Department of Roads

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HIGHWAY MANAGEMENT INFORMATION SYSTEM UNIT

Road Maintenance & Development Project (RMDP)

The Road Maintenance and Development Project (RMDP) is at the end of implementation phase being implemented by Department of Roads (DOR) under loan assistance from the World Bank. RMDP components included new road construction, upgrading works, various types of maintenance (Periodic, PBMC, Recurrent, and Routine), policy development, and institutional strengthening programs.

A. Salient Features of RMDP:

1. Name: Road Maintenance and Development Project (RMDP)
2. IDA credit no. : 3293-NEP
3. Approval date: November 23, 1999
4. Loan Agreement Date: December 22, 1999
5. Loan Effective From: February 21, 2000
6. Original Loan Closing date: December 31, 2004
7. Revised Loan Closing date: June 30, 2007
8. Total project cost: US $ 64.4 million
9. IDA financing: US $ 54.5 million
10. GoN financing: US $ 9.9 million

B. The components of RMDP and Achievements:

- **The Policy Component** included establishment of Road Board for managing the finance for road maintenance works for various road agencies in Nepal. The goal is to establish an adequate and stable source for financing road maintenance and therefore to preserve the road asset and to reduce total road user's costs.

- **The New Road Development and Upgrading Component** included new construction and/or upgrading of sections of the strategic highway network to connect currently non-road-served District Headquarters in Western part of Nepal. 50 km length of road was completed under New Road Construction. Out of total 36 km road length from Jumla towards Kalikot about 31 km road length has been newly constructed using Community based organizations. In upgrading component, 213 km length of existing earthen roads were upgraded to Gravel standard and out of total targeted 266 km about 256 km has been upgraded to Bituminous Seal standard.

- **The Rehabilitation Component** included a total of 276 km road rehabilitation works in various Strategic Roads to make them into maintainable condition.

- **The Periodic Maintenance Component** included a total of 676 km of various strategic roads to be resealed or overlay works. Out of total about 595 km road length has been completed till date. Under this heading PBMC contracts has been also implemented in different sections of highway.

- **Routine, Recurrent and Emergency Maintenance Component** included in almost all the Strategic road network under 25 Maintenance Divisions for nearly one and half years. Specific Emergency Maintenance works was implemented in three locations namely under Division road offices Dhankuta, Lalitpur, and Pokhara. These works are already completed.

- **Institutional Strengthening and Training Component** included activities and program for enhancing the DOR's capacity and capabilities by strengthening institutional establishment, support for human resource development. Major activities under this heading included renovation of DOR building, support for MIS and IT implementation, support for various study and training activities to DOR personnel, support for preparing the standard designs for road and bridges, support the mechanical training center to operate it as private sector organization, and support for conducting the technical audit through NVC.

- **Priority Investment Plan study** has been completed considering planning for next 10 years. This document shall be DOR's basis for overall planning and implementation of new road construction, upgrading, and various road maintenance activities. It is an important out put of RMDP which updates the previous PIP and covers a period of 2007-2016.

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C. Original Targets, Revised Targets and Overall progress:

Components	Original Target	Revised Target	Progress status (Till date Magh 2063)
New Road Construction	200 km	50 km	Completed
Upgrading to Gravel	260 km	213 Km	Completed
Upgrading to Bituminous Seal	-	266 km	255.5 km
Rehabilitation	160 km	276 km	Completed
Periodic Maintenance	472 km	676 km	595.01 km
Community Road Works	-	36 km	31 km
Emergency Maintenance (Dhankuta, Lalitpur and Pokhara)	-	Three locations	100%
Routine and Recurrent Maintenance Works	-	SRN under 25 Divisions	100%

Road Sector Development Project (RSDP):

Considering the completion of RMDP by June 2007 the GON has initiated to start and implement a new project under assistance from World Bank. The proposed RSDP plans to upgrade the four strategic roads connecting district headquarters that were identified under Priority Investment Plan study. The main objectives of the project could be stated as;

i. Expand the country's Road facilities to provide increased benefits from all weather accessibility to five District Headquarters fully and two District Headquarters partially as part of Development of Strategic Road Network within the Priority Investment Plan framework;

ii. Preserve the earlier investments made in road ;

iii. Contribute in poverty reduction through sustainable social development by reducing Vehicle Operating Costs and Travel Time Costs in project areas;

iv. Adopt and disseminate environmentally sustainable road upgrading practices;

v. Continue support to DoR in ongoing Institutional Strengthening Activities;

vi. Promote sustainable funding and more efficient public sector management of road maintenance by strengthening the Roads Board.

Project Components include

i. Upgrading of about 364 km of unsealed hill roads to all weather sealed gravel standards. Khodpe – Chainpur (110 km), Baitadi – Satbanj – Gokuleshwor (74 km); Surkhet – Kalikot (135 km); Sunkoshi – Okhaldhunga (45 km). These roads shall enhance the accessibility for the district headquarters of Baitadi, Bajhang Darchula, Dailekh, Kalikot, and Okhaldhunga.

ii. Institutional Strengthening and Training Component including support for the implementation of an ISAP, HDM-4, MIS-IT process, support in strengthening of the Roads Board Activities, and support to BOT Cell in MOPPW

The overall financing requirement for the proposed RSDP is US $ 35 Million.

GEO - ENVIRONMENT and SOCIAL UNIT

1. Introduction

A Geo-Environmental Unit (GEU), under Planning and Design Branch, within the Department of Roads was established in 1994, as a continuation of Environmental Management Unit established in 1988 as an initiation to support the Arun Access Road for the proposed Arun-III Hydropower Project; to provide specialized advisory and logistic services in the field of Geotechnical, Environmental and Bio-Engineering aspects of Road development. Later on, the scope of services has been broadened with the inclusion of social aspects. The sole objective being the integrated approach to Road planning, design, construction and maintenance, DoR realized a unit to cope all these aspects. Recently, in mid of 2006, the Department has decided to provide responsibility and authority to GEU and rename it as Geo-Environment and Social Unit (GESU), to cater all those four aspects of Road Development, with the following objective:

2. Objectives*

Road construction often produces adverse effects on the Bio-physical as well as Social, Economic and Cultural Environment. For these reasons **Environmental and Social impact assessments** on road development project are imperative to safe guard the Environment and to reduce and mitigate the negative impacts as well as to identify and enhance the beneficial ones. As per the DoR's KARYABIDHI-2061B.S. (Working Manual), page no.16 the objective of this unit can be identified as follows:

- To help in selection process of a road project by studying and analyzing the adverse effects likely to be generated due to the road construction / maintenance with their mitigation measures, if any, on the Geo-Environmental and Social aspects on road project area.
- To monitor the implementation of mitigation measures suggested to avoid/minimize negative Environmental and Social effects created by the construction of road/clearing the land slides on the road
- To prepare Geo-Environment related central level data base

3. Role and Responsibilities*

In order to meet the objectives assigned to this unit the main role of this unit is to enable the DoR high level management to reduce or mitigate the negative impacts of the roads on the Bio-physical as well as the Social, Economic and Cultural Environments in the project area by providing specialist advice and information on the following fields:

- **Geo-Technical Engineering**
- **Bio-Engineering**
- **Environmental and**
- **Social aspects**, in road construction and maintenance.

To fulfill the above role, the unit required to bear the following responsibilities.

- conduct Initial Environment Examination (**IEE**) of the road projects and bridges under DoR
- conduct Environment Impact Assessment (**EIA**) of the road project under DoR
- conduct Social Impact Assessment (**SIA**) of the road project and neighborhoods
- conduct Social and Environment Audit (**SEA**) of the road projects

- conduct geo-technical investigations of the roads under SRN to identify the potential sites requiring early attention to prevent the road closures
- research and Development of Geo–Environment and Social Aspects of road construction and maintenance
- promote the use of appropriate and Environmentally sound techniques for the construction and maintenance of the roads
- provide Bio-engineering Assistance to DRO's and Projects
- increase Environment and Social Awareness of road construction, maintenance and asset preservation among RDs and DROs staffs through **workshops and training**
- monitor Compliance of Environment Management Action Plans (**CEMAP**)
- monitor Compliance of Social Action Plans (**CSAP**)
- monitor Compliance of Social and Environmental Impact (**CSEI**) of road construction/ upgrading/ rehabilitation/maintenance
- **prepare, review** and **update** documents such as policy/ guidelines/ manual on Geo - technical Investigations and Practices, Bio-engineering Practices, Environmental and Social Aspects of integrated road development and **disseminate** to the DOR agencies
- collect and maintain Geo-Environment and Social related central level data base
- Land acquisition, compensation and Resettlement**(LCR)** plan for different Road Projects under DoR

4. GESU activities in this Fiscal year

1. Completed activities

a. EIA study of **Chakrapath-Tokha-Jhor-Chhahare Road Project**

b. EMAP compliance monitoring of **Narayanghat-Mugling Road**

c. Public Hearing on **Syafrubesi-Rasuwagadhi Road Project**, under EIA Study

d. Public Hearing on **Riu- Khola Vented Cause way**, under EIA Study

e. Bio-Engineering Works Monitoring of **Pokhara-Baglung Road**

f. Presentation on **Best Practices in Land Slide Risk Management**, in Thailand, on a international seminar on RECLAIM II by GESU Chief

2. On going activities

a. EIA Study of **Syafrubesi-Rasuwagadhi Road Project**

b. EIA Study of **Saljhundi-Juthepauwa-Sunguredhunga Road Project**

c. IEE of **Dhalkebar-Janakpur-Bhittamod Road Upgrading Project**

d. EIA Study of **Riu-Khola Vented Causeway,** under DRO Bharatpur.

e. EIA Study of **Nagma-Gamgadhi Road Project**, under SWRP/PIP projects

f. IEE of **15 different Road Projects**, under SWRP/PIP projects

g. Working in close collaboration with TA team for the Preparation of **Interim Guidelines on Enhancing Poverty Reduction Impacts of Road Projects**

3. Pipe line activities

a. Preparation of **Three year Business plan** of the unit

b. **EMAP Compliance Monitoring** of Six different Road Projects funded by ADB

c. Monitoring of **Bio-Engineering Works** and **Nurseries** under DROs

d. Public Hearing on **Saljhundi-Juthepauwa-Sunguredhunga Road Project**

e. EIA Study of **Dumkibas-Tribeni Road Project**, Under Butwal Division

f. IEE of **Putalikhet-Karkineta-Kushma Road Project**, under Palpa Division

g. EIA Study of Aurahi Brige and Gumnaha Bridge Under Nepalgunj Division

Note: * are granted departmental approval on date 2063/11/22(6th, March 2007)

ARMP 2007

The SMDU (Strengthen Maintenance Division Unit), Maintenance Branch of DoR organized a workshop on regional ARMP (Annual Road Maintenance Plan) from Falgun 13 to 18 with an aim to disseminate clear understanding of the ARMP and its compiling procedure, validation and upgrading of the data and the formats associated with it. It also aimed at collecting the feedbacks from the Divisions in order to improve upon the suitability of ARMP.

The workshop was conducted at Sanker Hotel, Kathmandu in 3 groups: each group with tenure of 2 days. A total of about 120 participants consisting of Regional Directors (RD), Division Chiefs (DC) and Engineers actively took part in the workshop. The workshop was opened by the Director General Mr. Durga Prasad KC and chaired and closed by the Deputy Director General (Maintenance) Mr. Ram Kumar Lamsal. They threw lights on the importance of preparing realistic ARMP and its applicability as an effective tool in allocating budgets. All the Regional Directors played the lead role in the workshop and at the end of the day they presented the outcomes of their corresponding regions. The presentation essentially focused on the tentative budget needs for maintenance of the SRN: categorically routine, recurrent, periodic, and specific emergency maintenance in F.Y. 2064-65.

Till last year, SDC/N has a set up as SMDP in DoR which was conducting and supporting such kind of events. It has now seized to exist and the responsibility has shifted to the DoR's shoulder for such events.

The major concern from the workshop has shown over periodic maintenance (reseal). The gap between the budget allocation and its need under this category is alarmingly increasing. This is indeed a poor trend and it must raise the eyebrows of the stakeholders to address this issue otherwise we would have to pay tremendous price for preservation of our SRN which is also considered to be an asset of the nation.

Periodic Maintenance Practice in DoR

INTRODUCTION

The DoR developed a strategy in 1995 for periodic road maintenance based upon cyclic resealing of paved roads, to be planned and executed at Regional and Divisional level. However, until recently, this strategy has been dormant as major maintenance interventions have been mainly project based, funded by Nepal's development partners and planned centrally with little or no involvement of the Regions or Divisions.

Funding available via the nascent Roads Board has now provided the opportunity for the original strategy to be introduced. The present road data management is limited to the lowest level of information quality level and hence substantial efforts and resources are yet to be mobilized to upgrade the existing data management practices. For the time being, prioritizing in the selection of the roads for resealing will be limited to the consideration of **four parameters namely road age, visual survey rating, traffic volume and strategic importance**.

METHODOLOGY

The recommended resealing interval of 5 to 8 years for each road would result in an annual programme of some 400 to 500 km resealing works in the strategic road network.
The management procedures and planning guidelines for periodic maintenance were developed under the Strengthened Maintenance Divisions Programme, and are based upon current DoR Policy. **The methodology consists of following 9 steps.**

Step 1 – Road links greater than eight kilometres can be divided into separate sections of no less than say five kilometres each, where there are radical changes along its length due to the terrain, surface type, traffic volume, or age of the surfacing.

Step 2 – Determine maintenance cycle **T** in years to find out which roads are to be resurfaced every 5,6,7or 8 years based upon traffic volume and terrain (refer table 1)

Table1 T, years	**Traffic Volume–vehicles per day**		
Terrain type	<250 (Low)	250-1500 (Moderate)	>1500 (High)
Plains	**8**	**7**	**6**
Rolling	**7**	**7**	**6**
Hills	**6**	**6**	**5**

Step 3 – Determine the age of surfacing **A** in years age that is again corrected using the suitable age correction factor depending upon the present surface condition (refer table 2)

Table 2	Road Condition Surface Distress Index(SDI)		
Age correction	0 – 1.7	1.8 - 3.0	3.1 - 5.0
	Good	Fair	Poor
Age correction Factor	**Plus 2 years**	**Zero**	**Minus 2 years**

Step 4 - The time/year for each road to be resurfaced is calculated by deducting the corrected age of the road from the nominated maintenance cycle selected from Table 1 **(T minus A corrected)**. If the time for resealing calculated is negative, then the road is due for resealing now, that is year zero. If the corrected time for resealing a good condition road is greater than eight years, then use eight years as a maximum to comply with DoR policy. The roads are then grouped into Year Zero (due for resurfacing now), Year 1 (due for resurfacing next year), Year 2, Year 3, Year 4 and so on.

Step 5 – Budget costs are prepared for roads that require resealing now; these are determined using DoR norms for resealing works during this preliminary assessment stage.

Step 6 –The Data is compiled in Excel spreadsheet. The spreadsheet lists all the details: link identity number, section number, name and length, pavement type, terrain, traffic volume group, surfacing age, road condition, costs and other data obtained from Tables 1 and 2. Beside these data, the spreadsheet also provides management information such as time for resealing, its urgency and subsequent planning for future years.

Step 7 – The screening is performed to identify and isolate roads needing rehabilitation or reconstruction. Visual screening and estimating the residual life of the road pavements are the basis for such screening process. These roads are excluded from the ranking and prioritization process. The remaining zero surface life links are then identified and listed as candidate roads for applying periodic maintenance. Each Road Divisional Office, with the active involvement of field technical personnel, carries out the screening process and presents its case to their respective DoR Regional Directorate for ranking and prioritization within the region.

Step 8 – The ranking and prioritization is carried out at regional level. Roads for year zero from each Division within the Region are merged into one table and each road is assigned index values from the following tables:

Traffic group Index (TGI)

Table 4	Traffic Group – vehicles per day		
	< 250	Between 250-1500	> 1500
TGI	**0.15**	**0.5**	**0.9**

Road Condition Index (RCI)

Table 5	Road Condition – Surface Distress Index (SDI)		
	0 – 1.7	1.8 - 3.0	3.1 - 5.0
	Good	Fair	Poor
RCI	**0.02**	**0.3**	**1.0**

Strategic Importance index (SII)

Table 6	Strategic Importance (SI)		
	Low	Medium	High
SII	**0**	**0.3**	**0.6**

If the same weighting is given to all three indices, then
Ranking Index (RI) = TGI + RCI + SII

Step 9 – Roads for resealing now are then ranked with the highest value of Ranking Index (RI) first. The list forms part of the Region's Annual Road Maintenance Plan, along with a list of roads that require resealing in later years and a list of those needing rehabilitation now.

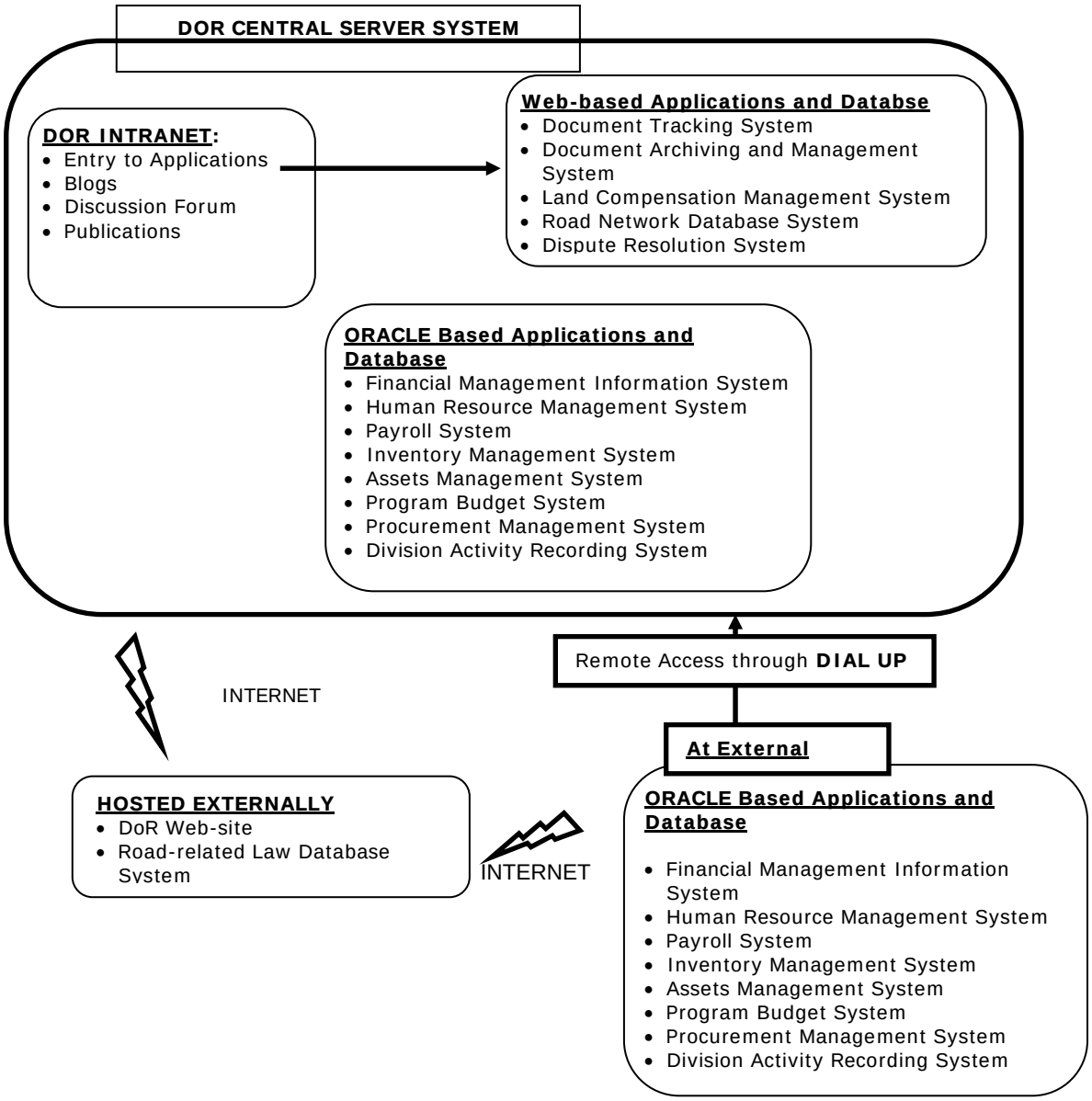
CONCLUSIONS

The cyclic method for determining road maintenance priorities has so far proved popular with the Department engineering staff, as they can readily see for themselves what the problems are instead of relying upon planning specialists at central level. All staff are fully involved in the planning process, from the Overseers who collect field data, Divisional Engineers who prepare their own priority list, Regional Directors who screen out the roads unsuitable for resealing and rank roads at a regional level, through to DoR central office who summarise the data to produce a national Integrated Annual Road Maintenance Plan for submission to the Road Board.
The current indices and DoR policy to resurface roads at a fixed interval of between five and eight years, depending on environment and traffic, are to be reviewed and refined for different surface types in different conditions. This review will be based upon historical data, data collected by the HMIS Unit and specific experience gained by road engineers throughout Nepal.

An Introduction to DOR MIS IT

With an objective to establish the Management Information System in Department of Roads, there was a study conducted to identify the MIS IT needs of Department under the Road maintenance and development Project (funded by IDA Credit 3293).

Based upon this study, Department of Roads procured hardware and software. The hardware consists of various servers in head office and computers both for head office and field offices. Under the contract of hardware, Local Area Network has already been established in DoR's head office. The service procured for software consists of total 16 tasks. The snapshot of the currently established MIS of DoR is described in the figure.



The hardware setup has already been complete. The development of software is also in the final stage. Once the developed software modules are installed in the computers of DoR's external offices, the establishment of MIS in DoR is almost complete. The remaining work will be the training of DoR's staffs on these new software modules, after which DoR will be ready to take a big leap towards MIS IT.

To be really successful in operating MIS IT in a sustainable way and to set an example to other governmental organisations, what DoR requires, is not only the successful initial MIS IT set up, but more important things are **"Commitment of DoR's high level management towards implementation"** and **"Building positive attitude towards the newly established MIS IT environment."**

Sector Wide Road Programme and Priority Investment Plan for Strategic Road Network of Nepal (2007-2016)

Background

Nepal is landlocked country lying between India and China on the lap of the Himalayas covering an area of 147,181 sq. km. Population of Nepal was 23.9 million in 2001 with annual growth rate of 2.27 percent per year.

Road is the principal mode of transport in Nepal carrying about 90 percent of freight and passenger traffic. As a result the socio-economic upliftment of the country is heavily dependent on the effective, reliable and sustainable road network. However difficult topography, young geology and deep river crossings are the basic problems in Development and Maintenance of the road infrastructure.

The extent and quality of the road network in the country is influenced by a number of factors, of which limited funding is probably the most significant. The present study shows that the road user costs at present range between 15 to 20 percent of the GDP which could be brought down substantially if the present expenditures in the road sector are doubled. Despite the huge costs, the benefits to the economy from a safe, reliable and efficient road network are much larger. Roads act as essential lubricant for the country's entire economy, providing a basis upon which many other social and economic activities prosper.

Sector Wide Road Programme

The Department of Roads has carried out a study to prepare a Sector Wide Road Programme. The first objective of the study was preparation of a Sector Wide Investment Plan for the Road Sector to provide all-weather motorable access within four hours walk in the Hills and two hours in the Terai. A comprehensive analysis of accessibility throughout the country has been carried out using GIS Techniques.

The second task was the definition of the existing and proposed road networks both Strategic and Local. Data available from various agencies active in road sector in Nepal have been compiled and an attempt has been made to produce a single map of all road networks. Due to varying standards and formats of the available data the accuracy of the compiled map, especially on the rural roads, needs to be verified and updated further.

Out of the 17000 km of total road network about 7000 km of Strategic Roads and about 4000 km of Local roads totalling to about 11000 km is providing 81 percent of the total population accessibility within 4 hours in the hills and 2 hours in the Terai.

The overall analysis has identified a limited number of pockets of high density population that are NOT served by either the SRN or the LRN. Thus, Future road programmes could be developed in these areas to define the best and most appropriate form of Road Network to meet the observed access deficiencies.

Priority Investment Plan

The Department of Roads has also prepared a Priority Investment Plan for the Management and Development of the Strategic Road Network for the period 2007-2016. The focus and content of the PIP- 2006 is significantly different from similar plan prepared 10 years ago. The main recommendation of PIP - 1996 was the extension of the network into the non-road-served hill areas, focussing on construction of new roads to unconnected District Headquarters. This plan has mostly been achieved. Out of the 14 unconnected district headquarters 8 will be connected within the next couple of years and the remaining 6 district headquarters of Humla, Mugu, Dolpa, Manang, Mustang and Solukhumbu will be connected within this plan period.

The present PIP-2006 recommends that future road network development programmes should focus on an intensification of the network in populated areas and at the same time on improvement in the serviceability and reliability of existing roads. Major share of expenditure during the next 10 years is for the upgrading of the initial earth or gravel tracks that have been opened. It is recognised that there are significant additional benefits to be achieved through the provision of regular and reliable access, which are manifest by more frequent trip-making and increased overall consumption of goods leading to greater economic activity and social interaction.

Mid Hills Links and Improvement of Terai roads

During the planned period, a Mid-Hills East-West Corridor that serves or passes close to 23 District HQs and connects the Indian Border at Pashupatinagar in the east and Jhulalghat in the west will be completed. The Mid-Hills Corridor will be around 1,700 km in length, of which over 1,000 km is existing SRN. Most of the remaining lengths comprise of either existing local roads or new links under construction.

Similarly improvement of about 1500 km of Terai roads to all weather standards is planned with the assistance from the Government of India along with the completion of Tanakpur Link from Mahendranagar.

Strategic Network Improvements

The construction of the Fast Track between Kathmandu Valley and the Terai would undoubtedly be the single largest project ever undertaken in the road sector in Nepal and potentially the most significant in terms of reducing overall transport costs and influencing the growth and development of the country. The fast track will be about 90 km of high standard road. This will allow Hetauda to be reached within an hour and Birgunj within two to three hours from Kathmandu Valley. Estimated cost of the road is NRs. 18 Billion (US $ 250 milion).

Due to the scale and importance of the project, a full and detailed assessment of the alternatives is being carried out with Technical assistance from The ADB so that a final decision is taken and construction committed.

In addition, Dhulikhel Bardibas Road (BP Rajmarg) will be completed during this planned period providing new link to Terai from Kathmandu including capacity improvement between Kathmandu and Bhakatapur, with the grant assistance from the Government of Japan.

Similarly the construction of Safrubesi-Rasuwagadi section along with outer ring road in Kathmandu is also planned to be completed with assistance from the Government of China.

Kathmandu Valley Urban Transport Improvement

Kathmandu is now beginning to experience serious traffic congestion, leading to delays at key locations throughout much of the day. The congestion is caused not only by the increases in vehicle numbers but, more significantly, by poor traffic management and driver discipline. There is a critical need to address these problems and to produce a coordinated package of improvement measures, including some physical infrastructures, to address capacity deficiencies.

Some of measures planned are capacity improvement of the existing Ring road, Radial Roads including capacity improvement of Kathmandu- Bhaktapur Road and some additional key new links.

Maintenance and Expansion of Strategic Network

Out of the 5411 km of SRN designated in 1996 more than 5,000 km have been completed and are providing all-weather accessibility. Out of which 3500 km are sealed. In addition substantial lengths of non SRN roads have been built and maintained by DoR. The length of operational roads under DoR is about 7,500 km. This Road Network alone is providing all weather access to 77 percent of the entire population. With local Road network of about 4000 km this figure is already 81 percent.

PIP aims at expanding the SRN by about 1,000 km before 2010 and an additional 1500 km by 2016, to create a total of about 10,000 km of Strategic Road Network. This extended Strategic Road Network alone will bring 85 percent of the total population within the accessibility criteria of 4 hours in the Hills and 2 hours in the Terai. With expected completion of 6000 km of Local Roads accessibility will increase by further 6 percent to 91 percent by 2016.

Regular Maintenance

The Road Fund Board was established to ensure regular and dedicated Annual Maintenance funds for the Road Network, through a fuel levy, tolls, vehicle registration and licence fees. However till now adequate funds is not available from this source. Road Board needs to be strengthened further and supported adequately in order to ensure regular and sufficient funding for the maintenance of the Road Network, to ensure safe and reliable roads and asset preservation

Periodic Maintenance

During the next 10 years 3,000 km of SRN will need periodic maintenance including rehabilitation of about 1000 km of Roads. This figure is likely to increase with proposed expansion of the Road Network.

The current practice of using reseals as periodic maintenance intervention will be evaluated against the benefits from Asphalt Concrete Overlays and appropriate strategy adopted by DoR.

Upgrading and New construction

During the next 10 years DoR intends to upgrade about 5000 km of existing unsealed roads to sealed standards. In addition further 1500 km new sealed roads are planned by 2016.

It will therefore be necessary to retain the involvement of donor assistance not only for the expansion of the road network but also to provide adequate funding for both periodic maintenance and upgrading works, for a foreseeable future.

Proposed Budget (2007-2016)

The total expenditure over the next 10 years for the SRN is estimated at about Rs. 100 billion at current 2006 prices, requiring average budget allocations of more than Rs. 10 billion per year. It should be noted here that this budget scenario is only for the maintenance and expansion of the Strategic Road Network. At present DoR is entrusted with the responsibilities of constructing and maintaining substantial length of non strategic roads including construction of Bridges. The budget ceilings for the Department of Roads in future need to accommodate this reality so that the strategic road network gets adequate funds to execute the plans as proposed. At the same time, allocation of funds for unplanned roads and duplicate allocation on same roads through different road agencies needs to be avoided.

Accessible Populations to Existing & Extended SRN

	SRN Length	Population served		
	km	Hill	Terai	Total
Existing Designated SRN 2006	5027	5.60 49%	10.93 75%	16.54 64%
Existing / Operational SRN 2006	7361	6.43 56%	13.5 93%	19.96 77%
Committed Additional SRN Links 2010	8392	6.99 61%	13.83 95%	20.82 80%
Extended SRN 2016	**9931**	**7.94** **70%**	**14.1** **97%**	**22.04** **85%**

Additional Populations served with LRN

	Length	Population served		
	km	Hill	Terai	Total
Existing / Operational SRN 2006	*7361*	*6.43* *56%*	*13.5* *93%*	*19.96* *77%*
PLUS 2006 LRN	+ 4,400 = 11,730	7.58 67%	14.19 99%	21.77 84%
Extended SRN 2016	*9,931*	*7.94* *70%*	*14.1* *97%*	*22.04* *85%*
PLUS 2016 LRN (Committed)	+ 6,000 = 15,700	9.08 80%	14.41 99%	23.49 91%
PLUS All known existing & planned roads	~31,000	9.92 87%	14.48 100%	24.40 94%

Department of Roads
Project Directorate (ADB), Bishalnagar

Glimpses of the Projects being undertaken by the Project Directorate

Road Network Development Programme (ADB Loan no. 1876-NEP)

Road Network Development Programme (RNDP) is being undertaken with loan (SDR US $ 35.686 million) from Asian Development Bank (ADB). The consultants for this project are Roughton International in association with Montgomery Watson Hazra and ITECO Nepal, Full Bright Consultancy and ICGS.

RNDP consists of the following Roads

- **Belbari-Chauharwa**: This component falls under East West Highway Pavement Strengthening. The total length of this component is 140 Km. The contractor for this component is IRCON International, New Delhi. This project consists of overlay of Asphalt concrete. This project was started on 16/04/2005 and its current progress is about 24%.
- **Biratnagar-Bardanga**: Urlabari-Bardanga: This is a Road Improvement Component. The total length of this project of 65 Km. This project consists of upgrading existing road to 3.5m and 1.25m shoulder with DBST on carriageway and SBST on shoulder. The contractor of this project is CTCE-Kalika JV. The project start date is 14/07/2005 and its current progress is about 50%.

- **Basantapur-Mudhe**: This road was initially a part of Basantapur Khandbari Feeder Road Project (BKFRP). This project has a total length of 13 Km. This is also a Road Improvement Component. The contractor for this project is Gorkha-CWE-Bokhim JV. The project start date is 21/08/2006 and its current progress is about 5%.
- **Piluwa Khola Bridge**: This Bridge lies between Mudhe and Chainpur. This consists of a single span single lane steel truss bridge of about 96 m span. This also consists of 120m of approach road. This project bid is under evaluation and will be awarded shortly. The project period is 20 months.
- **Damak-Gauriganj**: This is a Road Improvement Component. The total length of this project of 22 Km. This project has been divided into four LCB contracts. The project start date is 02/03/2005 and its current progress is around 40%.
- **Dolalghat-Chautara**: This is a Road Improvement Component. The total length of this project of 23.4 Km. This project has been divided into four LCB contracts. The project start date is 02/03/2005 and this project is almost complete. Only the fourth contract is remaining with more than 75% progress.
- **Pauwa Bhanjyang-Phidim**: This is a Road Improvement Component. The total length of this project of 24 Km. This project has been divided into four LCB contracts. The project start date is 24/02/2005 and its current progress is about 67%.
- **Hile-Basantapur**: This is a Road Improvement Component. The total length of this project of 22 Km. This project has been divided into four LCB contracts. The project start date is 07/04/2005 and its current progress is about 50%.
- **Mudhe-Khandbari**: This road was initially a part of Basantapur Khandbari Feeder Road Project (BKFRP). This is a Road Improvement Component. The total length of this project of 63 Km. This project has been divided into sixteen LCB contracts. The project start date is 19/11/2006 and its expected completion date is 18/05/2008.
- **Performance Based Maintenance Contracts**: The Performance Based Maintenance (PBM) Principles are preventive and catch-up maintenance works, Emergency works, Bio-engineering works and Improvement works. Preventive maintenance consists of minor pavement reconstruction, shoulder rehabilitation, crack sealing and resealing the full width and length of roads. Additional preventive maintenance measures include erosion control, support of cuttings and drainage improvements. Catch-up maintenance is concerned with the road drainage, general maintenance of bridges and culverts, road furniture and road markings. Emergency works include remedial action for damages due to disasters like washouts, landslips etc. Bioengineering works consists of planting of grass, shrubs and trees to stabilize unstable slopes and re-vegetate new works. Improvement works consists of improving the overall integrity and quality of the roads. These comprise improvement to erosion protection, cross drainage, longitudinal drainage and slope stability.

Currently there are two component of PBM; Hetauda to Narayani Bridge of approx. 77 Km and Kohalpur to Gadda Chowki of approx. 203 km. The Kohalpur-Gadda Chowki component is divided into four contracts. The contract period is of five years with the first two year as preventive and catch-up maintenance and the remaining period is for Performance Based Maintenance. The bid for Hetauda-Narayani Bridge is under evaluation and it will be awarded shortly. The PBM is over seen by the Division road office.

Road Connectivity Sector Project (ADB Grant No. 0051-NEP)

Road Connectivity Sector Project (RCSP) is being undertaken with Grant of US $ 55.2 million from Asian Development Bank (ADB). The objective of Road Connectivity Sector Project (RCSP) is to improve feeder road connectivity from Strategic Road Network (SRN) to rural areas, in particular north-south connectors to the hill districts and increase the capacity and efficiency of the road network in Nepal. The Project goals are consistent both with the current Nepal Country Strategy and Program (CSP) and Government of Nepal's 20 Year Road Plan (RMP). The efficient road transport and improved connectivity to rural areas are key to poverty reduction and economic development.

This Project is divided into two components, namely core-road and non core-road. The core-road has been identified and it consists of three roads of total length of 227 Km. The core-roads are i) Galchhi-Trishuli-Syaphrubesi [89 Km] ii) Phidim-Taplejung [55 Km] iii) Tamakoshi-Manthali-Khurkot [83Km]. The feasibility study of approx. 550 Km of Non core-roads has to be carried out and about 223 Km of the roads will be constructed. The selection of Consultant has been completed for RCSP and they will start work soon.

Sub-regional Transport Facilitation Project (STFP) Loan No.2097-NEP(SF)

This is a project developed with ADB, with the objective of improving border crossing access roads, customs, trans-shipment and freight handing facilities at principal border crossings in Nepal, thereby improving the sub-regional transport network between Nepal and India, Bangladesh, Bhutan and other third countries. The Loan agreement is of US $ 26.7 million.

Components:

- **Birgunj ICD access road sub-project-** consisting of upgrading of 0.6 km existing (Padam) road as 2 lane sealed road and new construction of 10.2 km bypass road from Padam road to Tribhuvan Highway and widening of 1.5 km road section at Jeetpur.
- **Bhairahawa – Bhumahi road upgrading sub-project**- consisting of upgrading of existing 29 km gravel road from Bhairahawa to Bhumahi on the East-West Highway, to sealed 2 lane standard road with 7m carriageway. Civil works contract packages are STFP/ICB/BM (From Bhairahawa to Mahau bridge,15Km) and STFP/ICB/MH (From Mahau bridge to Bhumahi,14Km).
- **Kakarbhitta ICD component**- comprising of construction of a road based ICD at Kakarbhitta at Nepal/India border, in an area of about 7.5 ha with all necessary facilities.
- **ASYCUDA**- The institutional capacity building custom component of the STFP, with the objective of enhancing the capacity of DOC by providing technical support for implementing customs operational procedures, regulations and information technology systems, including further deployment of the Automated System for Customs Data (ASYCUDA) modules.

Progress: Under the ADB financing the project is underway at present. The scheduled date of start was January 2007. At present the procurement of works is in the stage of completion.

Land acquisition and Resettlement- Updated Final Report of Land Acquisition and Resettlement Plan for Bhairahawa-Bhumahi Road and Birgunj ICD-Jeetpur Road sub-projects are recently made public on 7 Feb 2007.

North South Fast Track Road Project (NSFTRP) TA No. 4842-NEP

This is an ADB Technical Assistance (TA) project and has an overall objective of enhancing road connectivity to facilitate trade and goods flow, leading to faster economic growth and poverty reduction. The main outcome of the TA will be a comprehensive report on the feasibility study of the north - south fast track roads; preliminary design of the project roads; financing program suitable for ADB financing; and an institutional capacity building program. The North South Fast Track Road Project (NSFTRP) aims at improving transport reliability by providing a cost-effective investment program to improve links between Kodari and Birganj via Kathmandu, with considerable savings in both time and costs. Under the project, a Feasibility study for about 100km fast track road from KTM to the Terai, and about 30km road rehabilitation and slope stabilization between KTM and Kodari, considering engineering, economic, social, resettlement, road safety and environmental aspects will be carried out. The cost of the Project Preparation Technical Assistance has been estimated at $ 1.1m. The ADB has selected the Oriental Consultants Co., LTD (JAPAN) as the Consultants of the project. The scheduled date to start the project was February 2007 and end in January 2008.

Do You Know?

The world's longest national highway is the Trans-Canada Highway that run across Canada from Victoria, British Columbia to and St. John's, Newfoundland covering 7,821 kilometers.

Highway 401 also named as Macdonald-Cartier Freeway or The King's Highway No. 401 is considered to be the world's busiest highway, with an estimated Annual Average Daily Traffic (AADT) of over 500,000 in 2006, between the Weston Road and Highway 400 interchanges in Toronto

The list of district headquarters yet to be connected by the SRN.

1	Khadbari	8	Simikot
2	Salleri	9	Gamgadhi
3	Diktel	10	Jumla
4	Bhojpur	11	Martadi
5	Chame	12	Jajarkot
6	Jomsom	13	Chainpur
7	Dunai	14	Manma

According to traffic count survey 2005, Mahohara Bridge Station (ARM-TINKUNE-LOKANTHALI Sector) has the highest AADT (34,706 vpd or 42, 889 PCUs)

Chabahil East Station (Chabahil Junction -Jorpati Road) has the highest AADT, when motor-cycles are excluded (21,050 vpd or 21,086 PCUs)

Repair of Armadi Bridge at Pokhara - Baglung Road

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Abstract

Armadi Bridge, located at the chainage of 62+600 of Pokhara Baglung road was severely damaged, in 2054 Shrawan, by the flood after two years of its construction. It is a masonry arch bridge with a clear span of 13 and the overall width of 7.6 m. The flood washed out part of its right abutment, part of springing beam and arch slab. Traffic was diverted from it because it was not in a position to carry the traffic. The bridge was repaired in 2062 Jestha with a very cheaper cost. The repair & rehabilitation cost of the bridge was only 18 lakhs. ITECO had suggested replacing the bridge at a cost of 61 lakhs. Low viscosity epoxy polymer was used to repair the cracks. Anchor rods were provided to bring its right abutment to its original shape. DOR has an opportunity to learn the modern repair methods for such badly damaged bridges due to the flood or bomb blast.

1. The damaged bridge

The bridge was badly damaged by the debris-laden flood on 2054-4-2. The huge flood of monsoon could not accommodate within the clear span of the bridge. See photo 1. Traffic was diverted from it because it was not in a position to carry the traffic. The arch section observed a huge horizontal thrust across the bridge.

Photo 1 Damaged Armadi Bridge from upstream side

The impact of big boulders on bridge chipped off stone masonry and springing beam from right abutment. The bridge did not completely collapse but about 28% of the length of western side springing beam was swept up. The extent of damage was up to 8 m far from the inner face of abutment. Some of the blocks were completely crushed i.e. material failure occurred. This is **type 3 crack** as shown in photo 2 below.

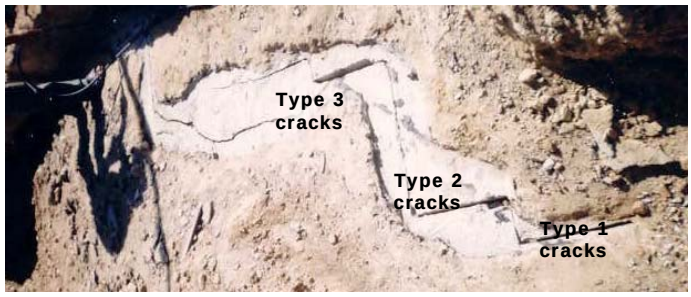

Photo 2, View of Cracks at the arch slab from top

Type 1 crack is the de-bonding crack between the blocks. The strength of mortar being lesser than the strength of

blocks the crack propagated along the joint. **Type 2 crack** is due to the shear failure of bond. See photo 2 & 3 to observe the size and type of cracks at the arch slab.

Photo 3, View of Cracks at the arch slab from below

2. Possible maintenance measures

A team of engineers from ITECO Nepal P Ltd conducted the investigation on the bridge failure. They recommended the following two options. One was for the maintenance, improvement and rehabilitations works with an estimated amount of NRs 1,24,97,808/- and the second option was replacing the bridge at an estimated cost of NRs 60,92920/- . Experts from Himalayan Engineering Associates, (HEA) Kathmandu assessed the bridge site on Paush 2060. HEA suggested treating the arch slab with the low viscosity epoxy joint sealer compound. HEA ascertained that the bridge could carry the designed load if treated with the low viscosity epoxy sealant compound.

The repair work was divided into two parts

1) Crack sealing works.
2) Civil maintenance works & river training works.

3. How the bridge was repaired by crack sealing?

The overburden load above the arch slab was completely removed. The exposed crack lines above the arch slab were cleaned. Scaffolding on soffit of arch was provided such that workers were able to reach the crack from below the arch slab. The crack was washed, cleaned with water & allowed to dry. Dust & dirt were removed away with help of a compressor machine. The fine cracks were first primed with Concessive 1020[1]. Concessive 2200[2] was then applied to the external face of cracks in order to retain (fix) the aluminum sheets around the cracks. Aluminum sheets were used as formwork for the epoxy concrete. The cracks face was sealed all over but aluminum nipples of 5 mm diameter were fixed at certain intervals. Master flow 400[3] was poured through one of the nipple lying at the lowest elevation. Master flow was applied with pressure. When it filled up the entire space between the two adjacent nipples connected through the cracks it appeared to flow out from the nipple situated at the higher elevation. After allowing the master flow to flow out for a few seconds it was plugged by a cap. Master flow was continuously charged unless all the nipples lying on the connected cracks shows overflow. The nipples from lower to higher elevation were plugged gradually.

Photo 4, View of Repaired Cracks at The arch slab from below the bridge

Where there was bigger size of cracks master flow was directly charged in to it. Master flow could not be charged into the very smaller cracks. So Concressive 1315[4] was used in such cracks. See photo 4 to observe the cracks repaired with epoxy resin. Emcekrete ready to use, free flow, non-shrink grout was used to fix the iron rods into the 25 mm diameter drill holes, It is reported that the compressive strength of 28 day Emcekrete grout is 75 MPa & flexural strength 10.1 MPa. The pullout bond strength of bond was 660 MPa (i.e.12 mm rod fails earlier than concrete grout).

4. Conclusions:

1) The bridge layout was eccentric. The span was smaller than requirement. It was curvilinear. The materials were of poor quality. The debris carrying nature of the bridge if taken into account while designing the bridge would prevent from such damage.

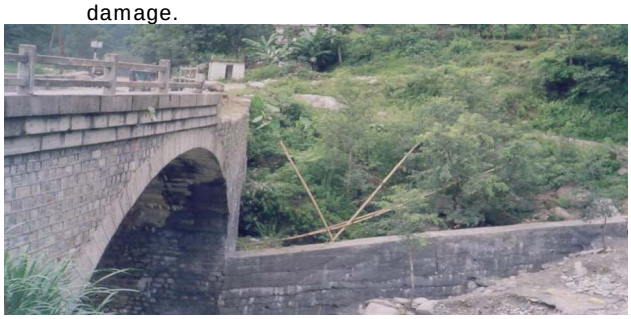

Photo 5. View of Bridge arch & abutment after maintenance

2) The author was little bit afraid when he saw the material failure section of the arch slab. It was terrible to repair such fully crushed part of arch block. Master Flow returned back the life of damaged blocks and failed joints.
3) Such type of bridge failure occurring else where in our country is proved repairable. There are several bomb blasted and/or flood damaged bridges in our country. We have to use the above-mentioned techniques to repair such bridges. The engineers who were afraid of the outcome are now happy to see the repaired Armadi Bridge. It is due to the use of modern construction materials and new methodology.
4) The work was completed in 14.5% of amount estimated by the first consultant however he had preferred to go for replacement that was again a costlier option.

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