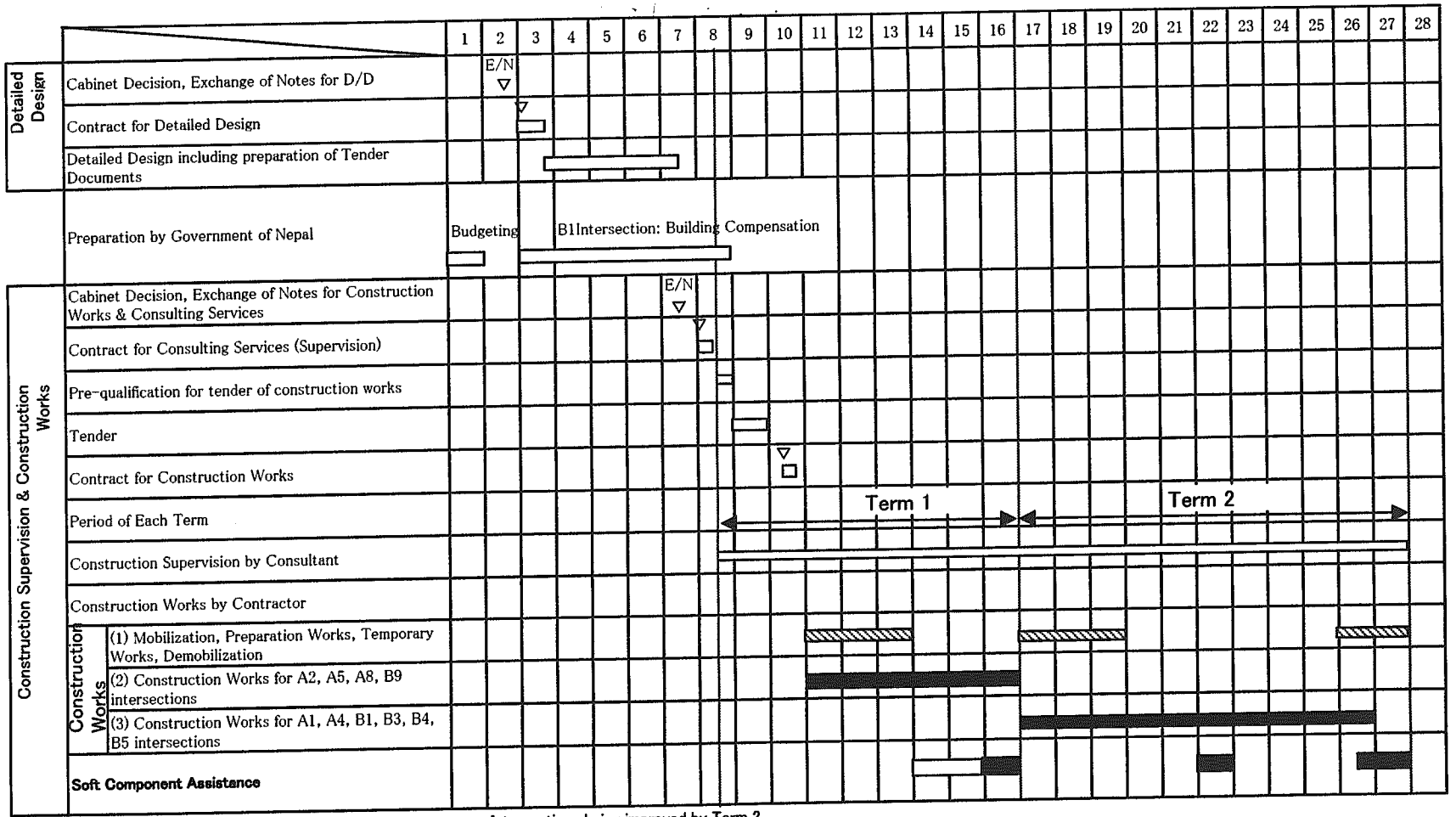
- Advertisement poster

iii) Seminar Arrangement

Table 3.2.1 Project Design Matrix (PDM) for Soft Component Assistance

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption (Risk Management)
Overall Goal It is expected to reduce the traffic congestion at the intersections and to enhance the socio-economic activities in the Kathmandu Valley.	Growth of GDP/Capita in Kathmandu City	Statistics of Nepal	
Purpose of Soft Component Assistance • To announce to the public that new signal system is adopted in the specific 10 intersections in the Kathmandu City. • To conduct a training program for proper use of the improved intersections.	Traveling time saving and reduction of traffic accidents	Accident Records by DOR Evaluation Report of Soft Component Assistance	
Expected Direct Benefit 1) Senior officers from DOR, Kathmandu Municipality and Traffic Police would recognize the significant effects to relieve the traffic congestion and to upgrade the traffic safety. 2) Officers from Traffic Police and TESU Unit of DOR would understand the mechanism of new signal system and aspect of signals (signalling term or signal phase). Accordingly, proper operation and maintenance (O/M) of new signals would be expected after completion of the Project. 3) Concerned personnel from electric maintenance firms and TESU Unit in the Kathmandu City would learn how the new signals and associated facilities are to be operated and maintained appropriately. 4) Kathmandu Traffic Police would able to control and manage traffic and pedestrians at the intersections after understanding the characteristics of new signal system. 5) School boys and girls, driving schools and citizens in the Kathmandu City would follow the traffic safety rule through the training and guidance by the Kathmandu Traffic Police.	1 How senior officers from DOR and Kathmandu Municipality recognize the significant effects. 2 Storage length at intersections and traveling hour between specific intersections. 3 Occurrence of mechanical trouble 4 Storage length and number of traffic accidents 5 Storage length and number of traffic accidents	1 Questionnaire 2 Evaluation Report of Soft Component Assistance 3 Completion Report of Defects Liability Period 4 Evaluation Report of Soft Component Assistance 5 Evaluation Report of Soft Component Assistance	
Activities 1) Staff from the Consultant and TESU Unit of DOR will prepare the materials for the traffic safety campaign: advertising poster, textbook for traffic safety rule, O/M manual of signals. 2) Staff from TESU Unit of DOR will ensure the coordination with media like TV and newspapers in connection with traffic safety campaign. 3) Staff from the Consultant and TESU Unit of DOR will provide training programs for the concerned personnel from the Government of Nepal, Traffic Police, electric maintenance firms, etc. 4) Traffic Police, who has already completed the training program, will conduct the traffic safety training towards school boys and girls, driving schools, citizens. 5) Staff from the Consultant and TESU Unit of DOR will examine verification indicators for the effects of Soft Component Assistance. 6) Staff from the Consultant and TESU Unit of DOR will prepare an evaluation report regarding the Soft Component Assistance.	**Inputs of Soft Component Assistance from Japan** [Term-1] i) Consulting Staff • A traffic safety specialist will prepare draft materials for advertisement, traffic safety textbook, signal O/M manual, etc., in English. • During the commissioning time of 4 intersections, the Consultant will send 3 staff: project manager, 2 traffic safety specialists. ii) Preparation of Materials for Soft Component • Advertisement poster • Textbook of traffic safety rule • O/M manual of signals iii) Seminar Arrangement [Term-2] i) Consulting Staff • During the commissioning time of 6 intersections, the Consultant will send 3 staff: project manager, 2 traffic safety specialists. ii) Preparation of Materials for Soft Component • Advertisement poster iii) Seminar Arrangement		**Pre-Condition** 1 No black-out takes place during field training. 2 Media like TV and newspapers cooperate to announce the necessity and significance of the program to the public.

Figure 3.2.1 Overall Time Schedule



Notes

Intersections being improved by Term 1

- A2 Maitighar
- A5 Koteswor Tinkune
- A8 Kalimati
- B9 Padmodaya Turning

Intersections being improved by Term 2

- A1 Kesharmahal
- A4 Koteswor Ring Road
- B1 Kalanki-Chowk
- B3 Singha Durbar
- B4 Ramshaha Path – Dilli Bazar
- B5 Naya Baneshwor