BASIC DESIGN STUDY REPORT
ON
THE PROJECT
FOR
RECONSTRUCTION OF BRIDGES (PHASE 2)
IN KATHMANDU
IN
THE KINGDOM OF NEPAL

OCTOBER 1991

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

In response to the request of His Majesty's Government of Nepal, the Government of Japan decided to conduct a basic design study on the Project for Reconstruction of Bridges (Phase 2) in Kathmandu and entrusted the study to the Japan International Cooperation Agency (JICA).
JICA sent to Nepal a survey team headed by Mr. Mamoru YAMAGATA, Project Manager, Honshu-Shikoku Bridge Authority, from April 9 to May 17, 1991.

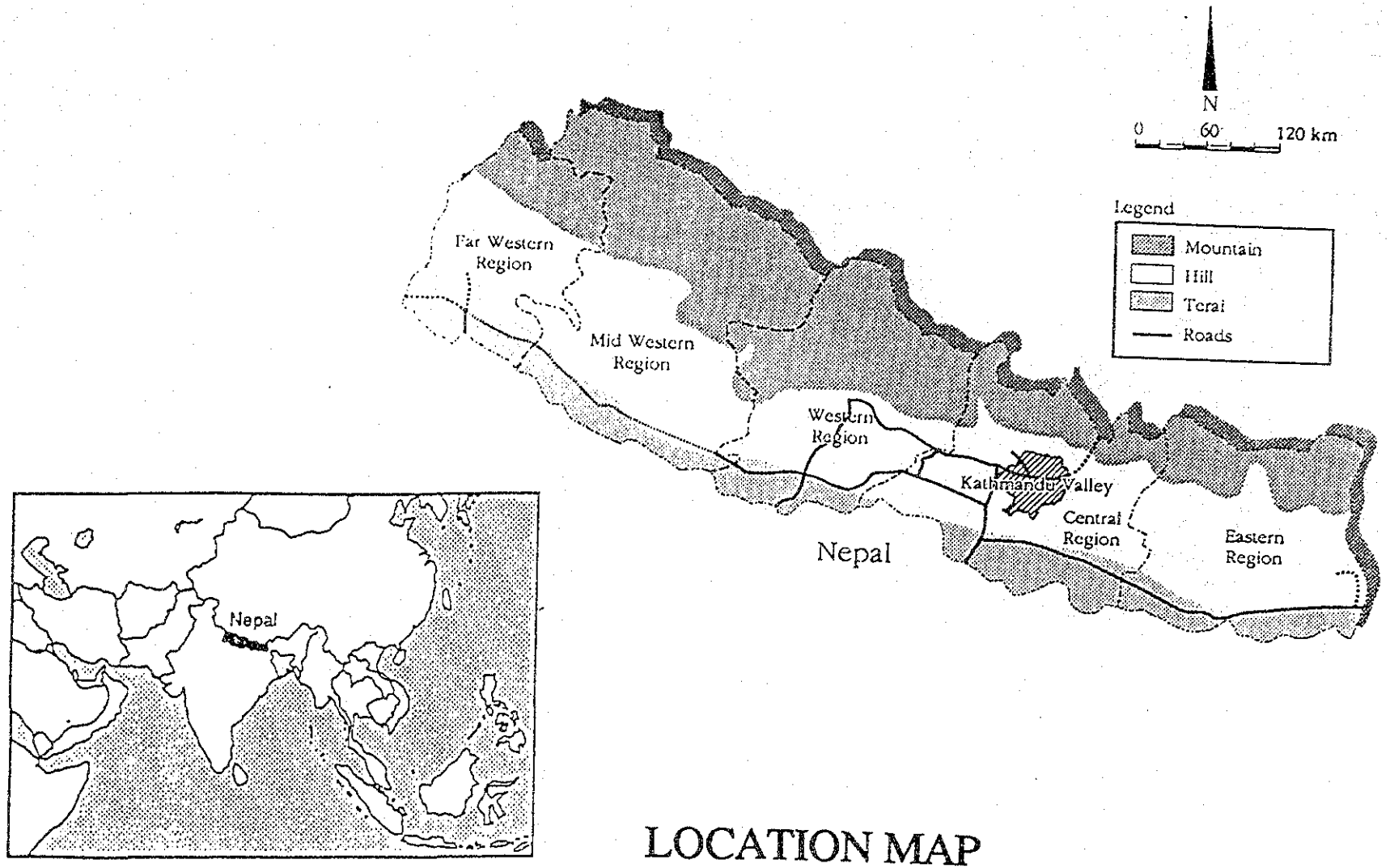
The team held discussions with the officials concerned of His Majesty's Government of Nepal, and conducted a field survey at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Nepal in order to discuss the draft report and the present report was prepared.

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 His Majesty's Government of Nepal for their close cooperation extended to the teams.

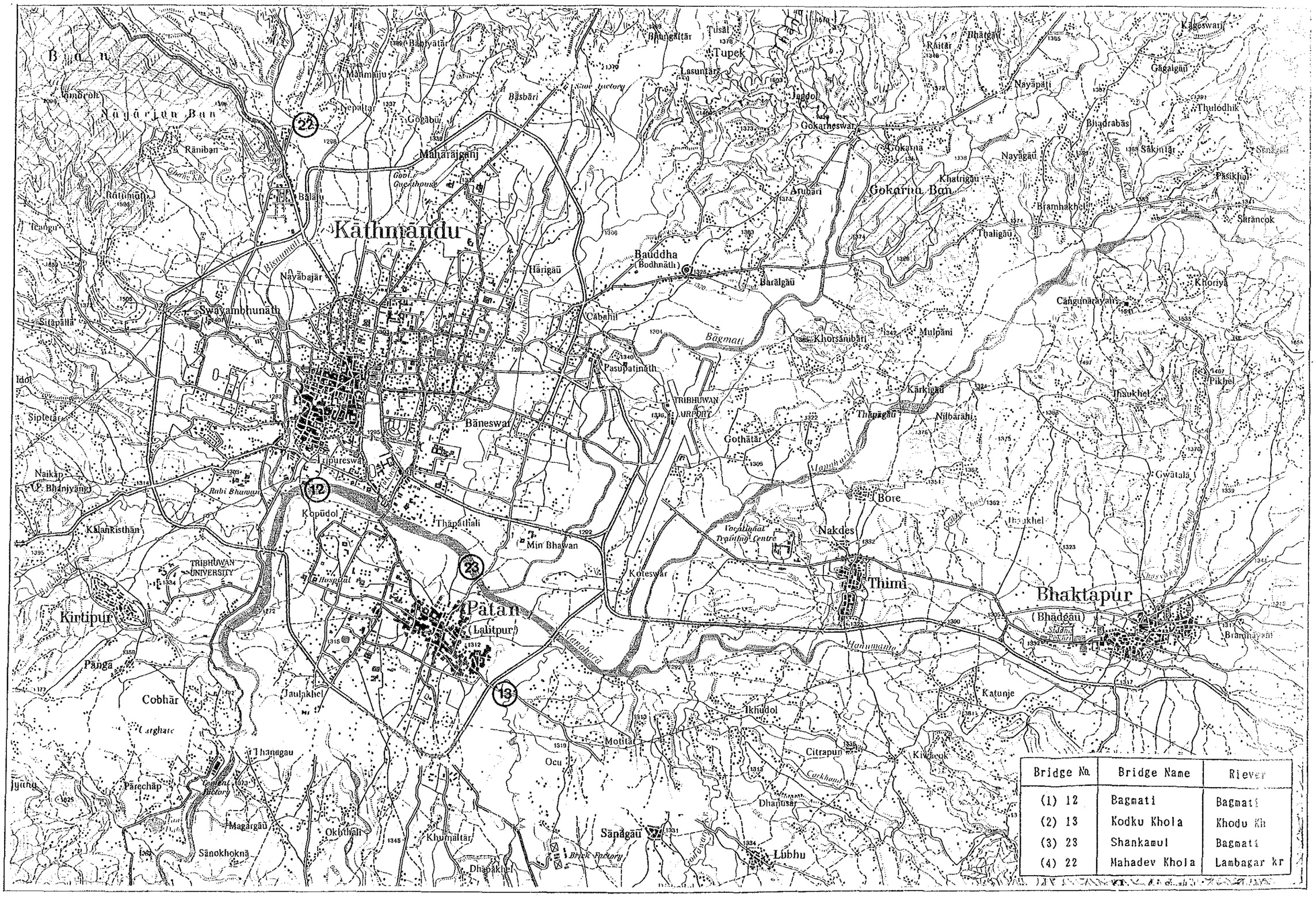
October 1991

Kensuke Yanagiya
President
Japan International Cooperation Agency



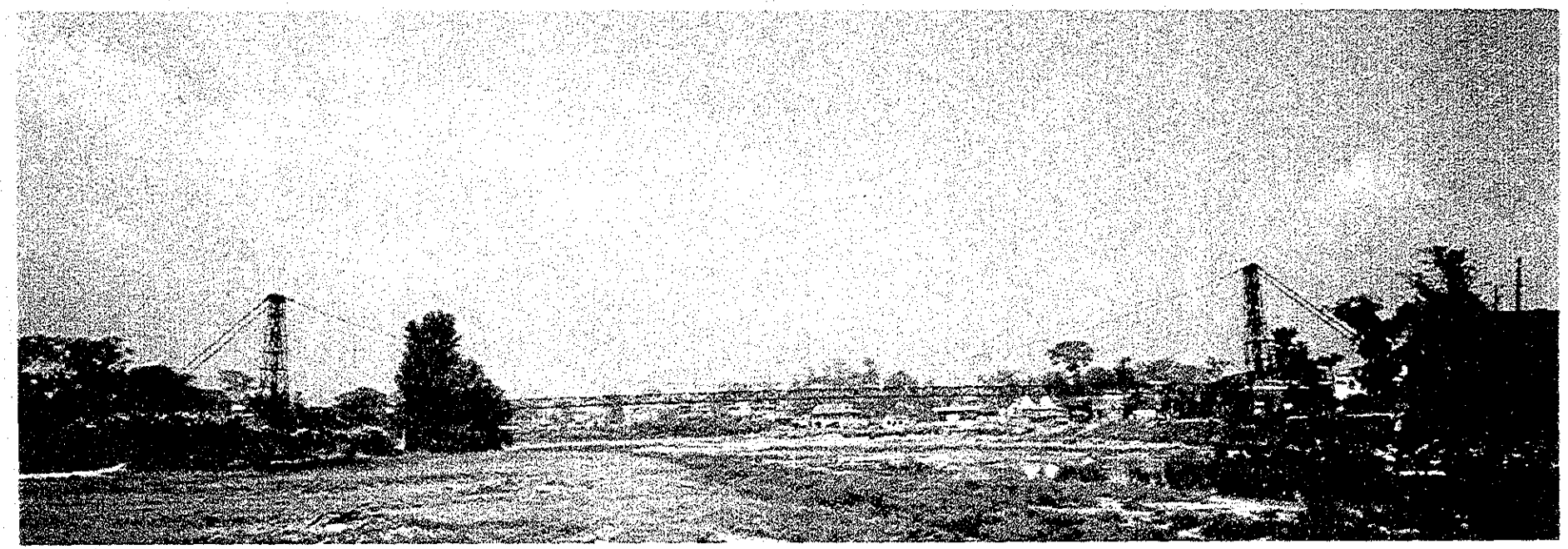
LOCATION MAP

PLANED BRIDGE LOCATIONS



Bridge No.	Bridge Name	River
(1) 12	Bagmati	Bagmati
(2) 13	Kodku Khola	Khodu Kh
(3) 23	Shankamul	Bagmati
(4) 22	Mahadev Khola	Lambagar kr

NO.12 Bagmati Bridge



	Existing Br.	Replacement
Length	122 m	130 m
Width	1.2 m	5.5 m
Type	Suspension Br.	Steel Plate girder
Year Constructed	1939	-

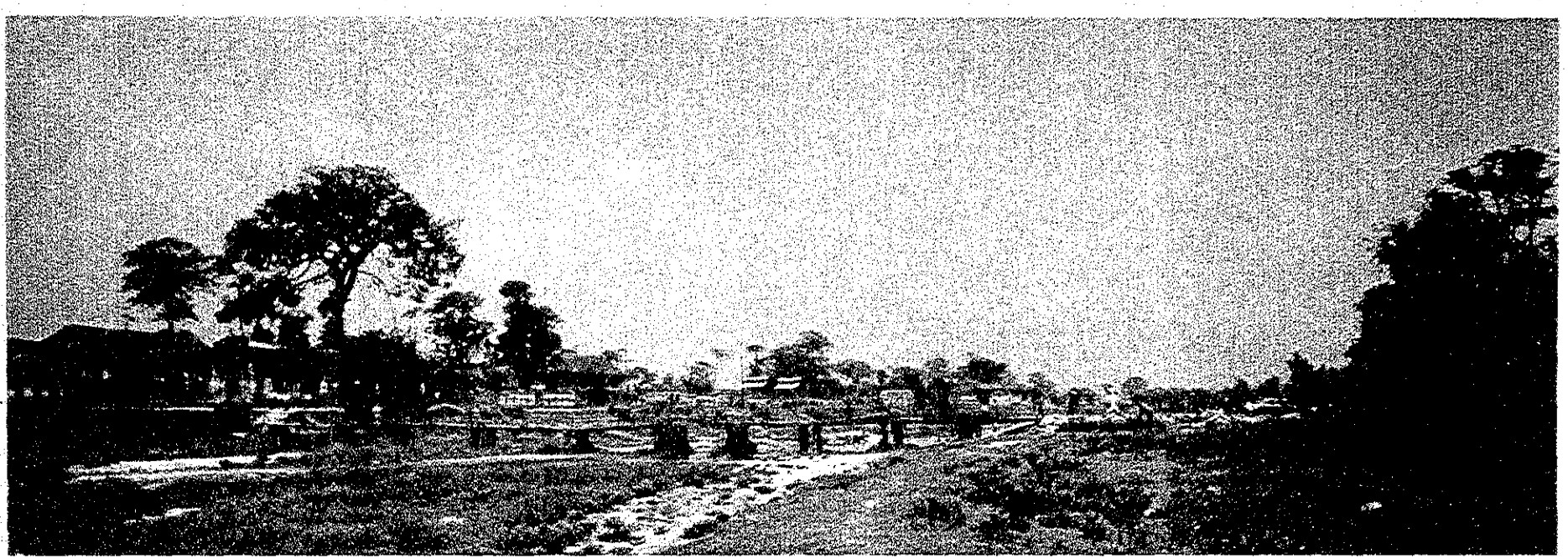
The left side shows the Patan City and right side shows the Kathmandu City. The buildings shown on the right side are temples.

NO.13 Kodku Khola Bridge

	Existing Br.	Replacement
Length	17 m	22 m
Width	3.0 m	8.5 m
Type	Steel Plate girder	Steel Plate girder
Year Constructed	1939	-

The left side shows the Patan City, and the right side indicates Sanagau and Lubhu where many brick factories exist. It is said that flood water over flows one metre above the bridge deck upon flooding.

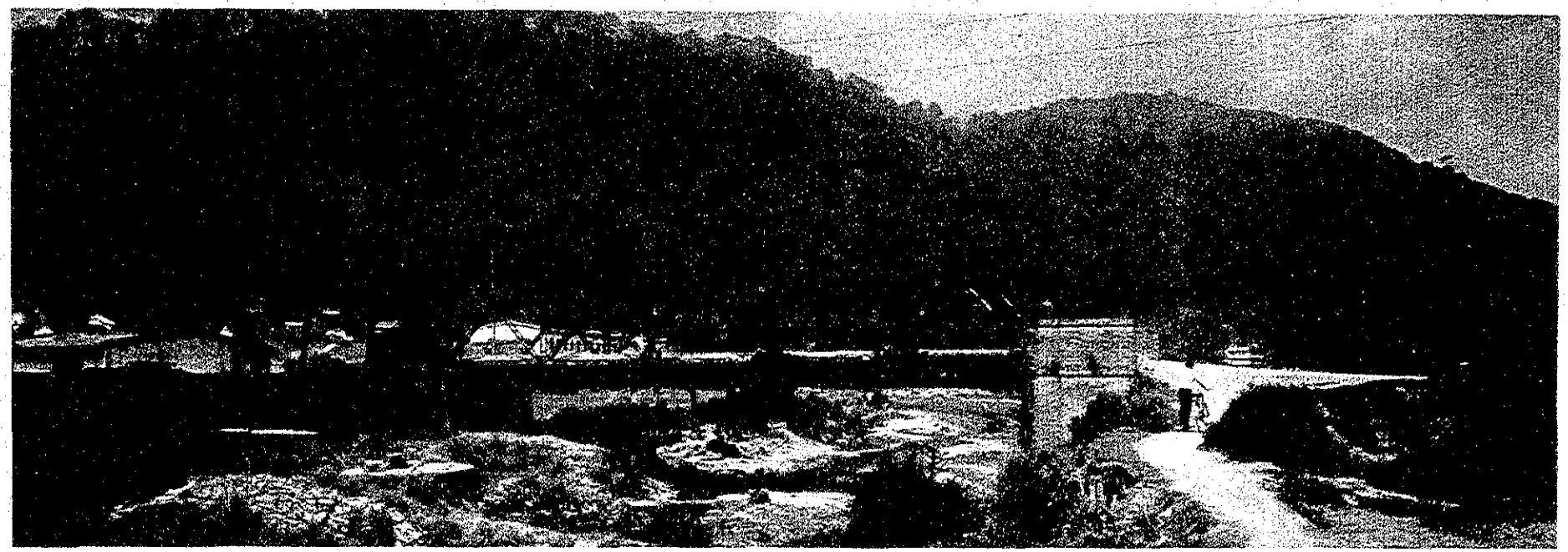
NO.23 Shankamul Bridge



	Existing Br.	Replacement
Length	150 m	115 m
Width	5.0 m	2.5 m
Type	Wooden Br.	Steel Plate girder
Year Constructed	1920	-

Original bridge fell down in 1988. The picture shows pedestrian temporally bridge.
The buildings shown on the left side are temples.

NO.22 Mahadev Khola Bridge



PH - 4

	Existing Br.	Replacement	
Length	25 m	30 m	The Katumandu City is located on the left side, and the Phutung is located on the right side.
Width	4.0 m	5.0 m	
Type	Steel truss Br.	Steel Plate girder	The concrete structure on the river bed in a circular shape is a water-intake well.
Year Constructed	before 1930	-	This elevation was the previous river bed level.

SUMMARY

All bridges in the city of Kathmandu are very old. They have never been adequately maintained, and are generally badly deteriorated. They risk the danger of collapsing due to scouring by flood flows during rainy seasons, and are also vulnerable to the destructive impacts of earthquakes as demonstrated by past records of bridges thus fallen.

Consequent to the national economic growth achieved in recent years which centered in Kathmandu, bridges in Kathmandu have been progressively falling behind the requirements of traffic demand, both in terms of volume and of loads. They have thus become bottlenecks of traffic in the city. Road congestion prevails as a result, and significantly impedes socioeconomic development not only in Kathmandu, but in Nepal as a whole.

Under such situations, His Majesty's Government of Nepal (HMG/N) requested the Government of Japan (GOJ) to extend financial assistance to reconstruct some of the bridges in Kathmandu on a grant basis.

In 1989, HMG/N identified 23 bridges which required replacement in Kathmandu, and sought assistance from World Bank (IBRD) to reconstruct four (4) of these, and from GOJ to reconstruct another six (6). GOJ responded by committing to provide the six bridges as requested on a grant basis. These are currently under construction. Subsequent to this assistance by GOJ, referred to as Phase 1, HMG/N requested GOJ in the following year to provide four (4) more bridges out of the 13 which remained to be replaced as Phase 2 Project.

In response to this, GOJ decided to undertake a preliminary study to establish the project requirements, and accordingly delegated a mission under JICA administration to conduct the necessary field study. During their 40-day visit

to Nepal, between 9 April and 17 may, 1991, the JICA Mission held meetings to discuss with responsible officials of HMG/N the scope and requirements of works involved in the request, conducted field reconnaissance, collected data and information for existing roads and bridge situations in and around Kathmandu, locations and environmental setting of bridges to be replaced, construction equipment, tools, and materials availability, market conditions and the current status of the local construction industry. They also conducted geologic, topographic, and traffic volume investigations at bridge sites, studied the required design criteria, scale, and type of structure for each of the four new bridges to be provided under the request.

On returning to Japan, and based on findings acquired through the field study, the Mission undertook a further study of the required bridge reconstruction schemes, determined the choice of type and span divisions for the new bridge structures, prepared their preliminary designs, quantities estimations, maintenance operation plans and cost estimates for the works involved.

The results of these studies are summarized in the Draft Final Report and are subject to presentation by The JICA Mission during their revisit to Nepal between 28 August and 5 September, 1991.

The primary objectives of this Project are, to prevent the development of hazards involved in the collapse of the existing bridges, to facilitate traffic operation, improve the urban roads service levels, contribute to the development of road transportation, thereby upgrading the environmental adequacy of life and socioeconomic activities in and around the city of Kathmandu.

The present situation of the four existing bridge structures involved in this Project, and the proposed schemes for their rehabilitation are as summarized below. (Note: Numbers in parenthesis following the bridge names are serial numbers given in the original list of the 23 bridges identified in 1989 for rehabilitation.)

(1) Bagmati Bridge (No. 12)

a. Present Situation

i. Bridge Features

- length : 122 m
- width : 1.2 m
- Structure : Suspension (pedestrian) bridge

ii. Bridge Condition

- Inadequate traffic capacity
- Severe deterioration of structure

b. Replacement plan

i. General Approach

- To construct a new bridge adjacent to the existing structure

ii. New Bridge Scheme

- type : Steel plate girder bridge
- spans division / length : 26 m x 5 = 130 m
- width : 5.5 m (including sidewalk)

(2) Kodku Khola Bridge (No. 13)

a. Present Situation

i. Bridge Features

- length : 17 m
- width : 3 m
- structure : Constructed of steel and timber in combination

ii. Bridge Condition

- Cannot accommodate two-way traffic
- Severe deterioration of structure

b. Replacement plan

i. General Approach

- To demolish the existing structure and construct a new bridge at the original location

ii. New Bridge Scheme

- type : Steel plate girder bridge
- spans division / Bridge length :
  22 m x 1 = 22 m
- width :
  1.0 m* + 6.5 m** + 1.0 m* = 8.5 m
  where, * = sidewalk widths
  ** = carriageway width

(3) Shankamul bridge (No. 23)

a. Present Situation

- The original bridge has already collapsed and is currently replaced by a temporary wooden pedestrian bridge.

b. Replacement plan

i. General Approach

- To construct a new pedestrian bridge at the original location

ii. New Bridge Scheme

- type : H-Beam steel girder bridge
- spans division / length :
  16 m x 6 + 19 m = 115 m
- width : 2.5 m (Pedestrian Bridge)

(4) Mahadev Khola Bridge (No. 22)

a. Present Situation

i. Bridge Features

- Length : 25 m
- Width : 4 m
- Structure : Steel truss bridge

ii. Bridge Condition

- Severe deterioration due to corrosion of structural members

b. Replacement plan

i. General Approach

- To demolish the existing structure and construct a new bridge at the original location

ii. New Bridge Scheme

- type : Steel plate girder bridge
- spans division/length : 30 m x 1 = 30 m
- width : 5.5 m (including sidewalk)

The substructures for all of the four new bridges will consist of steel pipe pile foundations with reinforced concrete piers.

The project cost is estimated at approximately 9.23 million Nepalese Rupees for the rececipient portion.

The total time period required for implementation and completion of the Project is estimated to be 23 months after commitment of the official agreement by the two Governments. This includes a total of six (6) months for consultant engagement, detailed design and engineering services, tender period and evaluation, contract preparation, and another 17 months for execution of works.

The immediate objective of this project is to reinstate or upgrade the bridges involved to such qualities and service standards as to be compatible with their current functional requirements. In practice, suitable solutions are required for each of the bridges respectively. Of the four bridges in this project, three are of inadequate bearing strength and are in danger of collapsing due to severe deterioration. They are: No. 12, Bagmati Bridge, No. 13, Kodku Khola Bridge, and No. 22, Mahadev Khola Bridge. The remaining one, i.e. No. 23, Shankamul Bridge, has already collapsed and is currently substituted by a hazardous temporary timber structure. The ultimate project objective is to contribute to the promotion of regional transportation and socioeconomic development through the dissolution of relevant traffic bottlenecks in the city

of Kathmandu, by upgrading the traffic capacities of the bridges to cope with their respective traffic demands.

In addition to such direct effects as the bridge rehabilitation, this project will also have a remarkably extensive impact on socioeconomic development particularly in the region of influence of Kathmandu. The urban center of Kathmandu today is being seriously confronted by numerous urban environmental problems brought about by population concentration. These include among others housing problems, traffic problems, air pollution, water contamination, and sanitation problems. In pursuit of improving such situations, studies are being undertaken by the relevant agencies of GON to establish urban development and road improvement programs for the metropolitan region of Kathmandu.

Principal orientations of future development identified in the Urban Development Program are, (1) to extend beyond the ring road which encompasses the over-congested city centre further outward into the outskirt of the city to its northwest and southeast, and (2) to develop the green area along the Bagmati river between Kathmandu and Patan, and integrate these two urban areas across the river. The main issues of development identified in the Road Improvement Programme are, construction and/or expansion of (1) the riverside road along the left bank of the Bagmati River, and (2) the two existing river crossing structures (i.e. Bagmati and Shankamul Bridges in this Project), and their approach roads.

Kodku Khola Bridge (No. 13) and Mahadev Khola Bridge (No.22) locate at strategic positions for future urban development in the outskirts of Kathmandu to its northwest and southeast, as stated above. Bagmati Bridge (No. 12) and Shankamul Bridge (No. 23) locate at places of such importance in the

Metropolitan area of Kathmandu, that their functional adequacy are prerequisite to sound urban and road transportation development in the Kathmandu Metropolitan area. In view of the importance of these bridges, their provision on a grant basis would be unquestionably of great help and hence a very meaningful assistance to HMG/N. It is therefore strongly recommended that this project be subject to implementation as requested by HMG/N as early as possible.

Regarding the construction scheme of Shankamul Bridge, it should be noted that the bridge proposed herein for the exclusive use of pedestrians and bicycles is only a provisional means to meet the immediate traffic demand. This is because the location and timing for construction of the riverside road along the left bank of the Bagmati river, which will eventually serve as the approach road to the bridge, is yet unknown, and that it would only be reasonable to construct the permanent bridge after the nature and details of its approach road is determined. In view of the foreseeable advantages of having a vehicular bridge at this location, it is strongly recommended that early actions be taken to render necessary contextual settings ready for the construction of such a road bridge.

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[APPENDIX]

[ABBREVIATION]

AASHTO	-	American Association of State Highway and Transportation Officials
ACRS	-	Atmospheric Corrosion Resistant Steel
ADB	-	Asian Development Band
D	-	Day
DHPP	-	Department of Housing and Physical Planning
DOR	-	Department of Roads
E/N	-	Exchange of Notes
EPCL	-	Epicenter Location
GDP	-	Gross Domestic Product
IMF	-	International Monetary Fund
JICA	-	Japan International Monetary Fund
JS	-	Japanese Standard
M	-	Month
MOF	-	Ministry of Finance
MOT	-	Ministry of Tourism
MOWT	-	Ministry of Works and Transport
NBCI	-	National Building Code of India
NGO	-	Non Government Organization
NRS	-	Nepal Road Standards
NTC	-	National Transport Corporation
Y	-	Year
cm	-	centimeter

kg/cm^2	-	Kilogram per square centimeter
kg/m^2	-	Kilogram per square meter
km^2	-	Square kilometer
kg/m^3	-	Kilogram per cubic meter
kg	-	Kilogram
m	-	millimeter
t	-	metric ton
%	-	percent
US$	-	United States Dollar

CHAPTER 1. INTRODUCTION

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His Majesty's Government of Nepal (HMG/N) made a request to the Government of Japan (GOJ) with respect to the replacement of four bridges comprising Bagmati, Kodku Khola, Shankamul and Mahadev located in the Kathmandu city under the grant aid programme.

The Japanese Government, in response to the request of the HMG/N, agreed to carry out the basic design study and dispatched to Nepal a study team headed by Mr. Mamoru YAMAGATA, project manager of the Honshu - Shikoku Bridge Authority during the period of April 9 and May 17, 1991.

The purpose of this study is to affirm the substantial contents of the request made by the Nepal Government, the background information and to review the social and economical effects of the project as well as the suitability of the grant aid programme and to undertake the basic engineering design required to achieve the most appropriate solutions for the bridge project.

Composition of the study team, itinerary of the study, a copy of the minutes of discussions, and a list of the related authorities of HMG/N are appended at the end of this report.

The basic design study team noted the views of the authorities pertaining to the existing site conditions at the four bridges mentioned earlier and was able to confirm the contents of the request through these discussions as well as the data collection and in addition, carried out the field study as summarized in the following:

- To carry out a study on the existing conditions at the project sites, soils, topography, hydrogeology, etc. also a traffic survey to determine the traffic conditions in order to review the technical points of the project;
- To carry out a study on the status of the construction industry within Nepal, related laws and ordinances and construction methods to be employed on site necessary to estimate the construction cost and to establish the construction schedule;
- To carry out a study on the construction planning and construction executive organization for the project;
- To carry out a study on the bridge maintenance organization and capability of the Nepal Government;
- To carry out a study confirming the scope of work to be undertaken by HMG/N;
- To carry out a study on the appropriateness of the project and the influence of the project after execution;

Based on the study results as described heretofore, the study team has prepared the Draft Final Report to present and to explain it to HMG/N. And though a series of discussions on the project with the officials concerned of the Government, the study team has compiled the Final Report.

CHAPTER 2. BACKGROUND OF THE PROJECT

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2.1 Outline of the transportation and traffic

2.1.1 Administration

The administrative organization of the Nepal Government comprises a total of 28 ministries and agencies, the administration for road transportation is in the hands of the Ministry of Public Works and Transport. However, the urban planning and road planning are the responsibility of the Ministry of Housing & Physical Planning. As this project is for replacing the existing bridges, it is in the charge of the Ministry of Public Works and Transport and the Department of Roads which is under the control thereof. An organization chart of the Department of Roads is as shown in Table 2-2.

2.1.2 Budget

The budget allocated for roads and bridges to the Ministry of Public Works and Transport in the past three years is as follows:

(Unit: Rupee 1,000)

Year	Roads	Bridges	Total
1) 1988/89	1.392,010	114,270	1.506,280
2) 1989/90	1.115,220	141,700	1.256,920
3) 1990/91	1.552,290	91,180	1.643,470

(Source of data : Ministry of Finance)

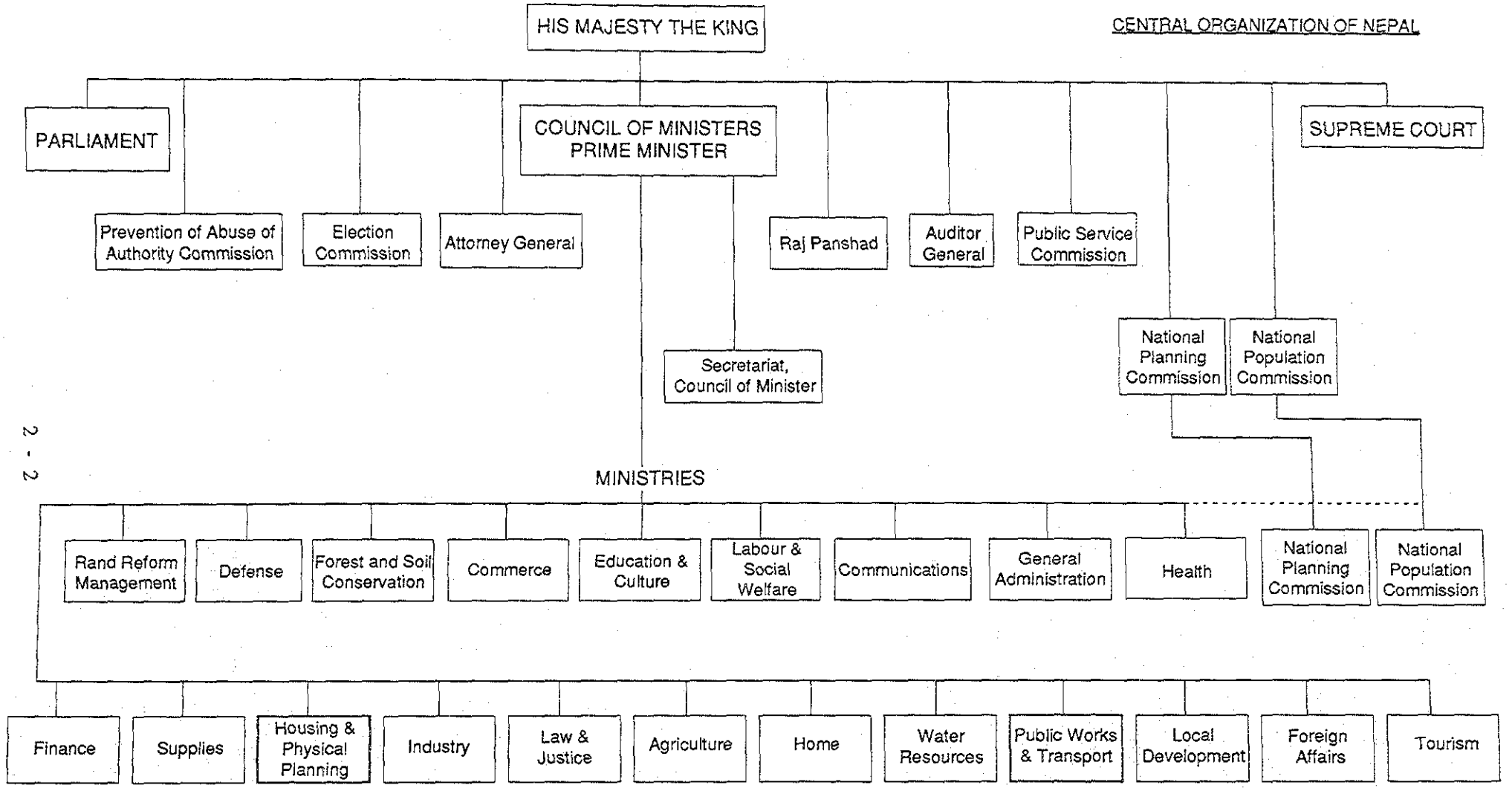
The portion of this budget allocated for the maintenance of roads and bridges was as follows:

(Unit: Rupee)

	Amount of budget	Amount executed	Ratio of Maintenance cost vs Budget total amount
1) 1978/88	40,000	29,700	-
2) 1988/89	50,000	47,756	3%
3) 1989/90	60,000	56,078	4%
4) 1990/91	50,000	-	-

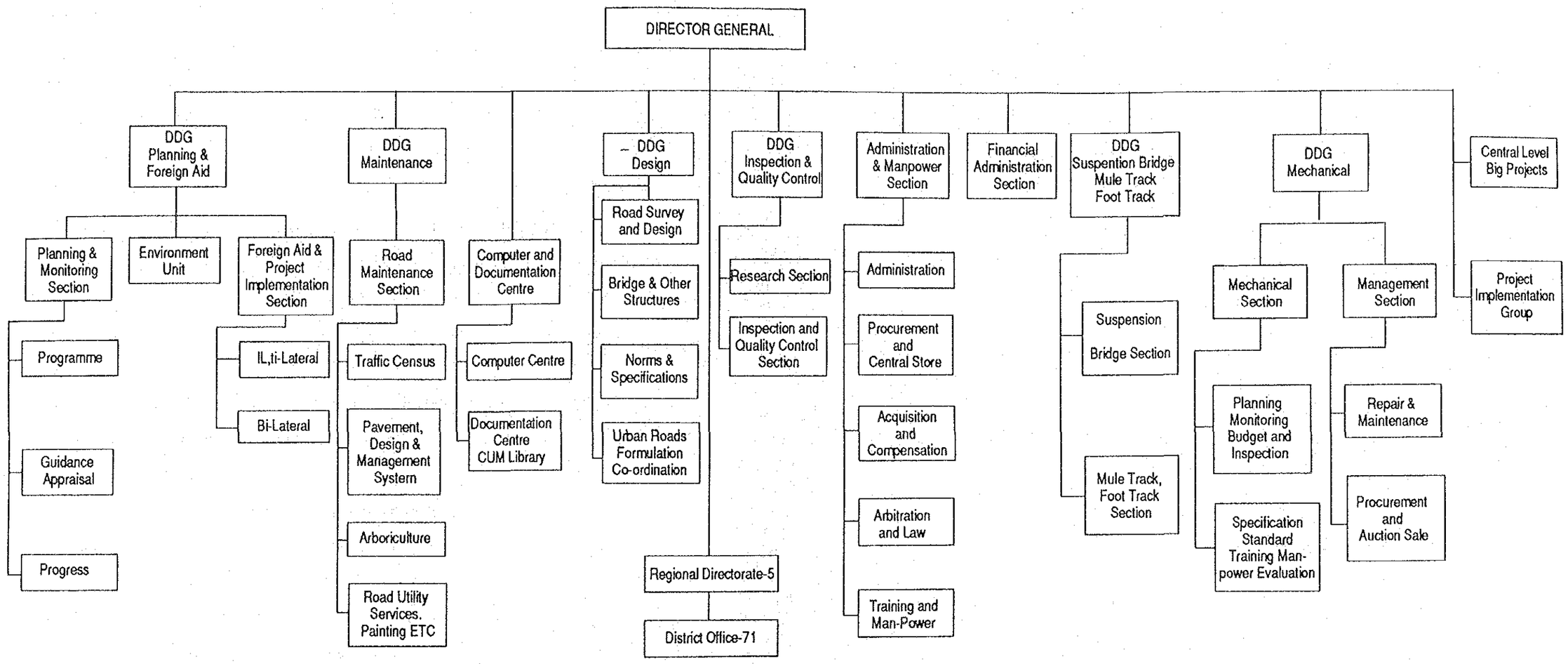
(Source of data : Department of Roads, Ministry of Public Works and Transport.)

Table 2-1 : Administrative organization of Nepal



His Majesty's Government
MINISTRY OF GENERAL ADMINSTRATION
Administrative Reforms Wing
Organization & Management Division
Harihar Bhavan, Pulchowk.

Table 2-2 Organization chart of Department of Roads



Note: DDG = Deputy Director General

2.1.3 Outline of traffic

The transportation system of Nepal is somewhat delayed and limited very much owing to the geographical and climatic conditions of the country. On account, a series of steep mountains and the tremendous amount of floods that occur during the monsoon season, consequently the transportation infrastructure, especially the improvement and maintenance of the roads and railways are impeded. In the past, transportation of goods was largely dependent on manpower and animals for long periods of time, which did not require any modernized methods of transportation traffic.

Improvement of the economical infrastructure to promote the development of natural resources, acceleration of industrial development, augmentation of agricultural production, etc., which are the objectives of the economical development scheme have become indispensable requirements in recent years. Because of this, a large amount of investment has now been granted to the transportation sector and the majority of this is allocated to the improvement of roads.

The Kingdom of Nepal is a land locked country, and the road traffic which constitutes the land transportation system is playing a principal role in the movement of goods. Nepal is bordered by India and China and the majority of imported goods other than from these countries are coming by way of the port of Calcutta in India to the major cities in Nepal via the in-land transportation system. The transportation of domestic goods with vehicular traffic is not too developed and the goods transport, except passenger transport in the cities to and from India, forms the main activity as the history of improvement for the road network is relatively recent and the development of the national economy is not progressing satisfactorily.

As far as transportation in the cities is concerned, the traffic volume in recent years is very much increasing especially in the Kathmandu city

where the concentration of the population is also significant. As the Kathmandu city was developed with almost no definite urban programme, there are certain problems concerning the traffic within the city which would require urgent attention, particularly, the protection of old historical streets, development of roads, safety measures for public hazards and so forth.

2.1.4 Situation of the project implementation

The total linear road length in Nepal was merely 376 km in 1951. However, it showed a significant increase, as much as 6,306 km in 1987, and approximately 44% of it has been paved with bituminous materials. In view of the fact that the road improvement scheme has been performed drastically at a nationwide level as described heretofore, a smooth economical development based on the national programme can surely be expected.

The Department of Roads which is responsible for road development comprises 5 Regional Roads Directorates, 75 Roads District Offices, 6 Heavy Construction Equipment Workshops and 13 Laboratories, and a total of 2,375 persons are employed at these offices. Although the number of staff at the Department of Roads has been increased very much in line with the dramatic increase in the total linear road length, the absolute number of technical staff is still inadequate and the technical capability is not high. Many construction projects were carried out under foreign aid programmes, nevertheless, it appears that the technical transfer was not adequately performed. Reportedly, a project to revise the organization of the Institution will be introduced by means of assigning the right man to the right job, improving the technical level, etc. which are aimed at the effectiveness of the budgetary execution of the Department of Roads with

assistance to be rendered by the ADB shortly. (Road and Road Transport Institutional Development Project)

Vers little, road improvement work has been carried out in the Kathmandu city area, to meet the increased traffic demands. Also, the number of people who utilized the public transportation service in the 11 years from 1972 to 1983 increased at the average high rate of 8 % annually.

The total number of vehicles registered in 1983, such as bus, private car, jeep, taxi, truck, etc. had increased to about twice that in 1972. In addition, according to the data in 1991, the registered number of vehicles has been increased to approximately twice the number recorded in 1983.

Despite the remarkable growth in traffic volume, only the construction of the ring road traversing the outside of the Kathmandu city was achieved. With respect to the planning for the Kathmandu city area, the Ministry of Housing and Physical Planning has a previous plan, but so far nothing has been achieved on account of the budgetary situation.

The planning of roads is included in urban planning, nevertheless, there is no prospect of either new construction or improvement of existing roads occurring and the plan itself is far exceeded by the current status of development.

In order to overcome this situation, a study was commenced to review the land use in the city area with the assistance rendered by ADB and consequently a new urban plan is in the process of being prepared. This study is in progress for the purpose of defining how the limited land could be used effectively against the increase in population and traffic volume in ten years from now. The submission of the Draft Final Report is expected in August 1991.

According to the Interim Report, the increase in the population shows as high as 3.5% annually (out of which the social increase amounts to 2.0%)

and the traffic volume is estimated to double in size. If the urban planning as well as the transportation programme remain unattended, the city's ability to function will be seriously impaired. The Nepal Government has already made a request to the Japanese Government to seek the technical assistance required for the establishment of the transportation programme, and its implementation is expected to commence shortly.

In addition, the World Bank and Japan are rendering their assistance in the restoration of some of the existing deteriorated bridges which are obstructing traffic flows in the cities, consequently this project forms part of the restoration.

2.2 Development programme

2.2.1 National development programme

The national development programme started its first 5 year plan in 1956 and the 8th five year plan (1990/91 ~ 95/96) is currently in progress. Up to the 4th five year plan an emphasis was placed on the importance of the improvement of the production infrastructure, consequently a large amount of the budget was allocated to transportation infrastructure. The emphasis was placed on the improvement of facilities for the economical infrastructure related to the transportation in order to accelerate industrial development; to increase agricultural production and to promote the natural resources development, all of which was the target of the economical development programme. In so far as investment was concerned, it was allocated to the improvement of the road network, particularly to the construction of some trunk roads. Inasmuch as the economical growth was unable to attain its programme successfully, after the 5th five year programme (1975 ~ 80) the priority changed to such sectors when the relation ship with production increased directly and yet was effective enough in a short period of time. As a result, the agricultural

sector was preferred to the transportation sector. The 8th five year plan has succeeded this trend in the object to accelerate the increment of production, the development of employment opportunities in the fields of production and the fulfillment of the needs of the nation, which are regarded as the three major targets.

The target growth rate of the GDP during the period of the plan amounts to 4.5%, out of which the agricultural and non-agricultural sectors are scheduled to attain 3.5% and 5.7% respectively. However, as the country is bordered by China and India and the national economy is not in a strong position it is likely to be influenced by the economy of these countries. Recently, the Indian currency has been devaluated and there is concern that some influence will occur in some form directly or indirectly.

2.2.2 Transportation and traffic programme

The transportation sector comprises the roads, bridges, airports, aerial navigations, railways and ropeways. They were assigned a high priority in the first 5 year plan and thereafter, out of which the improvement of the roads and bridges occupies more than 80% of this sector. The improvement of the roads was focused on the east-west highways which run through the Terai area in the southern part of the country and the several stretches of the north-south connecting highways. The improvement of these roads was carried out with the assistance rendered primarily by India, Soviet Union, USA, China, UK and the ADB. For the improvement of other road networks, the emphasis was placed on quality and quantity, within the central part of the country where a concentration of the population is in progress. (See Fig. 2-2-1).

For traffic to the Kathmandu city, which is the centre of economical and social activities, there are two routes available, they are, from India and China. However, there is one route from India and in the rainy season,

land-slides occur from time to time, which result in a bottle-neck to such an extent that the capital city is nearly isolated.

The importance of the Sindhuli Road is envisaged from the view point of access to the Kathmandu city from the south-eastern part of the country which forms a laterally long territory. This route links not only the Kathmandu city and Terai area in the south-east direction, but would also be vitally effective in terms of securing a substitutive route to serve as a life line for the transport of import and export goods. The Nepal Government made a request to the Government of Japan to seek assistance pertaining to this road scheme, consequently a feasibility study was conducted. However, no progress has since been made to realize its construction.

The drastic urbanization of the Kathmandu metropolitan area is in progress, as in other developing countries. However, the urban programme is not being carried out satisfactorily and the improvement of the urban traffic system is out of date in view of the improvement of facilities, and management & operation.

As spelled out in 2.1.4, the ADB is implementing the land use programme of the metropolitan area and the Japanese Government is expected to implement the preparation of the Master Plan for the target year 2015. This will include the road programme, in line with the land use referred to above, as well as the execution of the Feasibility Study with respect to the improvement plan under the short term.

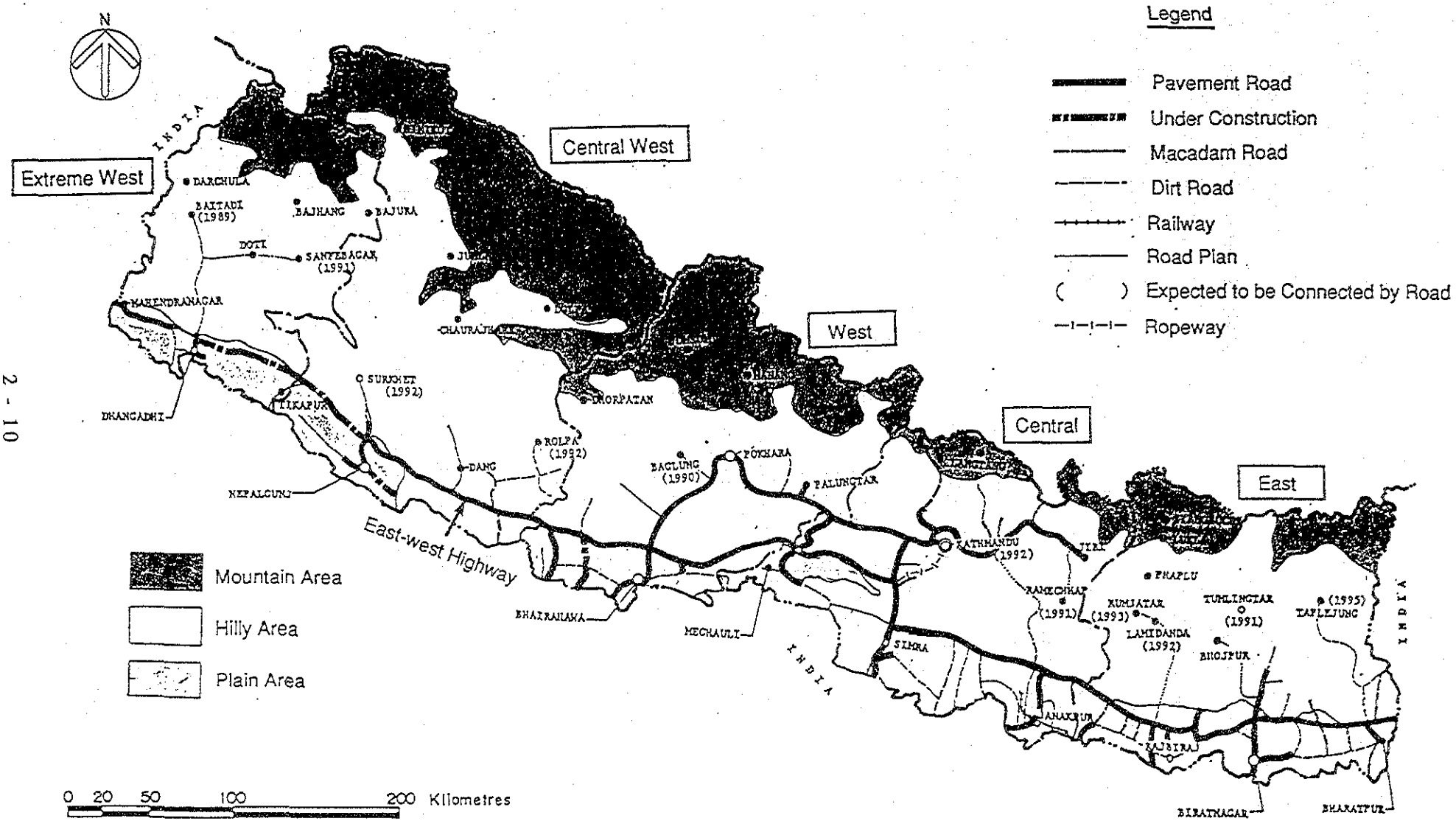


Fig. 2.2.1 Road Network and Improvement Plan by 1995 in Nepal

2.2.3 Relation ship with the assistance programme for related projects by international organizations

The following is a summary of related projects in surrounding areas of the Kathmandu city which are currently being executed or are planned to be executed:

(1) Replacement plan for six bridges in the Kathmandu area (Japan);

(2) Replacement plan for four bridges in the Kathmandu area (World Bank);

(3) Urban programme in the Kathmandu area (ADB); and

(4) Road programme in the Kathmandu area (scheduled to be carried out by Japan).

Paragraph (1) would correspond to Phase-1 and Phase-2 of this Project where paragraph (1) is under construction. By virtue of the completion of three projects, i.e., the project of paragraph (1) and of paragraph (2) by the World Bank and this Project, the bridge replacement programme for principal bridges will almost be completed.

With reference to the project of paragraph (3), it is under study at present and reportedly, the project of paragraph (4) is a matter of sometime in the future. It is understood that the bridge replacement programme by the implementation of the projects of paragraph (1) and (2) and this Project will form one of the fundamental premises in the execution of the projects of paragraph (3) and (4) mentioned above.

2.3 Circumstances and contents of the request

2.3.1 Circumstances

Almost all existing bridges in the Kathmandu city, with the exception of the ring road bridge constructed with the assistance rendered by the People's Republic of China, have a noteworthy deterioration in progress owing largely to their age and inadequate maintenance. Furthermore, they are in an unstable conditions due to the scouring action of floods which occur in the rainy season. In addition, the area is subject to earthquakes and as seen from past records damage to bridges has occurred.

It is stressed that the condition of the existing bridges is inadequate from a strength point of view to withstand the increase of vehicle traffic and loads connected with the recent economical development and urbanization centered in the Kathmandu city. Furthermore, the inadequate bridge widths and load limits are causing traffic jams. This situation is forming an obstruction to the development of Kathmandu city.

Under such circumstances as described above, the Nepal Government stated in 1989 that 23 bridges in the Kathmandu city would require replacement. The Government, therefore, made a request to the World Bank and the Japanese Government for assistance in the replacement of four bridges and six bridges respectively. (See Table 2-3-1 and Fig. 2-3-1). The Japan International Cooperation Agency (JICA) conducted the basic design study under the grant aid programme, in response to this request. From October 1989 to March 1990, the Government of Japan made a decision to provide the grant aid relevant to the project scheme (The Exchange of Note was signed in November 1990) and the work is in progress, as mentioned above.

A request was made on the replacement of four particular bridges out of the remaining 13 bridges at this time.

2.3.2 Contents of the request

The Four Bridges which are subject to replacement in the contents of the request are as shown in the following table:

No.	Name of Bridge	River to be bridged
12	Bagmati	Bagmati
13	Kodku Khola	Kodku
23	Shankamul	Bagmati
22	Mahadev Khola	Lambagar Kh

Table 2.3.1 Existing bridges requiring replacement in the Kathmandu valley.

		(m)	
1.	Biahhumati Bridge (Swaha Bhagwati)	80	World Bank
2.	Biahhumati Bridge (Dallu)	80	Phase-1
3.	Biahhumati Bridge (Kamkoswari)	80	
4.	Dhobi Khola (Kalo Pul)	45	Phase-1
5.	Dhobi Khola (Rato Pul)	45	World Bank
6.	Dhobi Khola (Handi Gaon)	60	Phase-1
7.	Dhobi Khola (Babar Mahal)	50	Phase-1
8.	Mahadev Khola Bridge	45	Phase-1
9.	Manmatta Bridge	45	Phase-1
10.	Manhara Khola Bridge	100	
11.	Nakkhu Bridge	50	World Bank
(12)	Bagmati Bridge	120	Phase-2
(13)	Kodku Khola Bridge	20	Phase-2
14.	Hanumante (Hanumante Ghat)	30	
15.	Hanumante (Ram Mandir)	30	
16.	Hanumante (Barahi Than)	30	
17.	Hanumante (Sallaghari)	30	
18.	Bageswari	15	
19.	Ratu Bridge	15	
20.	Naikap	30	World Bank
21.	Balkhu	30	
(22)	Mahadev Khola	45	Phase-2
(23)	Shankamul	145	Phase-2

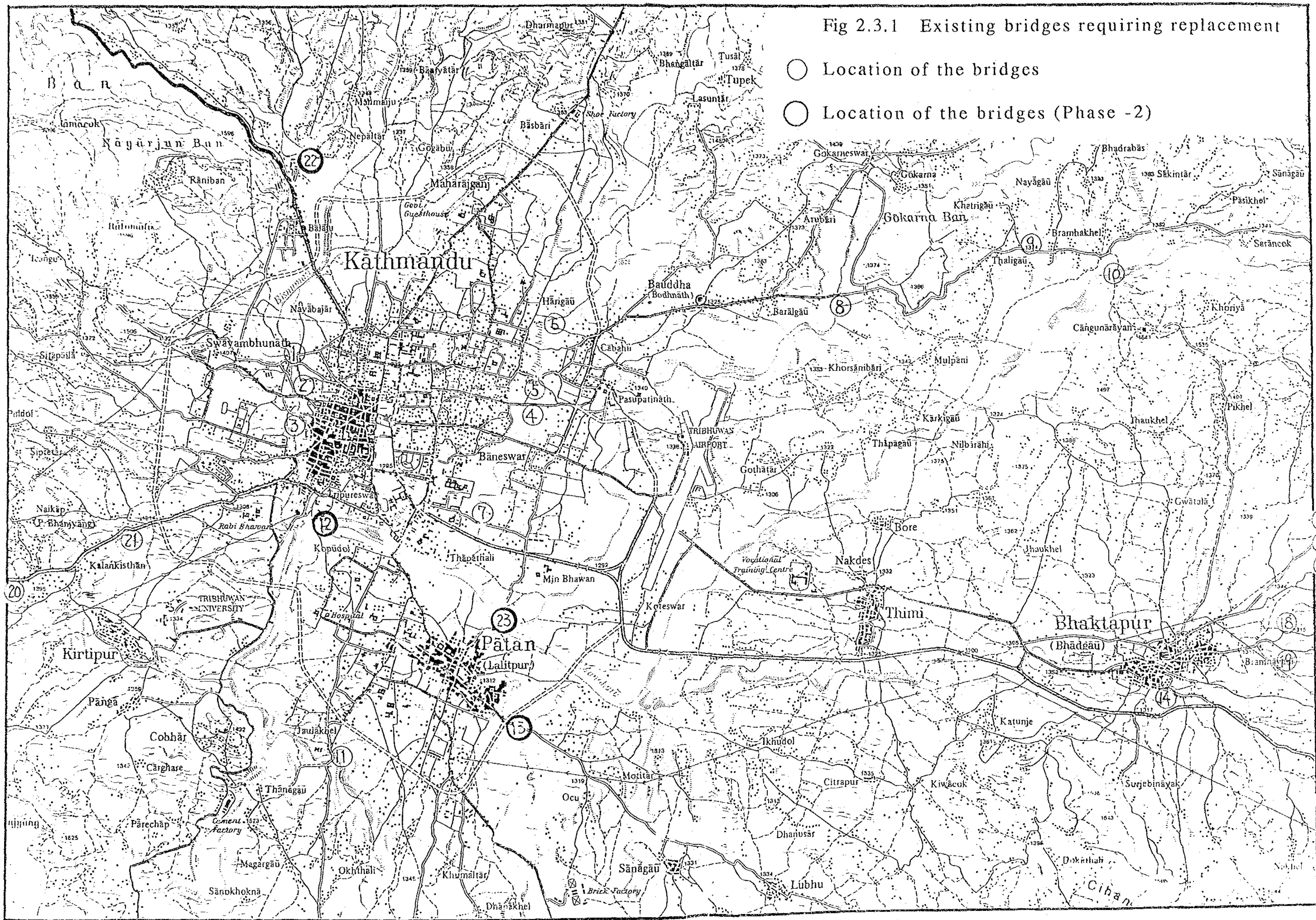


Fig 2.3.1 Existing bridges requiring replacement

CHAPTER 3. OUTLINE OF THE PROJECT SITES

CHAPTER 3 : OUTLINE OF THE PROJECT SITES

3.1 Outline of the Study Area

3.1.1 General

The Kathmandu city is the capital of the Kingdom of Nepal, having a population of approximately 600,000 and lying slightly eastward of the central part of the country and forming the political, economical and cultural centre. Kathmandu is located in a valley at approximately 1,300m above sea level and surrounded by mountains such as Purchouki (2,760m), Nagarkot (2,166m), Swaburi (2,725m), etc.

The flat area in the valley consists of either inundated land or lowlands of rivers where the Bishnumati and Dhobi Khola rivers flow from north to south and meet at the Bagmati river together with the Manohara and Hanumante rivers. At this point, the river changes its name to the Chobar Gorge river and eventually joins the Ganges river in India.

The Kathmandu valley is located in latitude 27°N, the climate belongs to the subtropical zone and the average daily temperature falls within the range of maximum 28°c and minimum -4°c.

The rainy season starts in May and ends in September, during which period the precipitation ranges from 100 to 400 mm, while in the dry season from October to April it ranges from 15 to 45 mm. The annual rainfall on average amounts to 1,307 mm. In the rainy season the wind blows either north or east, whilst in the dry season it blows either west or north-west. According to the seismic record taken in the past, an earthquake of greater than magnitude 5 occurs on average once a year in the Kingdom of Nepal. The National Building Code of India 1970, Part IV, Indian Standards

Institution reveals that the Kathmandu valley is regarded as one of the more dangerous zones in Nepal.

3.1.2 Population

The Kathmandu metropolitan area consists of Kathmandu city (the total population is 422,000 and the urban population is 235,000) and Patan city (the total population is 184,000 and the urban population is 81,000). The population of the metropolitan area in 1981 was 606,000 and for the urban area was 316,000. The average annual rate of increase of the total population of Kathmandu and Patan cities during the 10 years from 1971 to 1981 was 1.8% and 1.7% respectively, which is lower than the nationwide average growth of 2.7%. From the viewpoint of urban population alone, the Kathmandu and Patan cities indicate 4.6% and 4.7% respectively. The population of the urban metropolitan area is increasing, (Development Atlas of Nepal, 1988 & Population Monograph of Nepal 1987) the estimated population of the urban metropolitan area in 1991 would amount to 470,000.

3.1.3 General traffic conditions in Kathmandu city

It can be said that the urban traffic in the Kathmandu area as shown in Tables 3-1-1, 3-1-2 and 3-1-3 comprises of a high rate of traffic together with pedestrians and bicycles, one of the features of this area. In addition, there is a traffic of animal drawn carts such as cowcarts, cultivators, push carts etc. which are not reflected in the statistics, but impede the smooth flow of vehicles. Furthermore, many vehicles, the number of which have increased drastically, are parked on the roadside due to deficient parking facilities and are significantly decreasing the traffic capacity of the roads.

Table 3-1-1: Composition by classified Type of vehicles for urban traffic in Kathmandu city

Vehicle Type	1983	1972
private car	45%	25%
•Taxi		
Truck	2%	2%
Bus	4%	
Motor cycle	9%	10%
Bicycle	38%	59%
Rikshaw	2%	4%
Total	100%	100%

Source of data: International Development Centre, Economical Infrastructure Study Report for Nepal, Bangladesh, Pakistan and Sri Lanka, 1986

Table 3-1-2: Commuting methods in Kathmandu city

On foot	58.0%
Bicycle	8.8%
Bus	22.0%
Motor cycle	5.5%
Vehicle (excluding bus)	4.0%

Source of data: Ministry of Housing & Physical Planning (1990)

Table 3-1-3: Percentage of number of vehicles owned by the citizens of Kathmandu

Vehicle	4%
Motor cycle	12%
Bicycle	31%
Not included in the above	69%

Source of data: Ministry of Housing & Physical Planning

Table 3-1-4: Number of vehicles registered in Nepal (as of June 1991)

Prefecture / Vehicle classification	Mechi	Koshi	Sagarmatha	Janakpur	Bagmati	Norayoni	Gandaki	Lumbini	Rapati	Bheri	Seti	Mahakali
Bus. Minibus. Trucks and Heavy Vehicles	377	732	182	234	5,670	4,404	582	614	41	323	173	190
Tractors, Power Trailers	-	-	182	539	1,512	1,611	211	1,173	151	205	147	86
Private cars	4	27	-	-	2,236	576	-	84	2	-	2	1
Motorcycles, Scooters	469	1,822	681	778	21,929	4,422	797	1,322	143	602	132	169
Handy Carts	-	956	-	1	352	7	-	25	-	-	-	-
Rickshaws	1,286	2,317	626	712	470	1,043	-	5,242	26	695	527	-
Jeep Cars	228	3,053	388	241	17,937	2,581	931	427	42	309	97	104

3.2 Road improvements scheme in the study area

The road improvement scheme in the study area is shown on the Kathmandu Area Road Plans prepared by the Ministry of Housing & Physical Planning, Government of the Kingdom of Nepal.

The major portion of the scheme comprises the construction of the riverbank road along the left hand bank of the Bagmati river which runs between Kathmandu and Patan cities, shown with a dotted line in Fig. 3-2-1. Also, the new construction and widening of the road which traverses in a south-westerly direction through the eastern and western parts of Kathmandu city. All of these roads are planned with a provision of 4 lanes. And the two bridges (Bagmati and Shankamul) out of the four contained in this the project will be included in these planned alignments.

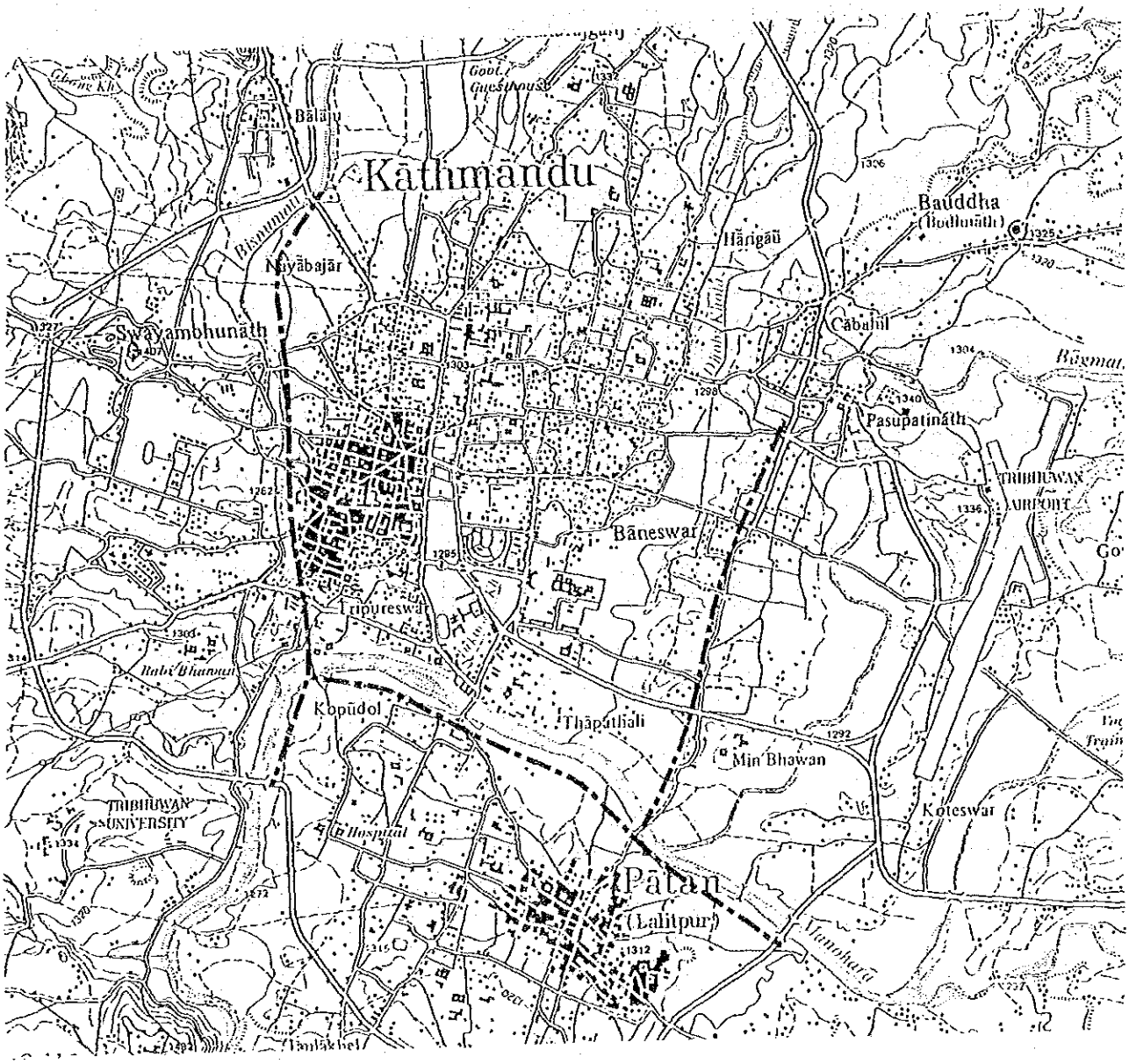


Fig. 3-2-1: Road improvement scheme in the Kathmandu area (The dotted lines show the major portions of the road improvement scheme.)

3.3 Outline of the requested area for bridge replacement

3.3.1 Location of proposed sites

The location of the proposed sites for the requested replacement of four bridges is shown in Fig.3-3-1.

3.3.2 Topography in the proposed sites

The Kathmandu valley, in general, forms a flat configuration and the rivers are flowing thereto with gentle slopes in the shape of flat and comparatively wide river beds. Three bridges out of four, that is, No.12 Bagmati bridge, No.13 Kodku Khola bridge and No.23 Shankamul bridge are located approximately in the central part of the Kathmandu valley. Consequently, they will be replaced under such site conditions as referred to above. As No.22 Mahadev Khola bridge is located in a nearby hilly area at the north-western part of the Kathmandu valley where the river bed forms a somewhat steeper slope as compared to those of the three bridges mentioned earlier, nevertheless, the construction site itself comprises a flat configuration.

3.3.3 River conditions at the proposed bridge sites

Bagmati bridge (No.12)

The Bagmati and Bisnumati rivers join down stream at a location very close to the bridge construction site afterwhich it then turns at an approximate right angle. Judging from the condition of the existing stone revetment, the river bed is now about 2 metres lower compared to the time when the revetment was constructed. This is due to the fact that the inhabitants are collecting the fine aggregate from the river bed. Therefore, the highest flood water level during the rainy season is deemed to be approximately 2 meters in comparison with the time before the fine aggregate was collected.

Kodku Khola bridge (No.13)

No river improvement work for this bridge has been carried out to date and the river is meandering freely, which involves many problems. It is understood, that at the time of flooding, the upper stream side of this bridge turns into a retarding basin and the river water runs over the bridge and approach roads.

Shankamul bridge (No.23)

The proposed bridge site is located down stream just close to the point of confluence of the Bagmati and Monohara rivers, and the river alignment so formed is almost straight. As stated, judging from the condition of the existing stone revetment, the river bed is deemed to be about two metres lower as compared to the time when it was constructed.

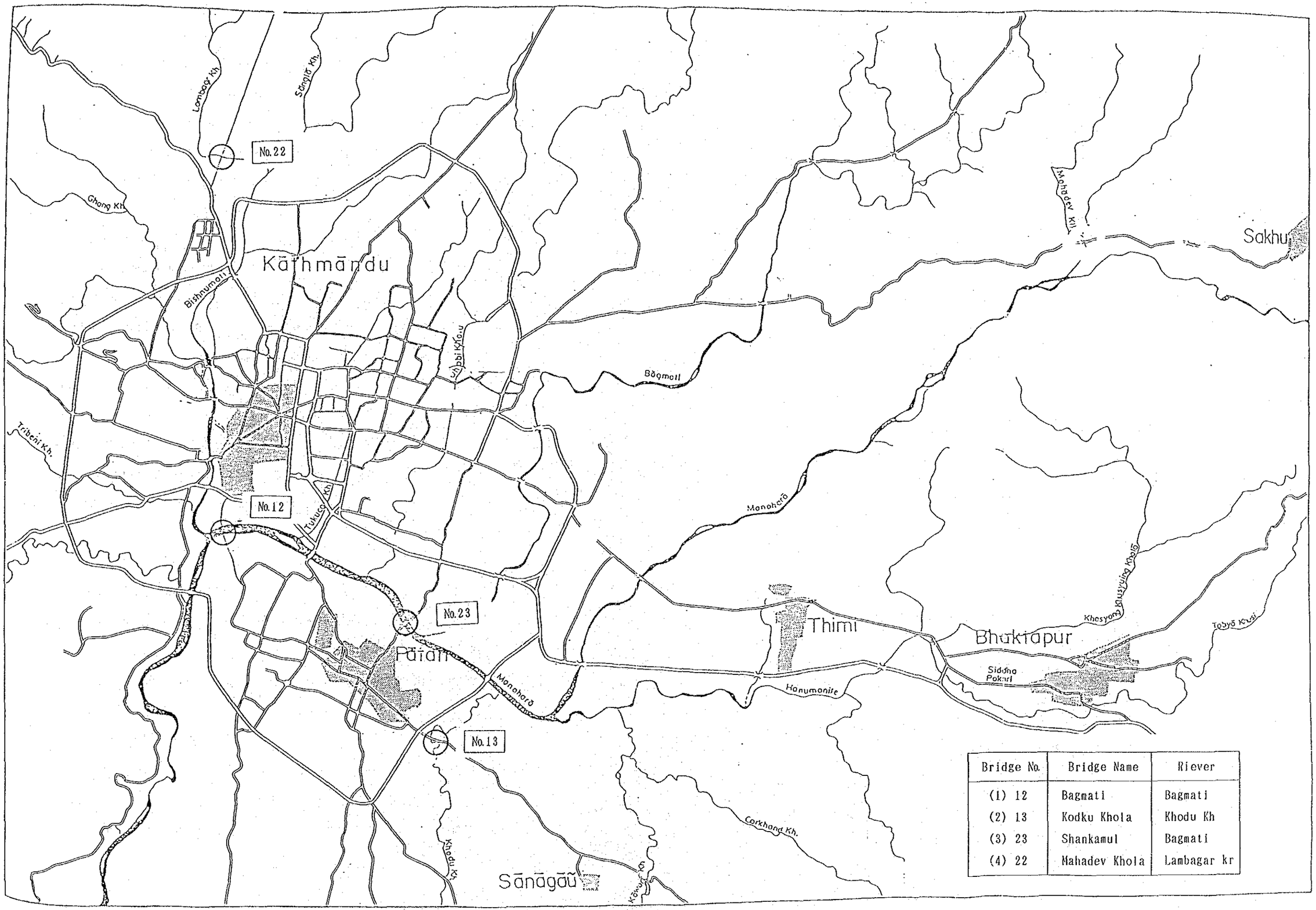
Mahadev Khola bridge (No.22)

At this proposed bridge site, the river alignment formed is almost straight and no particular problems are evident. However, the river bed has been lowered by about two metres judging from the construction level of the existing water in-take well provided in the river bed.

3.3.4 Existing bridge conditions

Bagmati bridge (No.12)

This is a pedestrian bridge and the width and span length are 1.2m and 122m respectively (bicycles, motor cycles, etc. are able to cross) and is described as a suspension type of bridge. The bridge deck is constructed with 10cm wide laminated wood pieces placed side-by-side, to which some damage has been noted.



Bridge No.	Bridge Name	Riever
(1) 12	Bagmati	Bagmati
(2) 13	Kodku Khola	Khodu Kh
(3) 23	Shankamul	Bagmati
(4) 22	Mahadev Khola	Lambagar kr

Fig. 3-3-1: Locations of the proposed bridge sites

- Some corrosion is apparent on the main trussed girder, and some deformation (10~15 cm) is noted of the main truss.
- No water drip hole is provided to the tower base where water collects at all times and is likely to accelerate the corrosion at this particular spot.
- A portion of the existing brick masonry adjacent to the abutment is deformed as a result of settlement.

Kodku khola bridge (No.13)

The bridge comprises three spans each of 5.4 metres, and is 3.0 metres wide. Four pieces of "H" type steel constitute the main girder and pieces of wood are provided across the steel girders, that is, the bridge structure consists of a combination of steel and wood. The bridge deck constructed in wood is significantly damaged and the corrosion of the steel beams is also progressing. Furthermore, a fairly large vibration can be noticed whenever a large vehicle passes over. The bridge parapets made of concrete are severely deteriorated and many of them are damaged at the base of the columns. A water supply main (130 mm) is laid over the bridge deck.

Shankamul bridge (No.23)

The original bridge had previously collected. Because of this, a temporary bridge constructed in wood at a width of about 1.0 metre is now provided for the use of pedestrians. A fairly large number of people, bicycles, motor cycles, etc. utilize this temporary bridge, however, the bridge often requires rebuilding after a flood takes place.

Mahadev Khola bridge (No.22)

This comprises a steel truss bridge with a span length of 25.0m and a width of 4.0m. Two lines of water supply mains (Φ340 mm) are attached underneath the cross beam. Some damage is noted to the lower chord

member on the both sides. Particularly, significant corrosion is noted to the lower chord member of the upstream side. Evidence of erosion is present at the rear of an abutment and has since been temporarily filled with some gabions.

* Attachments to the existing bridges.

Attachments to the existing bridges are as water pipes as follows:

No.12	Bagmati	None	
No.13	Kodku Khora	Φ130 x 1	On the bridge deck
No.23	Shankamul	None	
No.22	Mahadev Khola	Φ340 x 2	Underneath the bridge deck.

It is necessary to reconfirm the future plans of the Nepal Government to deal with these bridge attachments at the time of undertaking the detailed engineering design for the project.

3.3.5 Outline of geology at sites

(1) General

The Kathmandu valley is mainly dominated by igneous rocks comprising metamorphic and/or metamorphic type of sedimentary rocks generated during the Pre-Cambrian and Devonian periods as well as granites of the Third Period to which the rivers and metasediments of the Fourth Period are overlaying at random(See Fig. 3-3-2 and 3-3-3). It is envisaged that a lake with sedimentary deposits was formed by a blockage of the Bagmati river, caused by a rapid upheaval action of the Mahabharat Mountain Range, especially as the ravines in the southern part of the Kathmandu valley are running to the north. Presumably, the drainage of the lake commenced more than 5,000 years ago.

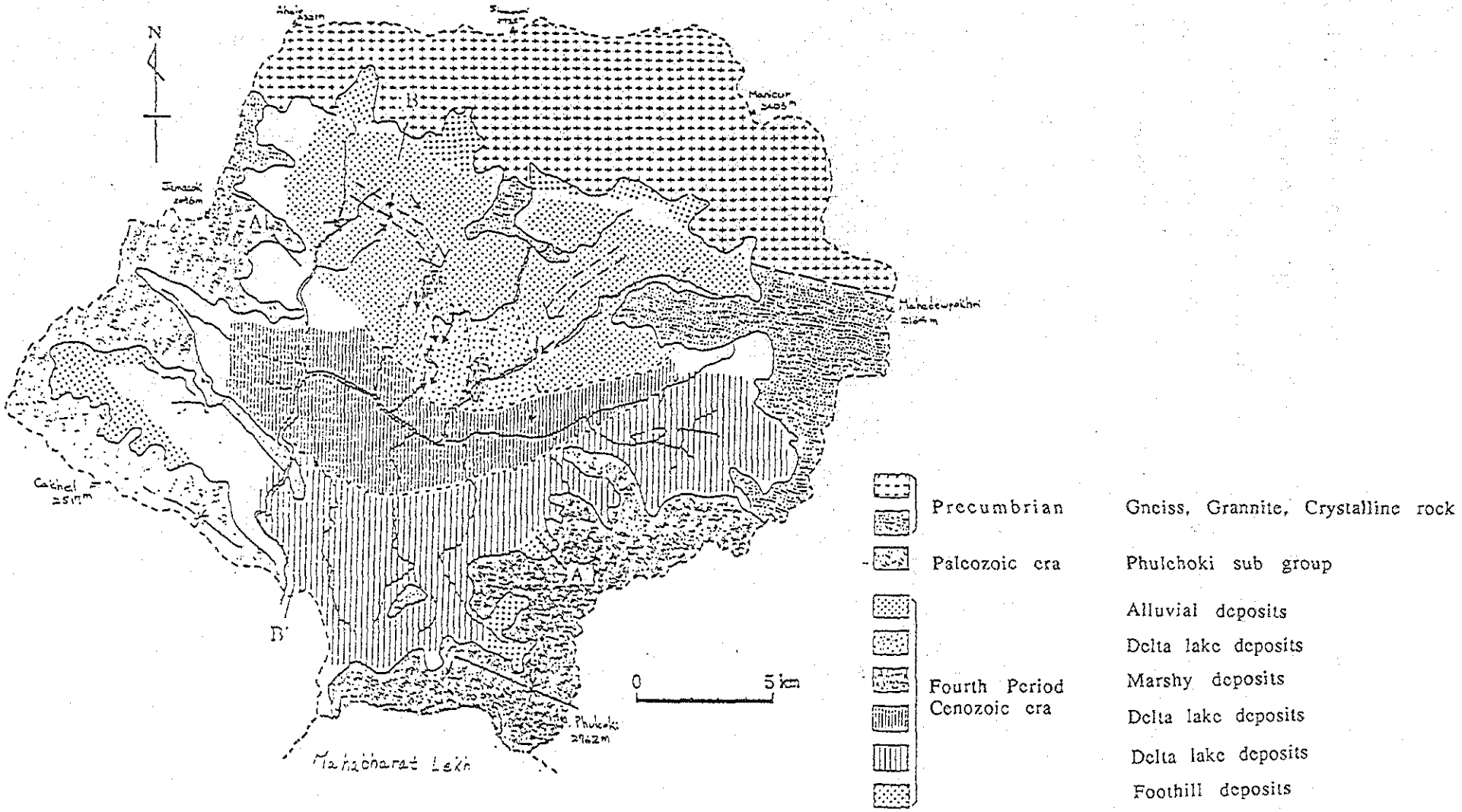


Fig. 3-3-2: Geological concept plan for the Kathmandu valley

The sedimentary deposits consist of clay, silt, sand and granular materials. The northern half of the valley contains the deposits of coarse materials and the southern half of the valley contains fine deposits such as clay, silt, etc. The fine deposits are laying to an average thickness of 200 metres, however, depending on the location it can exceed 450 metres. Coarse deposits are spread heavily below the fine deposits.

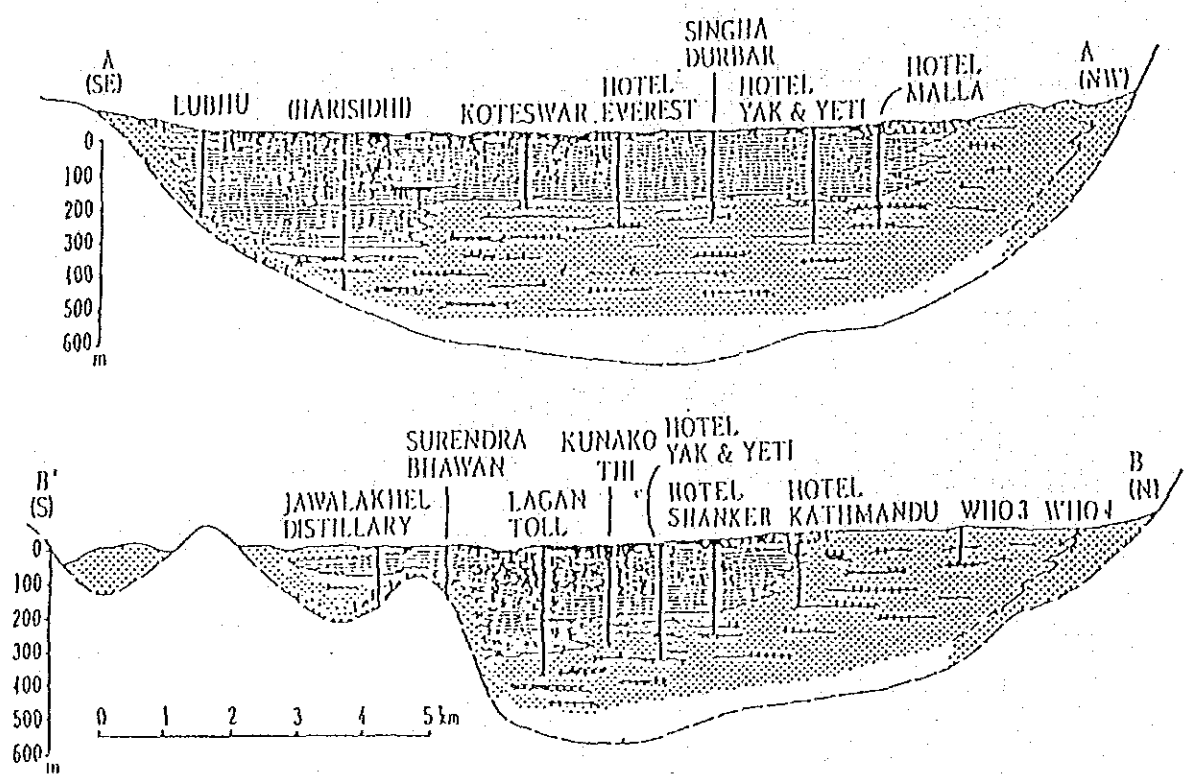


Fig. 3-3-3: Geological cross-section for the deposits of the Fourth Period

(2) Outline of geology at bridge sites

No.12 Bagmati bridge

The existing geology at this bridge site consists of lake deposits in a layered formation dominated by a dark brown coloured clayey silt, which includes a very thin layer of organic materials comprising of an extremely fine grained sand and silt. The river bank of the Kathmandu city side and the river bed contains a clayey silt of a soft stratum underneath the overburden ("N" value 2~3 down to a depth of 10 metres and "N" value 5~8 down to a depth of 35 metres) as well as a carbonaceous clay material collared in black or black grey, the local name of which is "Kalimati". Likewise, at the river bank of the Patang city, a soft stratum exists ("N" value 2~4 down to a depth of 9 metres, and "N" value 5~9 down to a depth of 23 metres). According the record of a previous sub-surface exploration carried out close to this bridge site, the same conditions as referred to earlier exist down to a depth of 200 metres and a sandy stratum continues down to the bedrock (deeper than 450 metres). While the boring operation was in progress a natural gas spouted out from one of the test boreholes at a depth of approximately 20~30 metres and this condition continued for as long as seven days. Therefore, care should be exercised during the construction stage.

No.13 Kodku Khola bridge

The existing geology at this bridge site is dominated by a soft stratum down to a depth of 15 metres with "N" value 3~7, it consists of the lake deposit material comprising a clayey silt and Kalimati. The Kalimati over the ground surface is a fertile soil abundant in organic material suitable for agricultural purposed. This river meanders over the inundated alluvial area and occasionally alters its location during flooding.

No.23 Shankamul bridge

This bridge site covers the low swampy land formed at the point of confluence of the Bagmati and Manokara rivers, it consists of lake deposits containing a rich organic material. In the locality of the abutment at the Kathmandu city side, it has been revealed that "N" value 3~6 continues down to a depth of 19 metres and furthermore, "N" values 3~5 continues down to a depth of 15 metres at a point nearby the existing pier foundation. In addition, at a deeper location, a soft clayey silt continues with "N" value 5~7. A soft stratum continues with "N" value 3~8 at the river bed close to some of the foundation piles that have been driven as on well as on the Patan City side. Natural gas for commercial purpose is now being collected in the neighborhood of the existing approach road located on the Kathmandu city side.

No.22 Mahadev Khola bridge

The bridge site is dominated by deposits accumulated over the inundated area consisting of a combination of coarse deposits such as granular material, sand, silt, clay, etc. and fine grained soils. The size of the coarse material appears to increase with depth and when it until a depth of 100 metres, afterwhich no fine grained soils such as silt, clay, etc. can be seen. On the Kathmandu side, the boring test shows "N" value 3~7 down to a depth of 9 metres and a soft stratum of a clayey material with "N" value 8~13 at deeper than 10 metres. It is found that the existing river bed shows "N" value 15~22 at sand stratum to the depth of 3~6 meters, after which, it turns into a soft stratum of clayey silt with "N" value 8~11.

3.3.6 Traffic volume at sites

A Traffic survey was carried out in two days, that is, 23th April 1991 (Tuesday) and 24th April 1991 (Wednesday), the results of which are as shown in Table 3-3-1.

There is no traffic (except motor cycles, bicycles) over the Bagmati and Shankamul bridges as these are so called pedestrian bridges. A large traffic volume of trucks to and from the brick production factories was noted on the Kodku Khola bridge. All bridges under the project involve the traffic of a large number of pedestrians without exception. This situation will probably change with the increase in the number of vehicles sometime in the future.

Table 3-3-1: The results of Traffic survey (April 23 and 24, 1991)

Name of bridges	Motor-cycle	Vehicles	Buses & Trucks	Others	16hrs. Traffic Volume	24hrs. Traffic Volume	Pedestrians	Bicycles	16hrs. Traffic Volume	24hrs. Traffic Volume
Bagmati	279	-	-	-	279	287	4,916	881	5,797	6,119
Kodku Khola	421	356	549	136	1,462	1,510	4,055	2,724	6,779	7,040
Shankhamul	83	-	-	-	83	84	3,741	955	4,696	4,880
Mahadev Khola	70	46	9	68	193	199	5,209	5,209	10,418	10,706

Traffic volume in 16 hours (6:00 a.m ~ 10:00 pm)

Traffic volume in 24 hours ···Traffic volume surveyed at 6:00 a.m was multipied by coefficient 0.7, then added to the traffic volume in 16 hours so as to be regarded as an assumed value.

Motor cycle ·····Motor cycle and Scooter

Vehicle ·····Sedan, Jeep & Wagon

Others ·····Tri-cycle & Tractor

CHAPTER 4. THE CONTENTS OF THE PROJECT SCHEME

CHAPTER 4 : THE CONTENTS OF THE PROJECT SCHEME

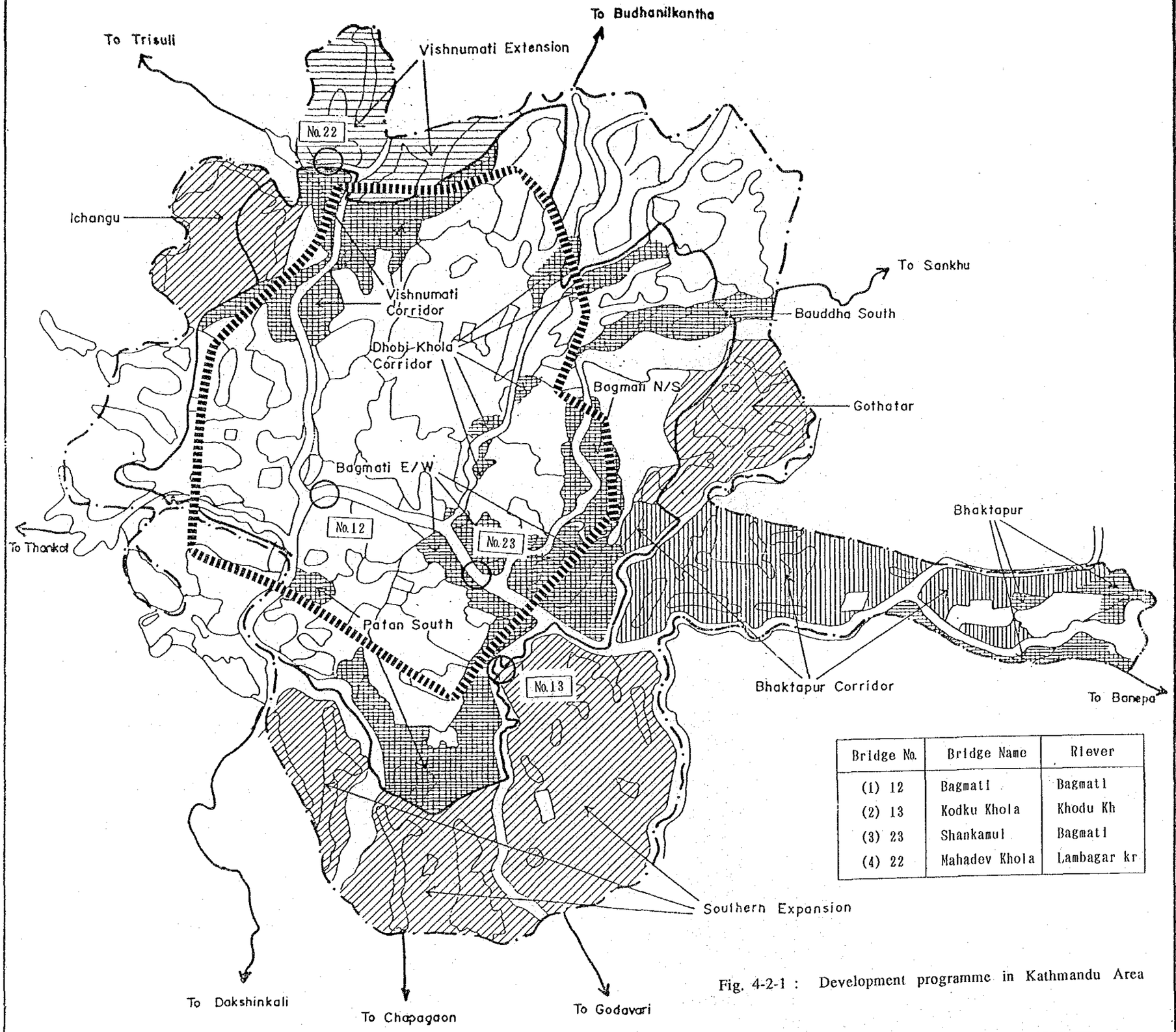
4.1 Purpose

It is about 50 to 70 years ago since the bridges were constructed. The purpose of this project is to replace these seriously deteriorated and damaged bridges located within the Kathmandu city and its neighboring areas. This will contribute toward the improvement of the road network Kathmandu city as well as its suburban areas and to improve social and economic activity.

4.2 Review of the request

4.2.1 Appropriateness of the request

At present, the central part of the Kathmandu city involves many serious urban problems such as housing, related to the concentration of population in the city, also, traffic, air and water pollution, and hygiene, etc. In order to relieve these problems, the urban development programme, road improvement programme, etc. in the Kathmandu metropolitan area are now being studied. The urban development policy under the development programme is directed toward the development of the green zones located in the north-western suburbs of the Kathmandu city. This will start from close to the ring road by keeping away from the overpopulated central city, and in the regions of the south-east and in the neighborhood area of Bagmati river between the Kathmandu and Patan cities. The development policy is also aimed at unifying the Kathmandu and Patan cities currently divided by the Bagmati river(See Fig. 4-2-1).



Bridge No.	Bridge Name	Riever
(1) 12	Bagmati	Bagmati
(2) 13	Kodku Khola	Khodu Kh
(3) 23	Shankamul	Bagmati
(4) 22	Mahadev Khola	Lambagar kr

Fig. 4-2-1 : Development programme in Kathmandu Area

ACCELERATED DEVELOPMENT AREAS

LEGEND:

Municipal Boundary

Urban Expansion Area

River Reserves

GENERAL PRIORITY, SEQUENCE

1990

1995

2000

2005

Ring Road

HMG/ADB
KATHMANDU VALLEY
URBAN DEVELOPMENT
PLANS & PROGRAMMES

3Km 2 1 0 1 2 3Km

In the road development programme, the left hand side of the bank of the Bagmati river and the two bridges crossing the Bagmati river (Bagmati and Shankamul bridges under the project) as well as the new construction and widening of the approach roads would be the main objectives of the programme (Refer to Fig. 3-2-1).

No.13 Kodku Khola and No.22 Mahadev Khola bridges occupy an important position in the development of the south-eastern and north-western suburbs of Kathmandu city referred to above. And furthermore, No.12 Bagmati and No.23 Shankamul bridges are indispensable bridges to unify Kathmandu and Patan cities.

The existing conditions of the above mentioned four bridges for which replacements have been requested are as described in the following:

No.12 Bagmati bridge

This is a pedestrian bridge, 1.2 metres wide, linking the densely populated southern part of Kathmandu city and the residential area in the western part of the Patan city, approximately 50 years have passed since it was constructed. Because of this, a significant deterioration is apparent on the structural steel members. There is a large traffic volume of people and bicycles, which is not compatible with the bridge width, the bridge is considered to have attained its limit in terms of traffic volume. There are some apprehensions regarding instability in view of the bridge loading capacity.

Failure of the bridge under, full locating will undoubtedly have serious affects, therefore, replacement of the bridge is requested.

No.13 Kodku Khola bridge

This bridge is located on the Patan ~ Sanagau Lubhu route which is one of the principal radial roads running to the south-eastern suburbs of

Kathmandu city. Approximately 40,000 regional residents in Sanagau Lubhu largely depend on the bridge, however, more than 60 years have passed since its construction and the "H" type steel beams are corroded and some damage to wooden bridge deck is noted. There is an extensive traffic of heavily loaded trucks transporting brick materials over the bridge, the loading capacity of which is inadequate.

Because of this, replacement of bridge is requested.

No.23 Shankamul bridge

This was a wooden bridge linking the south-eastern part of Kathmandu city and the central part of Patan city, the bridge length and width were 150 metres and 5.0 metres respectively. The bridge was nearly 70 years old when it collapsed in 1988. Reportedly, the accident took place when a truck was passing over the bridge. Afterwards, the construction of a concrete bridge to a width of 11.5 metres was commenced by the Nepal Government. However, it was obliged to suspend work due to lack of funds as the piling work was almost complete, this condition still continues to date. At present, a temporary wooden bridge with a width of slightly less than one metre is now provided on the site to an extent that people can scarcely pass each other collecting. Some local news papers report that the local residents are collecting a petition for construction of a new bridge.

No.22 Mahadev Khola bridge

This bridge is located on the Balaju ~ Dharmthali ~ Phutung route which is one of the principal radial roads extending to the north-western suburbs of Kathmandu city, approximately 60,000 regional residents are largely dependent on this bridge. However, more than 60 years have passed since the bridge was constructed, the steel members of the truss are corroded and sections of handrail are missing. There is concern for the stability of the

bridge in terms of loading capacity. Therefore replacement of the bridge is requested.

As stated previously the replacement of the four existing bridges is considered important not only to ensure safest but also to fulfill the traffic demands at present and/or in future.

The replacement of these four bridges would be difficult, judging from the current condition of the Nepal Government in view of its budgetary situation and technical capability. Therefore the request made by the Nepal Government is considered appropriate.

4.2.2 Executing agency

The project scheme is under the control of the Ministry of Works & Transport, and its execution is in the charge of the Department of Roads which is one of the subordinate agencies thereof.

The Department of Roads comprises five Regional Roads Directorates and District Roads Offices. Organization charts of these offices are as shown in Tables 2-2, 4-2-1 and 4-2-2. The numbers shown in the enclosures indicated in Tables 4-2-1 and 4-2-2 represent the average number of staff employed. The organization which is directly dealing with the construction and maintenance of the roads is the Central Regional Roads Directorate in charge of the Kathmandu area, although this project is under the control of the Department of Roads as described earlier.

Table 4-2-1: Organization chart of the Regional Roads Directorate

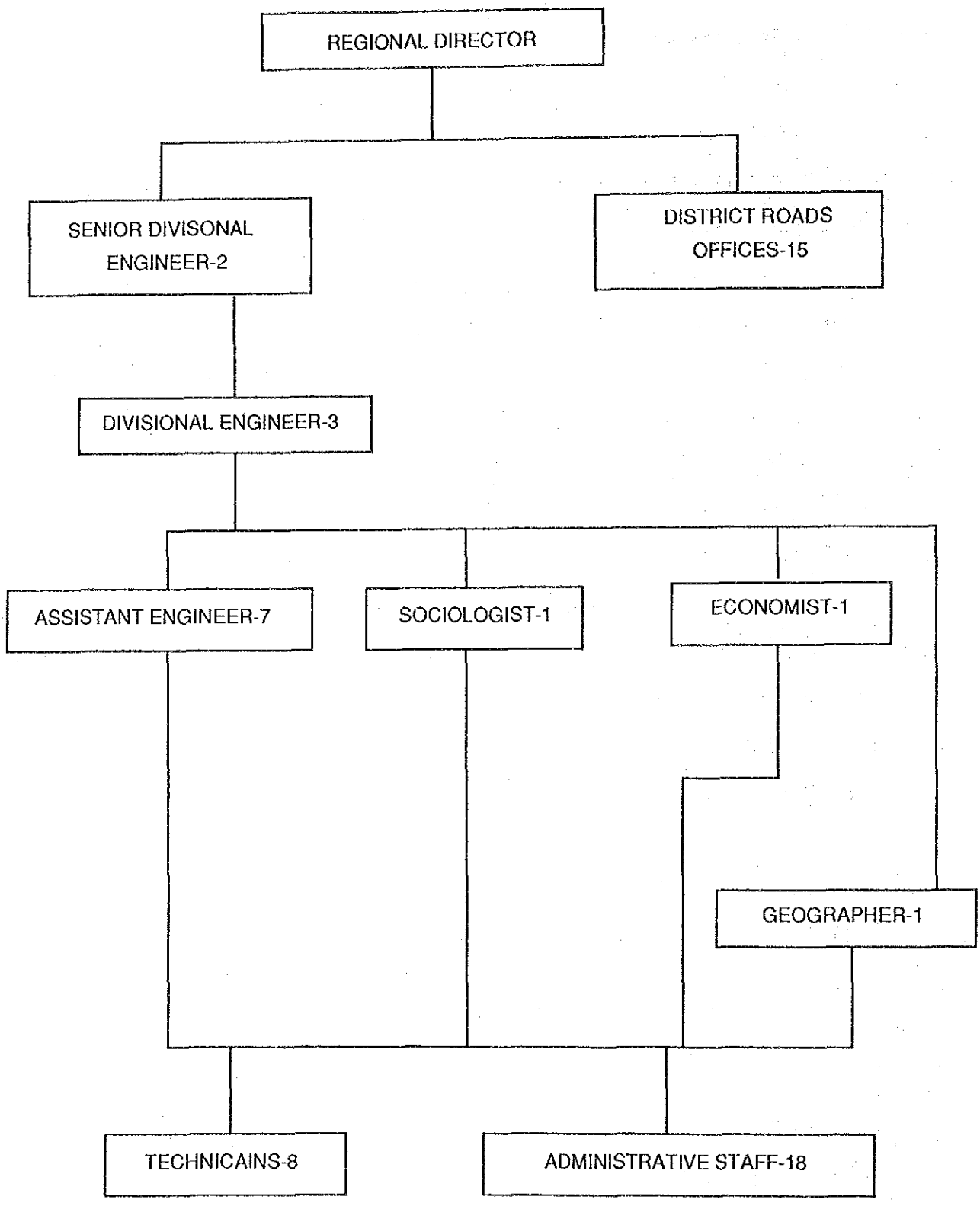
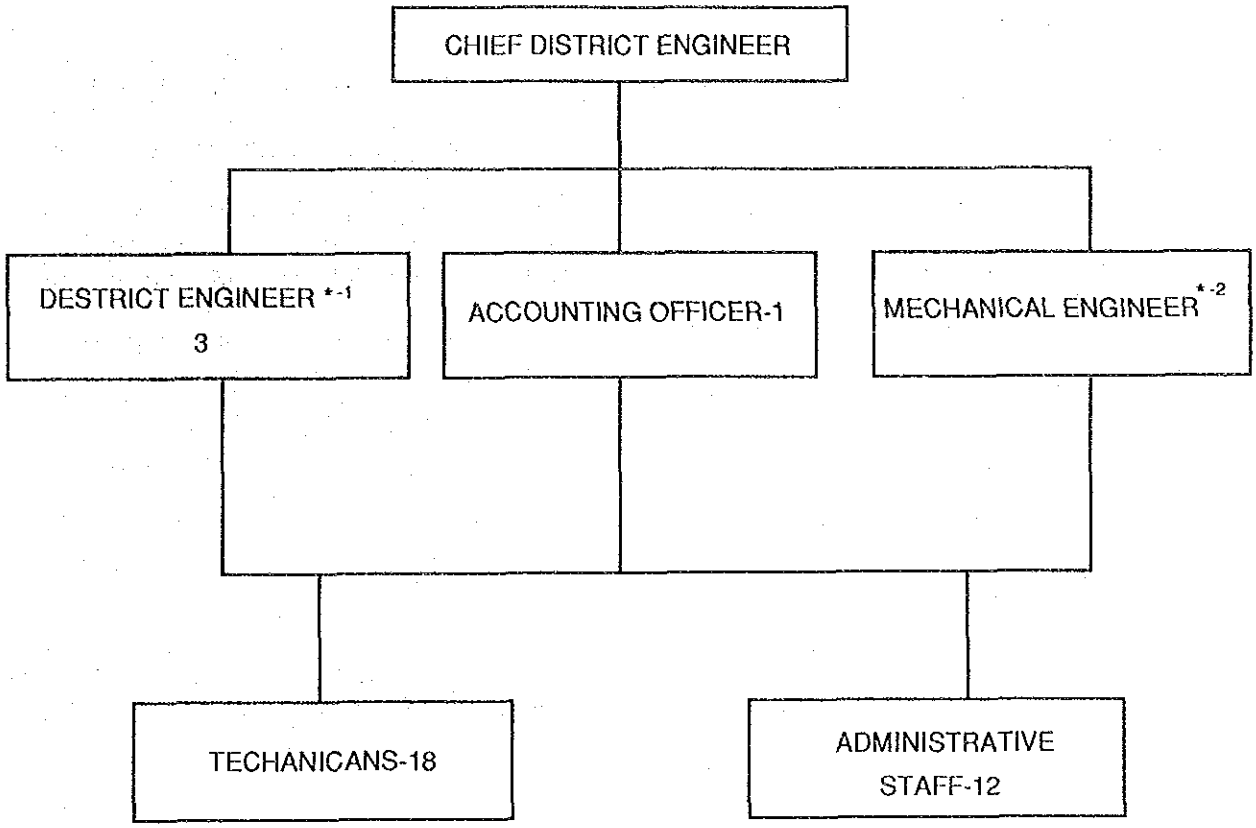


Table 4-2-2: Organization chart of the District Roads Office



*-1 KATHMANDU DISTRICT OFFICE HAS 6 DISTRICT ENGINEERS.
RAUTAHAT & DOLAKHA DISTRICT OFFICES. EACH HAS 2 DISTRICT ENGINEERS.

*-2 THERE IS 1 MECHANICAL ENGINEER FOR 2 TO 3 DISTRICT OFFICES.

4.3 Outline of the bridges to be replaced

4.3.1 Bagmati bridge (No.12)

Bridge site

There are some memorial structures such as temples, etc. on the right hand side bank of the bridge site and many houses are densely built on both sides of the approach road. The existing suspension bridge which is being used at present will remain in place acting as a temporary bridge during the course of the construction work and for the convenience of the pedestrians in the future. Due to these reasons, the new bridge will be constructed downstream where no memorial structures exist. The distance between the existing suspension bridge and the new bridge will be approximately 16 metres, measured from the road centerlines. This idea stems from the necessity to avoid the existing foundation of the suspension bridge wind stability cable and at the same time to secure a working space required for construction activity.

Bridge length and bridge deck height

An immovable stone statue of religious significance to the local residents stands on a stone terrace at the left hand side of the route for the new bridge construction. The new bridge will be required to clear the stone statues, therefore, it will be necessary to extend the bridge length by approximates 8 metres on the left hand side of the bank.

The existing stone terrace on the right hand side of the bank is a promenade for the residents, therefore, the new abutment on this side of the bank needs to be constructed at the rear of the stone terrace, similar to the existing bridge.

As described heretofore, the bridge length requires to be extended by 8 metres as a whole and eventually, the total bridge length will be made up to 130 metres. According to the results of interviews with the residents, it is understood that the flood water level in 1954 was the highest recorded, the headroom below the girder of the suspension bridge was 2.5 metres. After that, the river bed was lowered about 1.5m ~ 2.0m, which resulted in a headroom around 4.0 ~ 4.5m below the bridge girder due to the flood water volume referred to earlier.

If a steel girder is employed for the new bridge, the depth of the girder will increase to approximately 2.0 meters in comparison with the existing suspension bridge. Should the bridge deck height be formed so as to be similar to that of the existing suspension bridge, the height of room under the girder would be 2.0m ~ 2.5m, which is considered appropriate. As explained heretofore, the bridge deck height of the new bridge would be the same as that of the existing bridge.

Bridge width

According to the programme set up by the Ministry of Housing & Physical Planning, the Bagmati bridge is located on a future trunk road linking the Kathmandu and Patan cities. However, the existing approach road width is insufficient and a full scale widening of the road in the near future is not expected, furthermore, the existing bridge is exclusively for pedestrians.

In view of these conditions, the width of the new bridge will be increased to a minimal 5.5 metres which would allow large type of vehicles to pass each other, also, a sidewalk will be included in the bridge width.

Approach roads

The proposed location where the Bagmati bridge is to be relocated is approximately 16m downstream measured from the existing bridge centreline. Because of this, an approach road linking the existing road and the new bridge requires to be planned (Approximately 120 metres altogether for both banks).

4.3.2. Kodku Khola bridge (No.13)

Bridge site

This bridge is located on a straight road alignment that requires to be maintained. Because of this, after the existing bridge has been removed, the new bridge will be constructed in the same location. The width of the existing bridge is about 3.0 metres, which will be widened to 8.5 metres. As there are some houses at the downstream side of the river, the widening will be made primarily to the up stream side. This will require the construction a revetment, as the river at the upstream side is flowing in parallel with the road.

Bridge length and bridge height

According to the results of interviews with the residents, it is understood that during the flooding of 1954 the flood water occupied a wide area (Approximately 200 metres) approximately one metre higher than the existing bridge deck as well as the approach roads on both sides of the bank. The height of the road embankment is about 2.0 ~ 3.0 metres, and in the event of flooding, the road acts as a dike for the retarding basin of the up stream area. It is virtually impossible to secure the required water cross-section in the space underneath the girder of the bridge. If this is achieved the damages caused by running water at the downstream side will

be augmented. Should the height of the bridge deck and road embankment be raised, it will result in the augmentation of the retardation area and in an increase of retardation time, by which the area at the upstream side will be seriously damaged.

The bridge length and headroom below the girder will be selected to ensure that the running water cross-section under the new bridge will be almost the same as the existing, therefore maintaining the existing condition as a basis.

With the consideration of raising the height of the new bridge girder one metre higher than the existing bridge, the length will be increased by 5 meters to make up the total length of 22 metres, also to increase the height of the bridge deck by 50cm (The probability of greater damage caused by a flood at the upstream side could be disregarded in connection with the increase in the height to such an extent) and to decrease the headroom underneath the girder by 50cm.

Bridge width

The Kodku Khola bridge is located on a vital trunk route for the industries (brick factories, etc), of places such as Sanagau, Lubhu, etc. and a fairly large volume of extraordinarily traffic can be noted at present together with a large number of pedestrians.

Reportedly, in the future, the route is scheduled to extend up to Bhaktapur city, in the east.

In view of these conditions, the bridge will be provided with 2 traffic lanes (3.25m x 2 = 6.5m) with sidewalks on both sides (1.0m x 2 = 2.0m), the total bridge width will be made up to 8.5 metres.

Approach road

The proposed location for replacement of the Kodku Khola bridge would be similar to the existing. The proposed width of the new bridge is 8.5m, whilst the width of the existing approach road is only about 4.5m, therefore, the widening of the existing road is planned for a distance of approximately 70 metres in order to unify the road width.

4.3.3. Shankamul bridge (No. 23)

Bridge site

The original bridge no longer exists due to collapse, nevertheless, the new bridge will be provided basically in the same location as the original.

Bridge length and bridge height

There construction of this bridge as a concrete structure was programmed by the Nepal Government after the original bridge collapsed in the river. However, the work was suspended at such a stage that a significant amount of piling work was carried out and is left in place to date. At the planning stage of the bridge reconstruction, a comprehensive study was done by the Department of Roads in respect to the flood water level and other factors which are necessary in the selection of the bridge height & length, etc. (Report on Hydrological Study of Bagmati River at Shankumul Bridge Site, Department of Roads Bridge Section, March 1982).

According to the results of the study on these matters, the height of the bridge deck of the previously suspended bridge was almost equal to the original which had collapsed, and the original bridge length and the previously suspended bridge length was 148 m and 112 m respectively. The height of the bridge girder of the previously suspended bridge was 1.5

metres and the headroom below the girder against the flood water level was 1.8 metres.

The length of the previously suspended bridge is 36 metres shorter than that of the original bridge. This might be due to the fact that the increase in the running water cross-section, on account of the lowered river bed that took place afterwards, was taken into consideration.

The height of the deck being scheduled for the new bridge will be almost the same as that of the previously suspended bridge, and furthermore, the correlative comparison between the topographic survey results and the design drawings prepared for the previously suspended bridge reveals that the river bed is lower by as much as one metre. Owing to this reason, the headroom underneath the girder against the flood water level will be about 2.8 metres.

As stated earlier, the height of the new bridge deck will be same as the previously suspended bridge and the bridge length, due to the results of the survey, will become 3 metres longer than the previously suspended bridge, eventually, the total bridge length will be made up to 115 metres.

Bridge width

The width of the original Shankamul bridge, which collapsed, was 5.0 metres its re-construction as a concrete structure was programmed and the piling work almost completed. According to the Ministry of Housing & Physical Planning, the bridge is located at a point where a trunk road crossing from the south to the eastern part of Kathmandu city (for which a full scale widening is scheduled) will meet with a trunk road scheduled along the left hand side bank of the Bagmati river.

In addition, according to the urban development programme established by the ADB, the development of the green zones remaining between the

northern part of Patan city and the Bagmati river is regarded as one of the major programmes of the overall development programme in Kathmandu and Patan. In proceeding with these programmes, the Shankamul Bridge is regarded as a strategic and vital traffic facility.

However, at present, no definite schedule has yet been established with respect to the location and time of implementation of the road to be provided along the left hand side bank of the Bagmati river. The construction of a bridge for vehicular traffic will be delayed until a decision is made on these matters. Furthermore, the international organizations including NGO are rendering their cooperation to the preservation of Patan City. Should the construction of this bridge commence prior to the settlement of the road programme referred to above, a large number of vehicles will enter Patan City directly, and May cause a problem with the preservation plan mentioned earlier. If vehicular are prohibited to enter Patan City, the bridge will not be used by vehicles traffic until such time that the above mentioned road programme is implemented. However, a bridge for the use of bicycles, pedestrians, etc. is needed expeditiously and because of this, the width of Shankamul bridge will be scheduled for 2.5 metres (which would be necessary for bicycles and pedestrians). It is stressed that the restricted use of the bridge by vehicles should be in force after the urban development programme as well as the road programme have been established definitely and a decision to implement these programmes has been made.

Approach road

The proposed location for replacement of the Shankamul bridge would be similar as the original one which collapsed. However, the new bridge length is shorter than the original one, therefore, an approach road

requires to be planned. (The total road length will be about 70 metres which will include a partial widening of the existing road.

4.3.4 Mahadev Khola bridge (No.22)

Bridge site

This bridge is located on a straight road alignment that requires to be maintained. Because of this, the new bridge will be provided in the same location after the existing bridge has been removed.

Bridge length and bridge deck height

According to the results of interviews with some regional residents, the highest water level took place in 1971, which was the highest recorded. At that time, the headroom underneath the girder of the existing bridge was about one metre. The site study disclosed that the river bed has been lowered by about 2.5 metres and the headroom below the girder of the existing bridge is now about 3.5 metres. The depth girder of the new bridge will be increased by 1.5 metres as compared to that of the existing bridge. Should the height of the deck for the new bridge be made similar to the existing bridge, the headroom below the girder will become about 2.0 metres, which is considered appropriate. Because of this, the height of the deck for the new bridge will be made similar to the existing bridge.

At the time of flooding, which tanks place from time to time, the farms are covered with flood water, also scouring is noted at the rear of the existing abutment. As one of the measures to overcome these problems, it has been scheduled to extend the new bridge length by 5 metres to make up the total bridge length to 30 metres.

Bridge width

Bridge width

Mahadev Khola bridge is located on one of the principle radial roads which extends northwards in the suburban area of Kathmandu city, where urbanization and an increase in the traffic volume is expected. A large number of pedestrians (including bicycles) is noted, however, the vehicular traffic volume is small at present. In view of this, the bridge width will be scheduled for 5.5 metres, similar to that of, the Bagmati bridge.

Approach road

The proposed location for replacement of the Mahadev Khola bridge would be similar to the existing one. The proposed width of the new bridge is 5.5 metres, whilst the width of the existing approach road is 5.0m, therefore, a partial widening of the existing road, is planned, for a length of about 70 metres.

Table 4-3-1: Bridge length and headroom below the girder against the highest previous water level

Name of bridges	Bridge length (m)	Headroom below the girder (m)
12. Bagmati	130	Approx. 2.0 ~ 2.5
13. Kodku Khola	22	-
23. Shankamul	115	Approx. 2.0
22 Mahadev Khola	30	Approx. 2.0

Table 4-3-2: Composition of bridge width

No.	Name of Bridge	Composition of Bridge Width		
		Vehicle Lane	Sidewalk	Bridge Width
12	Bagmati	(Joint use for bicycles &pedestrians)		5.5
13	Koduk Khola	2 x 3.25	2 x 1.0	8.5
23	Shankamul		2.5	2.5
22	Mahadev Khola	(Joint use for bicycles & pedestrians)		5.5

4.3.5 Scope of the bridge replacement scheme

Bagmati bridge (No.12)

Construction of the new bridge and its approach road (approximately 120m).

Kodku Khola bridge (No.13)

Construction of the new bridge and widening of the existing approach road (approx. 70m) including the construction of a revetment at the embankment toe in connection with widening.

(Shankamul bridge (No.23)

Construction of the new bridge and its approach road (Approximately 70m).

Mahadev Khola bridge (No.22)

Construction of the new bridge and widening of the existing approach road (Approximately 60m).