Table 10-2 Vehicle Speed

2-Lane Road Km/h

Surface condition	Passenger Car/Motorcycle				Bus/Truck			
	Paved		Unpaved		Paved		Unpaved	
	Straight	Curve	Straight	Curve	Flat	Slope	Flat	Slope
Good	52.5	42.5	42.5	32.5	47.25	38.25	38.25	29.25
Fair	50.0	40.0	40.0	30.0	45.0	36.0	36.0	27.0
Poor	40.0	30.0	30.0	20.0	36.0	27.0	27.0	18.0
Bad	32.5	22.5	22.5	12.5	29.25	20.25	20.25	11.25
Very Bad	25.0	20.0	20.0	10.0	22.5	18.0	18.0	9.0

1-Lane Road Km/h

Surface condition	Passenger Car/Motorcycle				Bus/Truck			
	Paved		Unpaved		Paved		Unpaved	
	Straight	Curve	Straight	Curve	Flat	Slope	Flat	Slope
Good	44.5	36.0	36.0	27.5	40.0	32.5	32.5	25.0
Fair	42.5	34.0	34.0	25.5	38.5	30.5	30.5	23.0
Poor	34.0	25.5	25.5	17.0	30.5	23.0	23.0	15.5
Bad	27.5	19.0	19.0	10.0	25.0	17.0	17.0	9.5
Very Bad	21.5	17.0	17.0	8.5	19.0	15.5	15.5	7.5

(3) Unit Vehicle Operating Cost

Unit vehicle operating cost estimated in the Study on Kathmandu Valley Urban Road Development (JICA, 1993) is being applied in this Study. Unit vehicle operating cost by vehicle speed and road condition is set up as below:

1) Unit Vehicle Operating Cost by Vehicle Speed

Unit vehicle operating cost by vehicle type is set up applying established relationship between vehicle operating cost and vehicle speed in Japan as shown in Table 10-3.

2) Unit Vehicle Operating Cost by Road Condition

Unit vehicle operating cost by road condition is another factor which decides the size of vehicle operation cost. Size of unit vehicle operation costs by road condition is estimated as shown in Table 10-4 based on available study results such as "Quantification of Road User Saving" by Jan De Weille.

Table 10-3 Unit Vehicle Operating Cost

(1) Passenger Car

(NRs/1000km)

Speed Level (km/h)	Fuel	Oil	Tire	Maintenance		Depreciation	Crew	Capital	Subtotal	Overhead '(15%)	Total
				Parts	Labour						
5	5,191	491	166	1,108	89	74	1,500	3,822	12,440	1,866	14,306
10	4,142	391	166	1,108	89	74	750	1,911	8,631	1,295	9,926
15	3,467	328	166	1,108	89	74	500	1,274	7,005	1,051	8,055
20	2,969	281	166	1,108	89	74	375	956	6,016	902	6,919
25	2,649	250	166	1,108	89	74	300	764	5,400	810	6,210
30	2,400	227	166	1,108	89	74	250	637	4,950	743	5,693
35	2,204	208	166	1,108	89	74	214	546	4,609	691	5,301
40	2,080	197	166	1,108	89	74	188	478	4,378	657	5,035
45	1,956	185	166	1,108	89	74	167	425	4,168	625	4,793
50	1,884	178	166	1,108	89	74	150	382	4,031	605	4,636
55	1,831	173	166	1,108	89	74	136	347	3,924	589	4,513
60	1,796	170	166	1,108	89	74	125	319	3,845	577	4,422
65	1,778	168	166	1,108	89	74	115	294	3,791	569	4,360
70	1,796	170	166	1,108	89	74	107	273	3,782	567	4,349
75	1,813	171	166	1,108	89	74	100	255	3,776	566	4,342
80	1,849	175	166	1,108	89	74	94	239	3,793	569	4,361
85	1,884	178	166	1,108	89	74	88	225	3,812	572	4,384

(2) Bus

(NRs/1000km)

Speed Level (km/h)	Fuel	Oil	Tire	Maintenance		Depreciation	Crew	Capital	Subtotal	Overhead (25%)	Total
				Parts	Labour						
5	6,016	987	1,700	1,746	83	58	3,542	3,255	17,386	4,347	21,733
10	4,681	768	1,700	1,746	83	58	1,771	1,628	12,434	3,108	15,542
15	3,822	627	1,700	1,746	83	58	1,181	1,085	10,301	2,575	12,876
20	3,237	531	1,700	1,746	83	58	885	814	9,053	2,263	11,316
25	2,798	459	1,700	1,746	83	58	708	651	8,202	2,051	10,253
30	2,469	405	1,700	1,746	83	58	590	543	7,593	1,898	9,491
35	2,267	372	1,700	1,746	83	58	506	465	7,197	1,799	8,996
40	2,103	345	1,700	1,746	83	58	443	407	6,884	1,721	8,605
45	2,011	330	1,700	1,746	83	58	394	362	6,683	1,671	8,354
50	1,920	315	1,700	1,746	83	58	354	326	6,501	1,625	8,126
55	1,865	306	1,700	1,746	83	58	322	296	6,375	1,594	7,969
60	1,829	300	1,700	1,746	83	58	295	271	6,281	1,570	7,852
65	1,865	306	1,700	1,746	83	58	272	250	6,280	1,570	7,850
70	1,957	321	1,700	1,746	83	58	253	233	6,349	1,587	7,937
75	2,048	336	1,700	1,746	83	58	236	217	6,424	1,606	8,029
80	2,213	363	1,700	1,746	83	58	221	203	6,587	1,647	8,233
85	2,395	393	1,700	1,746	83	58	208	191	6,775	1,694	8,468

(3) Truck

(NRs/1000km)

Speed Level (km/h)	Fuel	Oil	Tire	Maintenance		Depreciation	Crew	Capital	Subtotal	Overhead (25%)	Total
				Parts	Labour						
5	4,708	927	1,700	1,422	83	47	3,542	2,652	15,081	3,770	18,851
10	3,598	708	1,700	1,422	83	47	1,771	1,326	10,656	2,664	13,320
15	2,916	574	1,700	1,422	83	47	1,181	884	8,807	2,202	11,008
20	2,446	482	1,700	1,422	83	47	885	663	7,729	1,932	9,661
25	2,105	414	1,700	1,422	83	47	708	530	7,011	1,753	8,763
30	1,906	375	1,700	1,422	83	47	590	442	6,566	1,641	8,207
35	1,692	333	1,700	1,422	83	47	506	379	6,163	1,541	7,704
40	1,607	316	1,700	1,422	83	47	443	332	5,950	1,488	7,438
45	1,493	294	1,700	1,422	83	47	394	295	5,728	1,432	7,160
50	1,451	286	1,700	1,422	83	47	354	265	5,608	1,402	7,010
55	1,422	280	1,700	1,422	83	47	322	241	5,518	1,379	6,897
60	1,436	283	1,700	1,422	83	47	295	221	5,488	1,372	6,860
65	1,451	286	1,700	1,422	83	47	272	204	5,465	1,366	6,831
70	1,493	294	1,700	1,422	83	47	253	189	5,482	1,371	6,853
75	1,564	308	1,700	1,422	83	47	236	177	5,538	1,384	6,922
80	1,692	333	1,700	1,422	83	47	221	166	5,665	1,416	7,081
85	1,835	361	1,700	1,422	83	47	208	156	5,813	1,453	7,266

(4) Motorcycle

(NRs/1000km)

Speed Level (km/h)	Fuel	Oil	Tire	Maintenance		Depreciation	Crew	Capital	Subtotal	Overhead '(15%)	Total
				Parts	Labour						
5	1,557	561	52	64	18	43	0	179	2,474	371	2,845
10	1,243	447	52	64	18	43	0	90	1,956	293	2,250
15	1,040	374	52	64	18	43	0	60	1,651	248	1,898
20	891	321	52	64	18	43	0	45	1,433	215	1,648
25	795	286	52	64	18	43	0	36	1,293	194	1,487
30	720	259	52	64	18	43	0	30	1,186	178	1,363
35	661	238	52	64	18	43	0	26	1,102	165	1,267
40	624	225	52	64	18	43	0	22	1,048	157	1,205
45	587	211	52	64	18	43	0	20	994	149	1,144
50	565	204	52	64	18	43	0	18	963	145	1,108
55	549	198	52	64	18	43	0	16	940	141	1,081
60	539	194	52	64	18	43	0	15	924	139	1,063
65	533	192	52	64	18	43	0	14	916	137	1,053
70	539	194	52	64	18	43	0	13	922	138	1,060
75	544	196	52	64	18	43	0	12	928	139	1,068
80	555	200	52	64	18	43	0	11	942	141	1,083
85	565	204	52	64	18	43	0	11	956	143	1,099

Table 10-4 Ratio of Unit Vehicle Operation Cost between Standard and Various Road Conditions

Km/h

Item		- Passenger Car - Motorcycle	- Bus - Truck
Pavement	Paved	1.00	1.00
	Unpaved	1.30	1.25
Surface condition	Good	1.00	1.00
	Fair	1.05	1.10
	Poor	1.15	1.20
	Bad	1.20	1.30
	Very Bad	1.25	1.45
Straight/Curve	Mostly Straight	1.00	1.00
	Mostly Curve	1.05	1.10

(4) Unit Time Cost

Unit time cost, essential for the calculation of time cost, has been estimated as shown in Table 10-5 applying income data, characteristic of passengers (number of passenger & purpose of trip) by vehicle type.

Table 10-5 Unit Time Cost

NRs./h

Vehicle Type	Passenger Car	Bus	Truck	Motorcycle
Unit Time Cost	7.8	98.0	12.7	5.9

10.2.4 Service Level of Project Road by Alternative of Road Development Plan

(1) Road Service Levels

Road service level of the Project Road by alternative of road development plan is established as shown in Table 10-6. Service level of the road decides not only the size of traffic volume on the Project Road but also total road user's cost thereon.

(2) Traffic Volume

Future traffic volume on the Project Road by alternative of road development plan has been forecasted considering above mentioned road service levels as explained hereunder:

- Traffic Volume on Two-lane Road

All the potential traffic on the Project Road mentioned in Section 3 in Chapter 2 are assumed to be accommodated by the Road.

- Traffic Volume on One-lane Road

Some of the normal traffic are expected to change their route to the existing one (Kathmandu – Hetauda – East Terai) because of reduction of travel speed due to substandard road service level, while some of the induced traffic, which are expected to be realized in the case of two-lane road, would be suppressed because of the imperfect function of the Road.

Future traffic volume by alternative of development plan is given in Table 10-7.

Table 10-6 Road Service Level (1999)

(Alternative 1)

	Section I	Section II		
	Bardibas – Sindhuli	Sindhuli – Khurkot	Khurkot – Nepalthok	Nepalthok – Dhulikhel
Number of Lane	one	one	one	one
Pavement Condition	unpaved	unpaved	unpaved	unpaved
Surface Condition	fair	good	fair	fair

(Alternative 2)

	Section I	Section II		
	Bardibas – Sindhuli	Sindhuli – Khurkot	Khurkot – Nepalthok	Nepalthok – Dhulikhel
Number of Lane	one	one	one	one
Pavement Condition	unpaved	unpaved	unpaved	unpaved
Surface Condition	fair	good	good	good

(Alternative 3)

	Section I	Section II		
	Bardibas – Sindhuli	Sindhuli – Khurkot	Khurkot – Nepalthok	Nepalthok – Dhulikhel
Number of Lane	one	one	one	one
Pavement Condition	paved	paved	paved	paved
Surface Condition	fair	good	fair	fair

(Alternative 4)

	Section I	Section II		
	Bardibas – Sindhuli	Sindhuli – Khurkot	Khurkot – Nepalthok	Nepalthok – Dhulikhel
Number of Lane	one	one	one	one
Pavement Condition	paved	paved	paved	paved
Surface Condition	fair	good	good	good

(Alternative 5)

	Section I	Section II		
	Bardibas – Sindhuli	Sindhuli – Khurkot	Khurkot – Nepalthok	Nepalthok – Dhulikhel
Number of Lane	two	two	two	two
Pavement Condition	paved	paved	paved	paved
Surface Condition	good	good	good	good

Road Service Level (2010)

(Alternative 1-5)

	Section I	Section II		
	Bardibas – Sindhuli	Sindhuli – Khurkot	Khurkot – Nepalthok	Nepalthok – Dhulikhel
Number of Lane	two	two	two	two
Pavement Condition	paved	paved	paved	paved
Surface Condition	good	good	good	good

Table 10-7 Traffic Volume on the Project Road by Alternative of Road Development Plan

Unit: vpd

Year	Road Dev. Plan	Section	Normal	Induced	Total
1999	Two-lane Road	I	637	481	1,118
	(Alt. 5)	II	613	445	1,058
	One-lane Road	I	533	134	667
	(Alt. 1-4)	II	509	123	632
2010	Two-lane Road	I	1,464	1,087	2,551
	(Alt. 1-5)	II	1,453	1,108	2,561

10.2.5 Stream of Annual Benefit

Benefits for the year 1999 and 2010 are estimated as shown in Table 10-8 and 10-9. Stream of benefit throughout the project life is obtained through the interpolation/extrapolation of estimated benefits of 1999 and 2010. Streams of annual benefit by alternative of development plan is given in Appendix-G.

Table 10-8 Benefit in the Opening Year (1999) – with slope protection work –

Unit: Million NRs.

Case	BOC Saving	TC Saving
ALT. 1	163.8	9.4
ALT. 2	170.3	15.4
ALT. 3	233.3	25.9
ALT. 4	251.7	30.2
ALT. 5*	371.8	49.3

* with slope protection

Table 10-9 Benefit after the Completion of Stage Construction Work (2010)

Unit: Million NRs.

Case	BOC Saving	TC Saving
ALT. 1-5	901.1	101.0

10.2.6 Result of Economic Evaluation

Calculated indicator for economic evaluation by alternative of road development plan is given in Table 10-10. The following are major findings of the evaluation:

- For all the alternatives, cases with the second stage construction works came up with higher IRR than those cases without the second stage construction works,

- Highest IRR came up with in Alternative 4, in which paved one-way road is being proposed,

- The IRR for Alternative 5, which is the case of paved, two-lane road introduced at the initial stage, is about 8.5%. This is lower than those of Alternative 3 and 4, both of which are cases of improvement road with paved, one-lane road constructed at the initial stage. This fact suggests appropriateness of stage construction of the Project Road under the well designed scheme of stage construction,

- The IRR for Alternative 1 in Partial Evaluation which is the case with minimal standard (unpaved, one-lane road), is about 4.2%,

- All the IRRs calculated are smaller than 12% of opportunity cost of capital officially admitted in Nepal, and

- Consequently, all the B/C ratios are less than one (1) and NPVs have negative values if calculated.

Table 10-10 Result of Economic Evaluation
– Internal Rate of Return –

	Total Evaluation (with Second Stage Investment)	Partial Evaluation (Initial Investment only)
Alternative 1	0.0808	0.0419
Alternative 2	0.0824	0.0432
Alternative 3	0.0851	0.0674
Alternative 4	0.0878	0.0705
Alternative 5	00845	–

10.3 Financial Analysis

10.3.1 General

In order to check the possibility of toll collection for maintenance expenditure, simple financial analysis has been carried out in this section. As the Project Road will save a travel time as much as three (3) hours for the road users between Kathmandu and East Terai, charging a toll fee, as long as it is within the reasonable extent, would not affect on the route selection of the users. However, it is obvious that anticipated total toll revenue from the road will not be large enough to cater to whole of the project cost, because of relatively small traffic volume expected of on the Road.

10.3.2 Toll Rate

Reasonable toll rates have been estimated in consideration of following factors:

- average time saving
- unit time cost

Same unit time cost for passenger car used in economic benefit calculation (Table 10-5) has been used for the estimation with the assumption of 3 hours' time saving by users. Estimated toll rate is given in Table 10-11 where the ratio between passenger car (including motorcycle) and bus & truck is assumed to be 1 : 1.5.

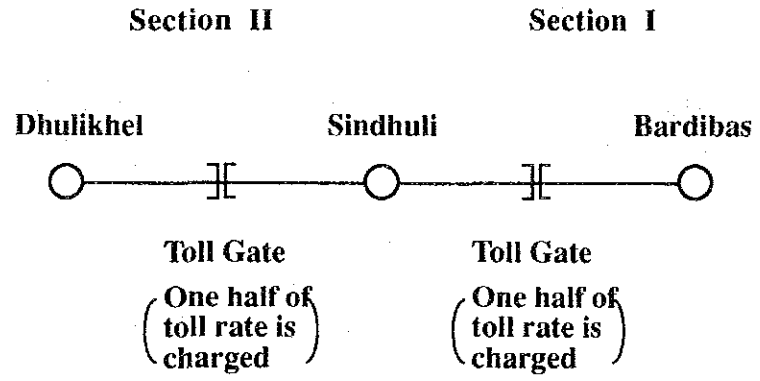
Table 10-11 Unit Toll Rate – Base Case –

Vehicle Type	Toll Rate (NRs./vehicle)	Remarks
Passenger Car	20	unit time cost (NRs. 7.8/h) × average time saving (3 hours)
Bus	30	1.5 times of passenger car
Truck	30	1.5 times of passenger car
Motorcycle	20	same as passenger car

10.3.3 Toll Collection System

Barrier type toll system in which installation of two barrier gates, one is in the middle of Section I and another in the middle of Section II of the Project Road, is adopted.

One half of toll rate established in Table 10-11 is to be collected at each gate as illustrated below:



10.3.4 Estimation of Toll Revenue

Toll revenues are estimated as shown in Table 10-12 based on future traffic volume and above-established toll rate.

Table 10-12 Toll Revenue (1999)
- One-lane Road -

		P/C	Bus	Truck	M/C	Total
Section I	Traffic Volume (vpd)	147	255	249	16	667
	Toll Revenue (NRs.)	1,470	3,825	3,735	160	9,190
Section II	Traffic Volume (vpd)	128	252	236	16	632
	Toll Revenue (NRs.)	1,280	3,780	3,540	160	8,760
Daily Toll Revenue (NRs.)		2,750	7,605	7,275	320	17,950
Yearly Toll Revenue (NRs, Million)		1.03	2.85	2.73	0.12	6.73

Toll Revenue (1999)
- Two-lane Road -

		P/C	Bus	Truck	M/C	Total
Section I	Traffic Volume (vpd)	221	371	500	26	1,118
	Toll Revenue (NRs.)	2,210	3,710	5,000	260	11,180
Section II	Traffic Volume (vpd)	186	368	478	26	1,058
	Toll Revenue (NRs.)	1,860	3,680	4,780	260	10,580
Daily Toll Revenue (NRs.)		4,070	7,390	9,780	520	21,760
Yearly Toll Revenue (NRs, Million)		1.49	2.70	3.57	0.19	7.95

Toll Revenue (2010)
- Two-lane Road -

		P/C	Bus	Truck	M/C	Total
Section I	Traffic Volume (vpd)	463	918	1,087	83	2,551
	Toll Revenue (NRs.)	4,630	9,180	10,870	830	25,510
Section II	Traffic Volume (vpd)	452	963	1,063	83	2,561
	Toll Revenue (NRs.)	4,520	9,630	10,630	830	25,610
Daily Toll Revenue (NRs.)		9,150	18,810	21,500	1,660	51,120
Yearly Toll Revenue (NRs, Million)		3.34	6.86	7.85	0.61	18.66

10.3.5 Financial Evaluation

Estimated toll revenue is far below the level of catering to total maintenance cost, much less is the total project cost. Increasing the toll rate in accordance with the hike of income level of the nation would cater to some portion of maintenance cost in future, which would result in saving in maintenance cost for DOR.

10.4 Socio-economic Impact

10.4.1 General

It is expected that the Project Road would come up with a variety of socio-economic impacts to the surrounding regions. Especially, the opening of motorable road in the area where there has been no motorable road at all so far would expose the area to the wave of external influences. Easy connection to the city of Kathmandu by land would change the life style of villagers in the region as well as industrial activities therein. Agriculture, which is a sole sector of industry in the region, would be exposed to the wave of modernization and living standard of the farmers would be greatly enhanced by the increased income and opportunity of employment.

10.4.2 Impact on Agriculture

Traditional agricultural style which is exclusively oriented in plantation of substantial crops would be exposed to market economy. Plantation of cash crops, which includes vegetable, fruit and herb would be introduced for the consumers in large cities. Some of the rice field will be converted into plantation area of these crops while reclamation of land will take place in the areas where flat land is abundant.

It is expected that the style of agriculture is modernized in a long term. New technologies of agriculture such as fertilizer, pesticide and machinery would be imported from outside while agricultural form will be restructured by the introduction of such institute as agriculture cooperative association, collective shipment center and so on.

Easy inflow of information about market price and consumers' choice for local products would enable the farmers to adopt planned farming method.

10.4.3 Improvement of Distribution Economy

Reduced transportation cost would streamline the distribution of commodities. At present, because of the lack of road network, distribution of commodity is not functioning in perfect manner within the national economy. Taking distribution of rice as an example, rice produced in Terai is distributed without reflecting region-wise demand/supply condition of rice market. It sometimes happens that surplus of rice in Terai is not fully transported to Kathmandu city and its surrounding urban area where the shortage of rice is keen throughout the year. However, more rice will be transported with the opening of the Project Road and this will result in reduction of rice price. On the other hand, rice producers in Terai could gain more profit from reduced transportation cost. In a long term, the Project Road would streamline the outdated system of

distribution in Nepal which has long been obstacled by inefficient transportation system in the nation.

10.4.4 Promotion of Local Industry

Easy access to Kathmandu, Terai and India to be realized by the Project Road would promote local industries. Agro-industry and light industry, which manufactures commodities for people's daily use, are two of the most potential industries to be promoted taking advantage of the Road.

10.4.5 Other Impact

The Project Road would come up with a variety of socio-economic impacts to the region. Major of them are described below:

- Promotion of integrated regional development plan
  Almost same kind of regional development plan as one proposed in Lamosangu-Jiri Road Construction Project is to be proposed taking advantage of the Road.

- Incentive role for the early realization of on-going plans
  The opening of the Project Road would promote related construction project such as roads and multi-purpose dams in the surrounding area including Jiri-Ramechhap Road and Sun Kosh Dam Construction Projects.

- Modernization of traditional society
  Easy inflow of information, consumption goods and outsiders to the traditional society would induce the change in life-style of villagers. This would result in modernization of society in a long term.

- Satisfaction of Basic Human Need
  The project road would satisfy basic human need (easy access to hospital, security control and so on) to the villagers.

10.5 Selection of the Optimum Alternative

10.5.1 Introduction

The alternatives of road development plans studied so far have been evaluated comprehensively in this section to select the optimum alternative of the plan. Alternatives of plan have been evaluated in terms of economic viability of the road in the national economy, socio-economic impact expected of the road, basic human need to be satisfied and project cost required as well as technical feasibility of the road.

10.5.2 Evaluation from Economic View Point

As studied in Section 2 of this Chapter, direct benefit (= total of vehicle operating cost saving and time cost saving) is relatively large for the size of traffic volume. This fact, by and large, comes from a large amount of travel distance to be saved by the Project Road. However, large construction and maintenance costs required for the Road, mainly due to harsh geological condition, has lowered the values of IRR to the level bellow the opportunity cost of capital in Nepal (12% a year). Therefore, the Project has more possibility to be implemented by grant aid from foreign country than by loans should it be done by foreign assistance.

However, the greatest achievements to be attained by the Project might be (1) shortcut between Kathmandu and East Terai, and (2) incentive role in regional development. In this context, socio-economic impact brought about by the Road is quite important for the nation building as well as for the region. The extent of the impact is inclined to differ little by alternative of road development plan, even if it is one-lane road or two-lane road. Linkage between Kathmandu and Terai, passing through the backward region of mountain area, is most important nature of the Project Road.

Basic human need is another factor to be considered. Most of the areas where the Project Road is proposed are far behind urban area in terms of such standards in welfare, security and culture/education. Easy access to such developed areas as Kathmandu and Terai would enhance the level of civil minimum which the local people should enjoy. To provide minimum level of accessibility is an urgent matter.

Least Cost Principle is another criterion to be introduced for the selection of the alternative. The alternative with the least project cost would come up with largest Cost-Efficiency Rate if there is not so much difference in the sizes of benefit among alternatives.

Toll system is not practical because of small revenue from the road due mainly to small traffic volume and limit of allowable fee to be charged to the traffic.

Taking the above factors into consideration, optimum road development plan, at least initial construction work is concerned, is to be one with minimal level of road standard. In other words, optimum development plan should be selected among the first four (4) alternatives all of which stand on the concept of one-lane road construction at the initial stage.

10.5.3 Evaluation from Technical View Point

There are two major differences among the alternatives in the first stage construction. One is the difference between gravel surface and penetration macadam pavement which are applied to alternatives 1 and 2, and alternatives 3 and 4 respectively, and the other is two bridge alternatives i.e. a single lane bridge with 4.0 m minimal width construction scheme (scheme - A) and construction scheme of full substructure (6.5 m width) and partial superstructure having 4.75 m width (scheme - B) which are applied to alternatives 1 and 3, and alternatives 2 and 4 respectively.

In terms of the pavement, it is obvious that penetration macadam is desirable taking into account driving comfortability, less maintenance cost and environmental impact, since air pollution is caused by dust derived from gravel surface.

In the bridge alternatives, it is recommended that scheme - B shall be selected as an advantageous scheme based on the following reasons;

(1) In the case of scheme - A, it could be difficult to construct the 2nd stage bridges because of relatively high construction cost and technical difficulties. While Scheme-B could be easily widened to double lane by only installation of an additional girder at one side or cantilever brackets at both sides with relatively small budget compared with widening cost for scheme-A.

(2) In the case of scheme - B, it is not cost effective to implement twice the temporary works such as installation of coffer dams and river access preparation and cleaning of erection yard, which is disadvantageous in terms of total cost required.

To this end, it is concluded that alternative 4 which incorporated penetration macadam option and scheme - B bridge option is the best development scheme out of four development scheme alternatives from technical view point, in case that the budget is available.

10.5.4 Conclusion

In due consideration of cost minimum aspect, Alternative-1 would be selected as a desirable development scheme out of four (4) alternatives. However, should more budget allow, alternative with higher design standard, originated in the concept of one-lane road construction at the initial stage, would preferably be proposed.

CHAPTER 11

ESTABLISHMENT OF PROJECT IMPLEMENTATION PROGRAM

CHAPTER 11

PROJECT IMPLEMENTATION PROGRAM

11.1 General

Implementation program was formulated on the basis of the construction plan and method as well as the project cost estimate taking into account the results of project evaluation made in the previous Chapter.

Alternatives of implementation program were studied to ensure the most realistic program for the materialization of the project. The project implementation by DOR's force account in minor to medium scale was considered as an alternative aiming at the self-reliance of Nepalese government as well as the technology transfer through the project implementation.

11.2 Framework for Programming

The following basic conditions and assumption were considered in the formulation of implementation program:

(1) Staged construction is introduced assuming:
- Commencement of construction for Sec-I is in 1994.
- 2nd staged construction is commenced in 2006 and opened to traffic in 2010.

(2) Implementation program is formulated on the basis of design alternative No.1 which was selected as a optimum design scheme for the project road as shown below:
- Single lane road with gravel (Unpaved road)
- Minimum provision of bridge by introduction of causeway
- Minimum provision of slope protection

(3) The project is assumed to be materialized with a financial assistance of foreign aid.

(4) Implementation of Sec. 1 is planned assuming the participation of DOR as follows;

- Earthwork and causeway with the exception of bridges will be done by DOR on force account basis aiming at self-reliance as well as the technology transfer through the project.
- Materials and equipment required for the above work are assumed to be supplied with the Japanese financial assistance.

(5) During the construction of project, DOR shall take over the maintenance obligation from the contractor after finishing 1 year contractor's guarantees for maintenance. The section to be handed-over shall be minimum 10 km or reasonable extent.

Strengthening of DOR's maintenance capability is essential for maintaining the road facilities, especially such a sever mountainous road of Sindhuli Road. The improvement of DOR's maintenance capability is included in the implementation of Sindhuli Road Construction Project as follows;

- Maintenance for Sec. 1: Materials/Equipment Supply
- Maintenance for Sec. 2: Establishment of Maintenance Offices including Materials/Equipment Supply

(6) Following preparatory works are required before commencing the construction work:

(i) Engineering Services including Basic Design and Detailed Design shall be conducted by an international consultant in accordance with the regulation of Japanese grant aid system.

(ii) Land/house acquisition and compensation and forest clearance arrangement shall be undertaken by DOR before commencing the construction work.

(7) 10 % of physical contingency should be allocated in the project cost.

11.3 Project Implementation on Force Account Basis

As stated above, it was proposed the participation of DOR in the project through the construction of a part of the project expecting self-reliance of Nepalese government for materialization of the project as well as the technology transfer from the international contractor through the project. However, since Sindhuli Road Construction Project is one of the most difficult road construction project in terms of construction technology of mountainous road, construction cost required, maintenance works, etc., it is necessary assess the possibility as well as the capability of the project implementation on force account basis by DOR from financial, managerial and technical view points.

The following is the result of evaluation:

(1) Financial View Point

As stated in Chapter 5, totaling NRs. 2,810 million of the road development budge was allocated in fiscal year 1992/1993. The budge consists of NRs.1,882 million from various foreign sources, which is 67% of the budget, and remaining 33% of NRs. 928 million allocated by HMG.

Out of these budget, the breakdown unraveled 55% approx. is allocated for road construction and remains for road maintenance. This means that 55% of NRs. 928 million or 510 million from HMG source is a maximum amount which HMG can allocate for the road construction project per annum.

The above fact reveals that the possible allocation for the construction of Sindhuli road would be 10 % to 15 % of the budget of road construction. In other words, the possible allocation from HMG source might be NRs. 50 million to NRs. 70 million per annum at the most for one road construction project.

Meanwhile, the possible allocation to maintenance work is 45% or NRs.420 million of HMG source per annum. This means that NRs. 40 to 60 million (10% to 15%) of the HMG's maintenance budget might be allocated for the maintenance of Sindhuli Road.

(2) Managerial View Point

Since the project is a huge scale, large number of engineers and professional staff are required for its implementation.

However, the recent Administration Reform Action results in more than 30 % decrease of the government officers and engineers and consequently total numbers of engineers presently available are only 230 to 240 in DOR.

Under such situation, it is presumed that DOR could not assign adequate number of qualified engineers and field staff if the project is implemented on force account basis totally.

However, it is recommended for DOR to participate in a part of the project aiming at the technology transfer of DOR's engineers. On-the-job-training through participation of the field work is essential for bringing-up of DOR's young engineers.

(3) Technical View Point

The road projects, which have been implemented on force account basis in the past, are mostly construction of feeder road with a small scale or maintenance with penetration pavement. Under such, it is assumed that DOR might not have enough construction experience in terms of bridge works, large scale earth work in mountainous road and slope protection works.

From the above assessment, it is concluded that the project implementation by DOR's force account could not be possible to the entire sections including Sec. 1 and Sec. 2 or to the whole section of Sec. II. However, if it is a small to medium scale work, such as earthwork and causeway work excluding bridge structures and large scale slope protection work, the implementation on the force account basis might be possible. Therefore, it is recommended for DOR to participate in the following construction sections:

Recommended Sections and Works to be conducted by DOR:

Sec. 1:	Works related to the earthwork and causeway excluding bridges
Sec. 2-3:	Works related to the earthwork and causeway excluding bridges

11.4 Alternatives of Implementation Program

The implementation programs are studied to ensure the most realistic implementation program taking into consideration the possibility of participation of DOR in the project. The program is studied assuming the following conditions:

(1) Engineering services including basic design and detailed design will be conducted before commencing the construction work as follows;

-	Basic Design		3 months
-	Detailed Design	for Sec. 1	4 months
		for Sec. 2	12 months
-	Supervision	for Sec. 1	2 years
-		for Sec. 2	5 years

(2) Land/house acquisition (Sec. 2 only) 12 months
Forest clearance arrangement (Sec. 2 only) 12 months

(3) Construction work by a international general contractor on turn key basis:

-	Sec. 1 (bridge only)	2 years
-	Sec. 2-1	5 years
-	Sec. 2-2	4 years
-	Sec. 2-3	5 years
	Sec. 2-3 (bridge only)	3 years

(4) Construction work by DOR on force account basis is carried out in the following sections:

-	Sec. 1:	Earthwork and causeway
-	Sec. 2-3	Earthwork and causeway

(5) Construction on force account basis is implemented assuming the financial assistance of foreign aid for materials and equipment supply.

-	Sec. 1 (earthwork/causeway)	2 years
-	Materials/Equipment Supply	
-	Sec. 2-3 (earthwork/causeway)	8 years
-	Materials/Equipment Supply	

On the basis of the above assumption and conditions, three(3) alternative implementation program are prepared with the following objectives:

Case A: Earliest Opening (1999) of the Project

(1) Land acquisition and forest clearance arrangement is done in parallel with detailed design work in 1993 -1994,

(2) Construction of Sec. 2 is commenced in the year of 1994 and completed in 1999.

(3) Earthwork and causeway in Sec. is done by DOR

Case B: Sufficient time given for Land Acquisition

(1) Sufficient time is given for land/house acquisition

(2) Sec. 2 is assumed to be commenced in 1996 after finishing land/house acquisition and forest clearance arrangement.

(3) Earthwork and causeway in Sec. is done by DOR

Case C: Maximum participation of DOR

(1) Sufficient time is given for land/house acquisition

(2) Earthwork and causeway in Sec. 2-3 is constructed by DOR in addition to Sec. 1.

(3) Construction period is spread over for 8 years taking into account the limited local budget.

Sections to be undertaken by DOR on force account basis in each alternative are summarized below:

	Construction by DOR on force account basis		
Alternative	Case A	Case B	Case C
Sec. 1	O	O	O
Sec. 2-1	X	X	X
Sec. 2-2	X	X	X
Sec. 2-3	X	X	O

Overall implementation program for each alternative is presented in Fig. 11.1.

Fig. 11-1 Alternatives of Project Implementation (Stage 1)

Case -A (1) Shortest construction period

Description	Construction Section	Construction	Constr. Period	1993 4	3	1994 1	2	1995 3	4	1996 5	6	1997 7	8	1998 9	10	1999	2000	2001	2002	2003	Remarks
Detailed Design	Sec. 1			vvvv																	
	Sec. 2			vvvv		vvvv															
Land acquisition and forest clearnace				zzz		zz															
Construction Works																					
(i) 1st Stage	Sec. 1	General Contractor	2 Y			XXXXX	XXXXX														Bridge only
		DOR				XXXXX	XXXXX														Earthwork, etc.
	Sec. 2-1	General Contractor	5 Y			XXX	XXXXX	XXXXX	XXXXX	XXXXX	XX										
	Sec. 2-2	General Contractor	4 Y				XXX	XXXXX	XXXXX	XXXXX	XX										
	Sec. 2-3	General Contractor	5 Y			XXX	XXXXX	XXXXX	XXXXX	XXXXX	XX										
(ii) 2nd Stage	Sec. 1 and Sec. 2	Widening to 2 lane	4 Y																		

Case -B (1) Sufficient time is given for land/house acqusistion and compensation before construction of Sec. 2

Description	Construction Section	Works to be done	Constr. Period	1993 4	3	1994 1	2	1995 3	4	1996 5	6	1997 7	8	1998 9	10	1999	2000	2001	2002	2003	Remarks
Detailed Design	Sec. 1			vvvv																	
	Sec. 2			vvvv		vvv															
Land acquisition and forest clearnace						zzz		zzzzzz													
Construction Works																					
(i) 1st Stage	Sec. 1	General Contractor	2 Y			XXXXX	XXXXX														Bridge only
		DOR				XXXXX	XXXXX														Earthwork, etc.
	Sec. 2-1	General Contractor	5 Y					XXXXX	XXXXX	XXXXX	XXXXX	XXXXX									
	Sec. 2-2	General Contractor	4 Y						XXXXX	XXXXX	XXXXX	XXXXX									
	Sec. 2-3	General Contractor	5 Y					XXXXX	XXXXX	XXXXX	XXXXX	XXXXX									
(ii) 2nd Stage	Sec. 1 and Sec. 2	Widening to 2 lane	4 Y																		

Case - C (1) Maximum participation of DOR in construction of Sec. 1 and Sec. 2-3 including maintenance work for whole section

Description	Construction Section	Works to be done	Constr. Period	1993 4	3	1994 1	2	1995 3	4	1996 5	6	1997 7	8	1998 9	10	1999	2000	2001	2002	2003	Remarks
Detailed Design	Sec. 1			vvvv																	
	Sec. 2			vvvv		vvvv															
Land acquisition and forest clearnace				zzz		zzzzzz		zzzzzz													
Construction Works																					
(i) 1st Stage	Sec. 1	General Contractor	2 Y			XXXXX	XXXXX														Bridge only
		DOR	2 Y			XXXXX	XXXXX														Earthwork, etc.
	Sec. 2-1	General Contractor	5 Y					XXXXX	XXXXX	XXXXX	XXXXX	XXXXX									
	Sec. 2-2	General Contractor	4 Y									XXXXX	XXXXX	XXXXX	XXXXX						
	Sec. 2-3	General Contractor	4 Y									XXXXX	XXXXX	XXXXX	XXXXX						Bridge only
		DOR	8 Y					XXXXX	XXXXX	XXXXX	XXXXX	XXXXX	XXXXX	XXXXX	XXXXX						Earthwork, etc.
(ii) 2nd Stage	Sec. 1 and Sec. 2	Widening to 2 lane	4 Y																		

11.5 Project Cost and Disbursement Schedule of Each Alternative

The project cost of each alternative is calculated on the basis of the construction plan and method and the cost estimate made in previous chapters.

The construction cost on force account basis for Sec. 1 and Sec. 2-3 was also calculated assuming that DOR is carry out the works related to the earthwork and causeway excluding bridge construction.

Detailed cost estimate on force account basis including the materials and equipment supply for construction of earthwork and causeway in Sec. 1 and Sec. 2-1 is calculated in Appendix 11-1.

Maintenance equipment and materials to be used for the DOR's maintenance operation was estimated assuming that the new maintenance organization will be established as shown below:

Maintenance Office and Materials/Equipment Supply

	Sec. 1	Sec.2-1	Sec. 2-2	Sec. 2-3
(1) (Main Maint. Office)	Bardibus	-	-	-
Materials/Equip. Supply	O	-	-	-
(2) Sub Maint. Office	-	Sindhuli B.	-	Banepa
Materials/Equip. Supply	-	O	-	O
(3) Field Unit Office	-	Khurkot	Naplthok	-
Materials/Equip. Supply	-	O	O	-

Note: Main maintenance office will be established in Sec. 1 at Bardibus utilizing existing DOR's Construction and Maintenance Office.

The project cost for each alternative is summarized in Table 11.1.

Detailed disbursement schedule was prepared for each alternative as shown in Table 11.2 on the basis of the implementation schedule.

Table 11-1 Summary of Project Cost

Unit: NRs. million

	F or L	Case A	Case B	Case C	Remarks
A. Foreign Portion					
A-1 Construction by International Contractor					
Sec . 1 Bridge only	F	309	309	309	
Sec. 2-1 All works	F	1,164	1,164	1,164	
Sec. 2-2 All works	F	737	737	737	
Sec. 2-3 All works	F	1,290	1,290		
Bridge only				169	
Total (1)	F	3,500	3,500	2,379	
Equiv. to Yen (million)	F	**8,790**	**8,790**	**5,970**	
A-2 Construction Materials and Equipment Supply					
Sec. 1 Supplier	F	48	48	48	
Sec. 2-3 Supplier	F			340	
Total (2)	F	48	48	388	
Equiv. to Yen (million)	F	**120**	**120**	**970**	
A-3 Maintenance Office					
Sec. 2 2-sub maintenance offices and 2-field units	F	78	78	78	
Total (3)	F	78	78	78	
Equiv. to Yen (million)	F	**200**	**200**	**200**	
A-4 Maintenance Materials and Equipment Supply					
Sec. 1 Supplier	F	63	63	63	
Sec. 2-3 Supplier	F	168	168	168	
Total (4)	F	231	231	231	
Equiv. to Yen (million)	F	**580**	**580**	**580**	
A-5 Engineering Services					
Detailed Design (4% of Construction cost)	F	141	141	119	Const. total (1)+(7)
Const. Supervision (6% of construction cost)	F	211	211	179	Const. total (1)+(7)
Total (5)	F	352	352	298	
Equiv. to Yen (million)	F	**880**	**880**	**750**	
A-6 Physical Contingency (10 % of construction cost)					
Total (6)	F	350	350	238	Const. total (1)
Equiv. to Yen (million)	F	**880**	**880**	**600**	
Total (A)=(1)+(2)+(3)+(4)+(5)+(6)		4,559	4,559	3,612	
Equiv. to Yen (million)	F	**11,440**	**11,440**	**9,060**	
B. Local Portion					
B-1 Construction by DOR					
Sec. 1 Earthwork and Causeway	L	24	24	24	
Sec.2-3 Earthwork and Causeway	L			573	
Total (7)	L	24	24	597	
B-2 Land/House Acquisition					
Sec. 1 Land/House Acquisition	L	91	91	91	Not affect on bridge work
Sec. 2 Land/House Acquisition	L	188	188	188	
Total (8)	L	279	279	279	
B-3 Forest Clearance Arrangement					
Sec. 1 None	L				
Sec. 2 To be done before construction	L	20	20	20	
Total (9)	L	20	20	20	
Total (B)=(7)+(8)+(9)	L	323	323	896	
Grand Total (A)+(B)		4,882	4,882	4,508	

Table 11.2 Detailed Disburesement Schedule (1/3)

NRs. 1.0 = ¥2.51 (1 US$ = NRs.45.88 = ¥ 115.08)

{Case A} Shortest construction schedule

Unit: NRs. (Million)

Work	Construction Section	Construction Unit	Works to be done	Constr. Period	Foreign or Local	1st Stage 1993 4	3	1994 1	1995 2	1996 3	1997 4	1998 5	1999 6	2000 7	2001 8	2002 9	2003 10	Total Amount 1st Stage
Engineering Services			Basic Design			vvv												
			Detailed Design for Sec. 1			vvvvv												
			Detailed Design for Sec. 1			vvvvv	vvvvvv											
			Supervision for Sec. 1				vvvvvvvvvvv	vvvvvvvvvvv										
			Supervision for Sec. 2					vvvvvv	vvvvvvvvvvv	vvvvvvvvvvv	vvvvvvvvvvv	vvvvvvvvvvv	vvvvvv					
Construction	Sec.1	Contractor	Bridge only	2 Y				xxxxxxxxxxx	xxxxxxxxxxx									
		DOR	Earthwork and Causeway	2 Y				xxxxxxxxxxx	xxxxxxxxxxx									
	Sec.2-1	Contractor	All works	5 Y				xxxxxx	xxxxxxxxxxx	xxxxxxxxxxx	xxxxxxxxxxx	xxxxxxxxxxx	xxxxx					
	Sec.2-2	Contractor	All works	4 Y					xxxxxxxxxxx	xxxxxxxxxxx	xxxxxxxxxxx	xxxxxxxxxxx	xxxxx					
	Sec.2-3	Contractor	All works	5 Y				xxxxxx	xxxxxxxxxxx	xxxxxxxxxxx	xxxxxxxxxxx	xxxxxxxxxxx	xxxxx					
Maintenance	Sec.1	Supplier	Equipment/Materials						V									
	Sec.2	DOR	Maintenance office							xxxxxxxxxxx								
		Supplier	Equipment/Materials							V		V						
Land and House acqusition		Sec. 1	Not affect on bridge work															
		Sec. 2				//////	//////											
Forest Clearance		Sec. 1	Not required															
		Sec. 2				//////	//////											

Project Cost Disbursement Schedule (excluding 5% of Contingency)

Construction	Sec.1	Contractor	Bridge only	2 Y	F		155	154									309
		DOR	Earthwork and Causeway	2 Y	L		12	12									24
		Supplier	Equipment/Materials		F		48										48
	Sec.2-1	Contractor	All works	5 Y	F			233	233	233	233	232					1,164
	Sec.2-2	Contractor	All works	4 Y	F				185	184	184	184					737
	Sec.2-3	Contractor	All works	5 Y	F			258	258	258	258	258					1,290
Engineering Services (4% for D/D and 6% for C/S)					F	141	10	39	41	41	41	40					352
Maintenance	Sec.1	Supplier	Equipment/Materials		F			63									63
	Sec.2	DOR	Maintenance office	1 Y	F				54		24						78
		Supplier	Equipment/Materials		F				106		62						168
Land/House Aquisition cost		Sec. 1	Not affect on bridge work		L		91										91
		Sec. 2	To be done	1 Y	L		100	88									188
Forest compensation cost		Sec. 1	None		L												0
		Sec. 2	To be done	1 Y	L		10	10									20
A. Funds to be covered by foreign aid																	
A-1 Construction by international contractor					F	0	155	645	676	675	675	674	0	0	0	0	3,500
A-2 Construction Equipment and Materials Supply					F	0	48	0	0	0	0	0	0	0	0	0	48
A-3 Maintenance Offices Construction					F	0	0	0	54	0	24	0	0	0	0	0	78
A-4 MaintenanceEquipment and Materials Supply					F	0	0	63	106	0	62	0	0	0	0	0	231
A-5 Engineering Services					F	141	10	39	41	41	41	40	0	0	0	0	352
A-6 Physical contingency (10% of construction cost)					F	0	16	65	68	68	68	67	0	0	0	0	350
Total (1)					F	141	229	812	944	783	869	782	0	0	0	0	4,559
Equiv. to Total (million ¥)					F	350	570	2,040	2,370	1,970	2,180	1,960	0	0	0	0	11,440
B. Funds to be arranged by local source																	
B-1 Construction works by DOR on force account basis					L	0	12	12	0	0	0	0	0	0	0	0	24
B-2 Land/House Aquisition					L	0	191	88	0	0	0	0	0	0	0	0	279
B-3 Forest Clearance					L	0	10	10	0	0	0	0	0	0	0	0	20
Total (2)					L	0	213	110	0	0	0	0	0	0	0	0	323
Total (1) + (2)						141	442	922	944	783	869	782	0	0	0	0	4,882
Equiv. to Total (million ¥)						350	1,110	2,310	2,370	1,970	2,180	1,960	0	0	0	0	12,250

[Case B]

Target : Sufficinet time required for land/house acquistion before starting the construction of Sec. 2

NRs. 1.0 = ¥2.51 (1 US$ = NRs.45.88 = ¥ 115.08)

Work	Construction Section	Construction Unit	Works to be done	Constr. Period	Foreign or Local	1st Stage 1993 4	3	1994 1	2	1995 3	4	1996 5	6	1997 7	8	1998 9	10	1999	2000	2001	2002	2003	Total amount 1st Stage
Engineering Services			Basic Design			vvv																	
			Detailed Design for Sec. 1			vvvvv																	
			Detailed Design for Sec. 1			vvvvv	vvvvvv																
			Supervision for Sec. 1				vvvvvvvvvvv	vvvvvvvvvvv															
			Supervision for Sec. 2							vvvvvvvvvvv		vvvvvvvvvvv		vvvvvvvvvvv		vvvvvvvvvvv		vvvvvvvvvvv					
Construction	Sec.1	Contractor	Bridge only	2 Y			xxxxxxxxxxx	xxxxxxxxxxx															
		DOR	Causeway &Earthwork	2 Y			xxxxxxxxxxx	xxxxxxxxxxx															
	Sec.2-1	Contractor	All works	5 Y						xxxxxxxxxxx		xxxxxxxxxxx		xxxxxxxxxxx		xxxxxxxxxxx		xxxxxxxxxxx					
	Sec.2-2	Contractor	All works	4 Y								xxxxxxxxxxx		xxxxxxxxxxx		xxxxxxxxxxx		xxxxxxxxxxx					
	Sec.2-3	Contractor	All works	5 Y						xxxxxxxxxxx		xxxxxxxxxxx		xxxxxxxxxxx		xxxxxxxxxxx		xxxxxxxxxxx					
Maintenance	Sec.1	Supplier	Equipment/Materials						V														
	Sec.2	DOR	Maintenance office	1 Y								xxxxxxxxxxx							xxxxxxxxxxx				
		Supplier	Equipment/Materials									V1							V2				
Land and House acquisition		Sec. 1	Not affect the bridge work																				
		Sec. 2						//////	//////////////														
Forest Clearance		Sec. 1	Not required																				
		Sec. 2						//////	//////////////														

Project Cost Disbursement Schedule

Construction	Sec.1	Contractor	Bridge only	2 Y	F		155	154										309
		DOR	Causeway &Earthwork	2 Y	L		12	12										24
		Supplier	Equipment/Materials		F		48											48
	Sec.2-1	Contractor	All works	5 Y	F				233	233	233	233	232					1,164
	Sec.2-2	Contractor	All works	4 Y	F					185	184	184	184					737
	Sec.2-3	Contractor	All works	5 Y	F				258	258	258	258	258					1,290
Engineering Services (4% for D/D and 6% for C/S)					F	141	10	10	30	40	40	40	41					352
Maintenance	Sec.1	Supplier	Equipment/Materials		F			63										63
	Sec.2	DOR	Maintenance office	1 Y	F				54		24							78
		Supplier	Equipment/Materials		F				106		62							168
Land/House Aquisition cost		Sec. 1	Not affect on bridge work		L		91											91
		Sec. 2	To be done	1 Y	L		100	88										188
Forest compensation cost		Sec. 1	None		L													0
		Sec. 2	To be done	1 Y	L		10	10										20
A. Funds to be covered by foreign aid																		
A-1 Construction by international contractor					F	0	155	154	491	676	675	675	674	0	0	0	0	3,500
A-2 Construction Equipment and Materials Supply					F	0	48	0	0	0	0	0	0	0	0	0	0	48
A-3 Maintenance Offices Construction					F	0	0	0	54	0	24	0	0	0	0	0	0	78
A-4 MaintenanceEquipment and Materials Supply					F	0	0	63	106	0	62	0	0	0	0	0	0	231
A-5 Engineering Services					F	141	10	10	30	40	40	40	41	0	0	0	0	352
A-6 Physical contingency (10% of construction cost)					F	0	16	15	49	68	68	68	67	0	0	0	0	350
Total (1)					F	141	229	242	730	784	869	783	782	0	0	0	0	4,559
Equiv. to Total (million ¥)						350	570	610	1,830	1,970	2,180	1,960	1,960	0	0	0	0	11,440
B. Funds to be arranged by local source																		
B-1 Construction works by DOR on force account basis					L	0	12	12	0	0	0	0	0	0	0	0	0	24
B-2 Land/House Aquisition					L	0	191	88	0	0	0	0	0	0	0	0	0	279
B-3 Forest Clearance					L	0	10	10	0	0	0	0	0	0	0	0	0	20
Total (2)					L	0	213	110	0	0	0	0	0	0	0	0	0	323
Total (1) + (2)						141	442	352	730	784	869	783	782	0	0	0	0	4,882
Equiv. to Total (million ¥)						350	1,110	880	1,830	1,970	2,180	1,960	1,960	0	0	0	0	12,250

[Case C]

Target: Maximum participation of DOR in the works taking into account the limitted funds of Japanese Government

NRs. 1.0 = ¥2.51 (1 US$ = NRs.45.88 = ¥ 115.08)

Work	Construction Section	Construction Body	Works to be done	Constr. Period	Foreign or Local	1st Stage 1993 4	3	1994 1	2	1995 3	1996 4	1997 5	1998 6	1999 7	2000 8	2001 9	2002 10	2003	Total Amount 1st Stage
Engineering Services			Basic Design			vvv													
			Detailed Design for Sec. 1			vvvvv													
			Detailed Design for Sec. 1			vvvvv		vvvvvv											
			Supervision for Sec. 1					vvvvvvvvvvv		vvvvvvvvvvv									
			Supervision for Sec. 2								vvvvvvvvvvv	vvvvvvvvvvv	vvvvvvvvvvv	vvvvvvvvvvv	vvvvvvvvvvv	vvvvvvvvvvv	vvvvvvvvvvv	vvvvvvvvvvv	
Construction	Sec.1	Contractor	Bridge only	2 Y				xxxxxxxxxxx		xxxxxxxxxxx									
		DOR	Causeway &Earthwork	2 Y				xxxxxxxxxxx		xxxxxxxxxxx									
			Equip./Materials Supply					V											
	Sec.2-1	Contractor	All works	5 Y							xxxxxxxxxxx	xxxxxxxxxxx	xxxxxxxxxxx	xxxxxxxxxxx	xxxxxxxxxxx				
	Sec.2-2	Contractor	All works	4 Y								xxxxxxxxxxx	xxxxxxxxxxx	xxxxxxxxxxx	xxxxxxxxxxx				
	Sec.2-3	Contractor	Bridges only	3 Y												xxxxxxxxxxx	xxxxxxxxxxx	xxxxxxxxxxx	
		DOR	Earthwork only	8 Y							xxxxxxxxxxx	xxxxxxxxxxx	xxxxxxxxxxx	xxxxxxxxxxx	xxxxxxxxxxx	xxxxxxxxxxx	xxxxxxxxxxx	xxxxxxxxxxx	
			Equip./Materials Supply								V								
Maintenance	Sec.1	Supplier	Equipment/Materials							V									
	Sec.2	DOR	Maintenance office	1 Y								xxxxxxxxxxx			xxxxxxxxxxx				
		Supplier	Equipment/Materials									V			V				
Land and House acquisition		Sec. 1	Not affect the bridge work																
		Sec. 2						//////		//////////////									
Forest Clearance		Sec. 1	Not required																
		Sec. 2						//////		//////////////									

Project Cost Disbursement Schedule

Construction	Sec.1	Contractor	Bridge only	2 Y	F		155	154										309
		DOR	Causeway &Earthwork	2 Y	L		12	12										24
			Equip./Materials Supply	2 Y	F		48											48
	Sec.2-1	Contractor	All works	5 Y	F				233	233	233	233	232					1,164
	Sec.2-2	Contractor	All works	4 Y	F					185	184	184	184					737
	Sec. 2-3	Contractor	Bridge only	3 Y	F									55	59	55		169
		DOR	Causeway &Earthwork	8 Y	L				72	72	72	72	72	71	71	71		573
			Equip./Materials Supply		F				340									340
Engineering Services (4% for D/D and 6% for C/S)					F	119	10	10	18	29	29	29	29	8	8	8		298
Maintenance	Sec.1	Supplier	Equipment/Materials		F			63										63
	Sec.2	DOR	Maintenance office	1 Y	F				54		24							78
		Supplier	Equipment/Materials		F				106		62							168
Land/House Aquisition cost		Sec. 1	Not affect on bridge work		L		91											91
		Sec. 2	To be done	1 Y	L		100	88										188
Forest compensation cost		Sec. 1	None		L													0
		Sec. 2	To be done	1 Y	L		10	10										20
A. Funds to be covered by foreign aid																		
A-1 Construction by international contractor					F	0	155	154	233	418	417	417	416	55	59	55		2,379
A-2 Construction Equipment and Materials Supply					F	0	48	0	340	0	0	0	0	0	0	0		388
A-3 Maintenance Offices Construction					F	0	0	0	54	0	24	0	0	0	0	0		78
A-4 MaintenanceEquipment and Materials Supply					F	0	0	63	106	0	62	0	0	0	0	0		231
A-5 Engineering Services					F	119	10	10	18	29	29	29	29	8	8	8		298
A-6 Physical contingency (10% of construction cost)					F	0	16	15	23	42	42	42	42	6	6	6		258
Total (1)						119	229	242	775	489	574	488	487	68	73	68		3,612
Equiv. to Total (million ¥)						300	570	610	1,940	1,230	1,440	1,220	1,220	170	180	170		9,060
B. Funds to be arranged by local source																		
B-1 Construction works by DOR on force account basis					L	0	12	12	72	72	72	72	72	71	71	71		597
B-2 Land/House Aquisition					L	0	191	88	0	0	0	0	0	0	0	0		279
B-3 Forest Clearance					L	0	10	10	0	0	0	0	0	0	0	0		20
Total (2)					L	0	213	110	72	72	72	72	72	71	71	71		896
Total (1) + (2)						0	229	25	23	42	42	42	42	6	6	6		258
Equiv. to Total (million ¥)						0	570	60	60	100	100	100	100	10	10	10		650

11.6 Selection of Optimum Implementation Plan

Each alternative implementation program was evaluated taking into consideration the following factors:

(I) Total construction cost required
(ii) Required local funds to be arranged by HMG
(iii) Ease of land/house acquisition and forest clearance
(iv) Construction period or early opening to traffic (benefit of users).
(v) Self-reliance of Nepalese government and Technology transfer

Evaluation is made from the practical view points paying due attention to the availability of financial sources, land/house acquisition procedures as well as the limited local funds to be arranged by HMG, etc. Following is the conclusion made by the Study team:

[Case A]

(1) Case A is the shortest construction period (5.5 years in total), however, land/house acquisition to be conducted before construction is very tight which may raise the troubles between the land owner and contractor during the construction which will affect on keeping the work progress.

(2) Annual funds required for construction is the highest among three alternatives.

[Case B]

(1) Construction period of Case 2 (7 years) is longer than that of Case A, however, a sufficient time is given to DOR for land/house acquisition as well as forest clearance arrangement before commencing the construction, which may reduce the troubles and problems between the land owner and the contractor during the construction.

(2) Annual cost to be allocated for the construction is smaller than that of Case A, though total construction cost is same.

[Case C]

(1) Total construction cost is the cheapest among the alternatives, however, local funds to be arranged by HMG for the construction of Sec. 2-3 will be NRs. 70 million per annum, which is about 15% of the total local budget allocated for road construction In 1993. Though this program was made aiming at maximum self-reliance of Nepalese government, NRs. 70 million per annum will impose a heavy burden on the local budget.

(2) Overall construction period including Sec. 1 and a whole section of Sec. 2 requires 10 years in total, which seems to be not realistic from the view point of needs as well as the urgency of the project.

Among three (3) alternatives stated above, it is concluded that Case B is recommended for the implementation of Sindhuli Road Construction Project from the view point of limited fund of foreign aid as well as the local budget, and land/house acquisition procedures.

11.7 Project Management and Organization for Construction

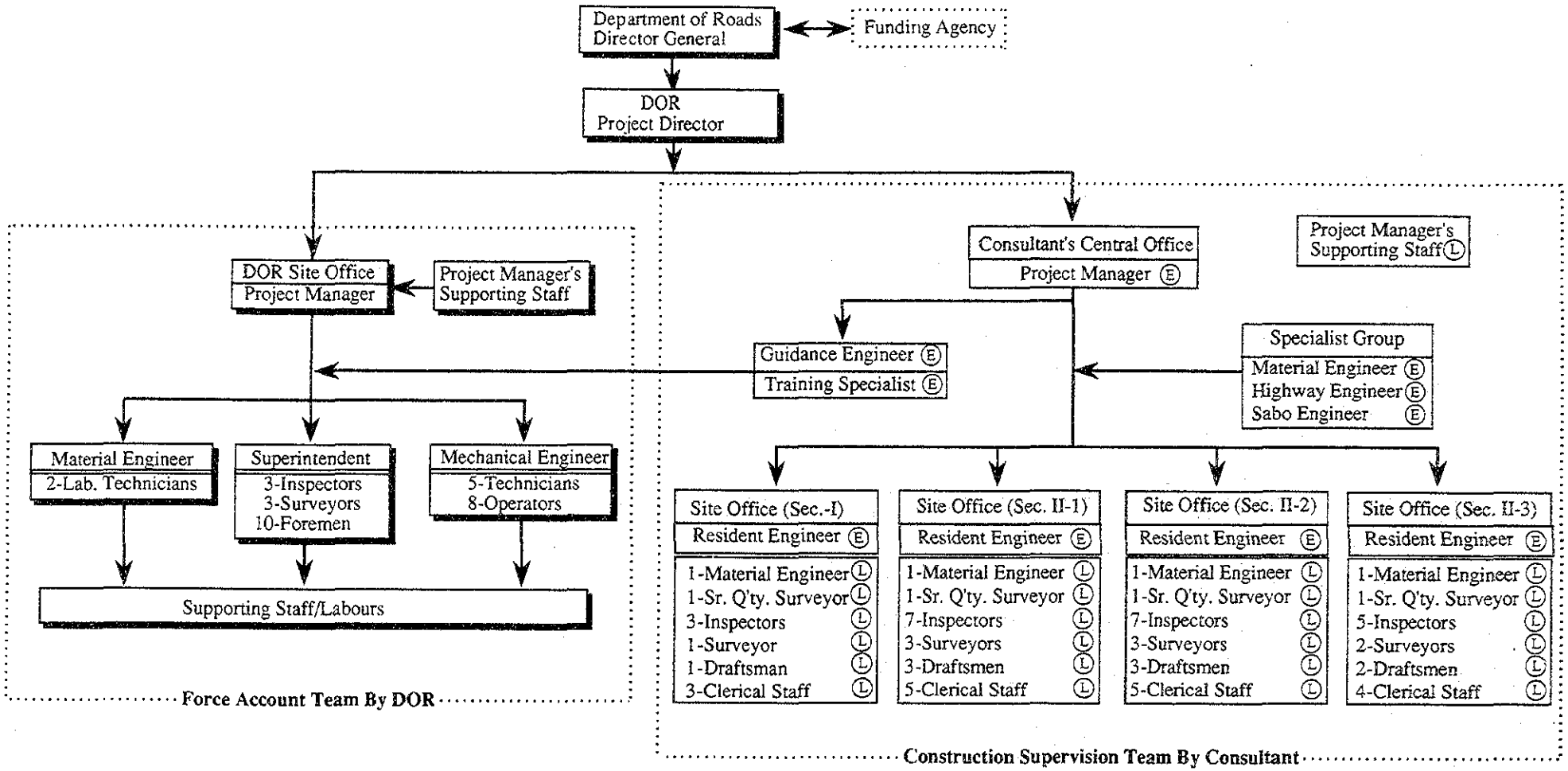
DOR shall be the executing agency for the project implementation and acts as a coordination body between HMG and a funding agency as well as between the Government agencies concerned.

The project implementation method is broadly divided into two categories as formulated in the previous section. The first category is the implementation by DOR on a force account basis for earthwork and causeway work in Sec. 1 and the second category is by a international contractor on a turn key basis for the entire section of Sec. 2 and bridge work in Sec. 1.

Accordingly, the field implementation team under the overall management by DOR's Project Director is also divided into two, one is the force account team comprising of engineers and staff from DOR, and the other is a consultant team to supervise the construction to be executed by a international contractor. In this regard, it is recommended to second DOR engineers to the consultant team in order to ensure maximum technology transfer and training impacts on DOR's staff thorough the project implementation.

Proposed organization chart is presented in Fig. 11-2.

Figure 11-2 Organization Chart of Project Implementation



Legend:
- DOR's Unit
- Consultant's Unit
- Chain of Command

(E) means expatriate engineer.
(L) means engineer and staff seconded from DOR or local consultants.

CHAPTER 12

CONCLUSIONS AND RECOMMENDATIONS

CHAPTER 12

CONCLUSIONS AND RECOMMENDATIONS

12.1 General

The conclusions and recommendations presented in this Chapter were formulated not only after thorough evaluation of all the study results such as traffic forecast, field reconnaissance, environmental impact assessment, preliminary design, project cost estimate, project evaluation, implementation program established, but also based on assessment of the further schedule to materialize the project within the earliest possible time.

12.2 Conclusions

12.2.1 Necessity of Sindhuli Road Construction

In the present road network in Nepal, especially for the roads connecting Kathmandu Valley and Terai Plain where the main agricultural belt of Nepal is located, the followings are the insufficient and deficient points;

- Sole trunk road available is not stable and reliable during the rainy season because of the frequent landslides and slope failures,
- Roundabout transport distance linking between Kathmandu Valley and Eastern Terai, for instance, the distance from Janakpur to Kathmandu is about 390 km on the roads in spite of only 130 km of a straight distance on a map,
- Lagged road development linking north and south in Central Development Region because of hindrance due to the ranges which stretch in east - west direction and are in steep topography and fragile geology.

Rapid agricultural development as well as enhancement of the economic activities in these areas have led the necessity of direct connection between Eastern Terai and Kathmandu Valley as a matter of urgency, and an alternative reliable trunk road has been envisaged from the points of security, economic growth and expansion in the capital city of Kathmandu.

Taking into account the above mentioned necessity of a new road directly connecting Kathmandu with Eastern Terai, HMG formulated "Sindhuli Road Construction Project" linking Bardibas on East West Highway and Dhulikhel on Kodari Road , and has given high priority to the Project as stressed in "Eighth Plan " covering 1992-1997 issued by National Planning Commission.

12.2.2 The Desirable Development Scheme

In formulation of the development scheme alternatives taking into account the roles of Sindhuli Road and the basic concepts applied, five alternatives were established as listed below;

Alternative-1 **Stage wise construction of minimal development scheme**
Alternative-2 **Stage wise construction of minimal development scheme considering bridge widening**
Alternative-3 **Stage wise construction of medium development scheme with bituminous pavement**
Alternative-4 **Stage wise construction of medium development scheme with bituminous pavement and bridge widening**
Alternative-5 **Full scale construction**

Alternatives		Nos of Lane	Pavement	River Crossing Structures		Slope Protection
				Bridges	Causeway/1	
ALT-1	1st Stage	1 lane	Gravel	4 m /4 m /2	Applied	Minimum
	2nd Stage	2 lane	As.Macadam	Adding	Replacement	Full Const
ALT-2	1st Stage	1 lane	Gravel	4.75/6.5m/3	Applied	Minimum
	2nd Stage	2 lane	As Macadam	Widening	Replacement	Full Const
ALT-3	1st Stage	1 lane	As Macadam	4 m/4 m/2	Applied	Minimum
	2nd Stage	2 lane	Widening	Adding	Replacement	Full Const
ALT-4	1st Stage	1 lane	As Macadam	4.75/6.5m/3	Applied	Minimum
	2nd Stage	2 lane	widening	Widening	Replacement	Full Const
ALT-5	Full	2 lane	As Macadam	2 Lane Br.	2 Lane Br.	Full Const

Notes; 1) Alt-1 through Alt-4 are in stage construction.

2) Alt-5 is a plan to implement the full scale construction.

/1;Most of the causeways installed in the first stage are replaced by 2 lane bridges in the 2nd stage.

/2;A single lane bridge with 4 m width of superstructure and substructure.

/3;A single lane bridge with 4.75 m width of superstructure and full width substructure.

Through the preliminary design, construction planing and schedule, cost estimate, and project evaluation carried out for the above respective alternatives, the results are summarized in below:

Alternatives		Const. Period	Construction Cost in Mil.NRs	(in Mil. yen)	Economic IRR	Final Selection
Alt-1	1st	5 years	3,562	(8,940)	4.19	**Selected**
	2nd	4 years	5,128	(12,870)	8.08	
Alt-2	1 st	5 years	3,791	(9,520)	4,32	Discarded
	2 nd	4 years	4,888	(12,270)	8.24	
Alt-3	1 st	5 years	4,181	(10,490)	6.74	Discarded
	2 nd	4 years	4,633	(11,630)	8.51	
Alt-4	1 st	5 years	4,410	(11,070)	7.05	Discarded
	2 nd	4 years	4,449	(11,170)	8.78	
Alt-5	Full	7 years	7,566	(18,990)	8.45	Discarded

From the above summary, it is concluded that the full construction alternative of Alt -5 is inferior to the stage wise construction alternatives comprising Alt-1 through Alt-4 as indicated by those IRRs. Among the stage wise construction alternatives, alternative-1 is selected, never-the-less that of IRR, as a desirable development scheme taking into account the least cost principle and the same extent of indirect benefits derived from each alternative.

12.2.3 The Project Implementation

On the basis of the development scheme of Alternative 1 "Stage wise construction of minimal development scheme" selected above, the implementation programs was prepared taking into consideration the following assumption and conditions:

(1) In the stage wise construction, the 2nd stage construction shall be completed in the year 2010 to cope with the traffic demand.

(2) Preparatory works including engineering services and land/house acquisition and forest clearance arrangements shall be done before commencing the construction work.

(3) The project is assumed to be implemented with the financial assistance of foreign aid.

(4) Sec.- 1 is planned assuming the participation of DOR in the construction of earthwork and causeway aiming at the self-reliance as well as the technology transfer through the project.

(5) Strengthening of DOR's maintenance formation including construction of maintenance office and supply of materials and equipment is included in the part of Sindhuli Road Construction Project.

Three(3) alternative implementation program were established to achieve the following objectives:

Case A: Earliest Opening (1999) of the Project
Case B: Sufficient time given for Land Acquisition
Case C: Maximum participation of DOR

Evaluation is made from the practical view points paying due attention to the availability of financial sources, land/house acquisition procedures as well as the limited local funds to be arranged by HMG, etc. Followings are the results of evaluation:

[Case A] Case A is the shortest construction period (5.5 years in total), however, land/house acquisition to be conducted before construction is very tight, and annual funds required for construction is the highest among three alternatives.

[Case B] Construction period of Case B (7 years) is longer than that of Case A, however, a sufficient time is given for land/house acquisition as well as forest clearance arrangement before commencing the construction.

[Case C] Total construction cost is the cheapest among three (3) alternatives, however, local funds to be arranged by HMG for the construction of Sec. 2-3 is NRs. 70 million per annum, which may impose a heavy burden on the local budget since it would be 15% of the local budget allocated for road construction in Nepalese Government. In addition, overall construction period of 10 years

of Case C is not practical from the view point of needs and urgency of the project.

Among three(3) alternatives stated above, Case B is recommended for the implementation of Sindhuli Road Construction Project from the view points of practical implementation in terms of limited funds of foreign aid as well as local budget and land/house acquisition procedure.

Overall implementation program of Case B including disbursement schedule is presented in Fig. 12-1.

Total project cost is presented below:

		NRs.M	(Equiv. to ¥ M)
A. Funds to be covered by foreign aid			
A-1	Construction cost	3,500	(8,790)
A-2	Materials/equipment supply for construction of Sec. 1	48	(120)
A-3	Maintenance office cost	78	(200)
A-4	Maintenance materials/equipment for maintenance office	231	(580)
A-5	Engineering services	352	(880)
A-6	Contingency (10% of Const. cost)	350	(880)
	Total	**NRs. 4,559**	**(¥11,440)**
B. Funds to be covered by local budget			
B-1	Construction by DOR	24	-
B-2	Land/house acquisition	279	-
B-3	Forest clearance arrangement	20	-
	Total	**NRs. 323**	-

(Exchange rate: US$ 1.0= NRs. 45.88=¥ 115 or NRs. 1.0=¥2.51)

Table 12-1 Recommended Implementation Program

Description	Construction Section	Construction Unit	Works to be done	F or L	Constr. Period	1993 4 3	1994 1	1995 2	1996 3	1997 4	1998 5	1999 6	2000 7	Total
Engineering Services														
(i) Basic Design	Sec.1 & Sec.2	Consultant	All works		2 M	xx								
(ii) Detailed Design	Sec.1	Consultant	All works		4 M	xxx								
	Sec.2	Consultant	All works		1 Y	xxx	xxxxx							
(iii) Supervision	Sec.1	Consultant	All works		2 Y		xxxxxxxxx	xxxxxxxxx						
	Sec.2	Consultant	All works		5 Y				xxxxxxxxx	xxxxxxxxx	xxxxxxxxx	xxxxxxxxx	xxxxxxxxx	
Land/House Acquisition	Sec.1	DOR	Not required		0									
	Sec.2	DOR	Required		2 Y		xxxxxxxxx	xxxxxxxxx						
Forest Clearance	Sec.1	DOR	Not required		0									
	Sec.2	DOR	Required		1 Y			xxxxxxxxx						
Construction Works	Sec. 1	Contractor	Bridge only		2 Y		xxxxxxxxx	xxxxxxxxx						
		DOR	Earthwork and Causeway		2 Y		xxxxxxxxx	xxxxxxxxx						
		Suppiler	Materials/Equipment Supply				V							
	Sec. 2-1	Contractor	All works		5 Y				xxxxxxxxx	xxxxxxxxx	xxxxxxxxx	xxxxxxxxx	xxxxxxxxx	
	Sec. 2-2	Contractor	All works		4 Y					xxxxxxxxx	xxxxxxxxx	xxxxxxxxx	xxxxxxxxx	
	Sec. 2-3	Contractor	All works		5 Y				xxxxxxxxx	xxxxxxxxx	xxxxxxxxx	xxxxxxxxx	xxxxxxxxx	
Strengthening of Maintenance	Sec. 1	Supplier	Materials/Equipment Supply					V						
Office	Sec. 2	Contractor	Construction of office		1 Y					xxxxxxxxx			xxxxxxxxx	
		Suppiler	Materials/Equipment Supply							V1			V2	

Construction Cost and Disburesement Schedule

A. Funds to be covered by foreign aid											
A.1 Construction works by an international contractor	F			155	154	491	676	675	675	674	3,500
A.2 Construction equipment and materials supply	F			48							48
A.3 Maintenance office construction by an international contractor	F					54		24			78
A.4 Maintenance equipment and materilas supply	F				63	106		62			231
A.5 Engineering services including detailed design and supervision	F		141	10	10	29	40	40	40	40	350
A.6 Physical contingency (10% of the construction cost)	F			16	15	49	68	68	68	67	350
Total amount to be assisted with foreign aid	F		141	229	242	729	784	869	783	781	4,557
Equiv. to yean million	F		350	570	610	1,830	1,970	2,180	1,960	1,960	11,430
B. Funds to be covered by local source											
B.1 Construction works by DOR on force account basis	L			12	12						24
B.2 Land/house acquisition cost	L			191	88						279
B.3 Forest clearance arrangement cost	L			10	10						20
Toatl amount to be arranged by DOR	L		0	213	110	0	0	0	0	0	323

12.3 Recommendations

12.3.1 Strengthening DOR's Formation for Maintaining Sindhuli Road

The optimum development scheme alternative selected, especially in the first stage was formulated on condition with provision of the road and bridge maintenance to secure the construction investment, and to provide the road serviceable in all the time. It is therefore absolutely necessary and requisite to carry out inspection and maintenance of Sindhuli Road on a DOR's force account basis, not only after substantial completion of certain sections and structures, but also after handing over the whole sections from Bardibas to Dhulikhel.

However, these are no DOR district offices at present in Sindhuli and Kabhre Districts where nearly 90 % in length of Sindhuli Road passes through. To make matters worse, the maintenance budget in DOR is very limited and DOR has not enough experienced staff and equipment for road maintenance.

In view of the above situation, it is recommended that DOR's formation for maintaining Sinduli Road shall be established with financial assistance from a funding agency

12.3.2 Desirable Pavement Type and Bridge Scheme for The Project

(1) Desirable Pavement Type

In the pavement options, two alternatives consisting of gravel surface and penetration macadam were considered and gravel surface was selected form economical view point.

In this regard, it is recommended if an additional budget available that penetration macadam pavement shall be selected taking into account riding comfortability, less maintenance compared with gravel surface environmental aspect, since this selection with a small amount of additional budget (17 % increase of construction cost) results in 60 % increase of the I.R.R.

(2) Bridge Scheme

Out of two bridge alternatives comprising a single lane bridge with 4.0 m minimal width construction scheme (scheme- A)and construction scheme of full substructure(6.5 m width) and partial superstructure having 4.75 m width (scheme -B), scheme-A was selected as an optimum plan also from economical view point.

In case of scheme -A, it could be difficult to construct the 2nd stage bridges because of relatively high construction cost and technical difficulties. While Scheme-B can be easily widened to double lane by only installation of an additional girder at one side or cantilever brackets at both sides with relatively small budget compared with widening cost for scheme-A.

However, scheme A is not cost effective to implement twice the temporary works such as installation of coffer dams and river access preparation and cleaning of erection yard, which is disadvantageous from the total cost view point.

To this end, it is recommended that the scheme -B bridge option is desirable scheme , in case that an additional budget is available.

APPENDIX - A

SCOPE OF WORK FOR AFTERCARE STUDY FOR SINDHULI ROAD CONSTRUCTION PROJECT

SCOPE OF WORK

FOR

AFTERCARE STUDY

FOR

SINDHULI ROAD CONSTRUCTION PROJECT

IN

KINGDOM OF NEPAL

AGREED UPON BETWEEN

HIS MAJESTY'S GOVERNMENT OF NEPAL

AND

JAPAN INTERNATIONAL COOPERATION AGENCY

KATHMANDU
SEPTEMBER 22, 1992

R. B. SHARMA
Director General,
Department of Roads
Ministry of Works and Transport
His Majesty's Government of Nepal

Yasuyuki KOGA
Leader,
Preparatory Study Team
Japan International
Cooperation Agency

I. INTRODUCTION

In response to the request of His Majesty's Government of Nepal (hereinafter referred as "HMG/N"), the Government of Japan decided to conduct Aftercare Study for Sindhuli Road Construction Project (hereinafter referred to as "the Study") in accordance with the relevant laws and regulations in force in Japan.

Accordingly, Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programmes of the Government of Japan, will undertake the Study in close cooperation with the authorities concerned of HMG/N.

The present document sets forth the scope of work with regard to the Study.

II. OBJECTIVE OF THE STUDY

The objective of the Study is to renew the previous road development plan of Sindhuli Road. The Study will include the following two sections;

Section I : preliminary design of 15 bridges between Sindhuli Bazar and Bardibas,

Section II: feasibility study of the renewed road project between Sindhuli Bazar and Dhulikhel

III. STUDY AREA

The study area will cover between Sindhuli Bazar and Bardibas for the section I and between Sindhuli Bazar and Dhulikhel for the section II.

IV. SCOPE OF THE STUDY

In order to achieve the objective mentioned above, the Study shall cover the following items.

1. Data Collection and Analysis
   (1) Review of the existing data
   (2) Review of the previous study

2. Design of Roads and Bridges
   (1) Design standards and criteria (geometry, structure, and pavement)
   (2) Preliminary design
   (3) Construction plan
   (4) Maintenance and management plan
   (5) Cost estimation for land acquisition, construction and Maintenance

3. Economic Analysis
   (1) Estimation of benefits
   (2) Net present value for the project
   (3) Cost/Benefit Ratio
   (4) Internal Rate of Return
   (5) Sensitivity analysis

4. Environment Impact Assessment

5. Project Evaluation and Recommendation
   (1) Project evaluation
   (2) Recommendation

V. STUDY SCHEDULE

The Study will be carried out in accordance with the attached tentative work schedule.

VI. REPORTS

JICA shall prepare and submit the following reports in English to the Department of Roads.

1. Inception Report (20 copies)
   The Inception Report will be submitted within one (1) month from the commencement of the Study.

2. Draft Final Report (30 copies)
   The Draft Final Report will be submitted within five (5) months from the commencement of the Study.
   The Department of Roads shall send the comments to JICA within one (1) month after the receipt of the Draft Final Report.

3. Final Report (30 copies)
   The Final Report will be submitted within two (2) months after the receipt of the comments on the Draft Final Report from the Department of Roads and will contain all the essential recommendations, results and findings of the Study.

VII. UNDERTAKING OF HMG/N

HMG/N shall accord privileges, exemptions and other benefits to the Japanese study team in accordance with the Agreement on Technical Cooperation between the Government of Japan and HMG/N.

1. To facilitate smooth conduct of the study, HMG/N shall take necessary measures;
   (1) to secure the safety of the Japanese study team,
   (2) to permit the members of the Japanese study team to enter, leave and sojourn in Nepal for the duration of their assignment therein, and exempt them from alien registration requirement and consular fees.
   (3) to exempt of the members of the Japanese study team from

taxes, duties (,fees) and other charges on equipment, machinery and other materials brought into Nepal (and out) for the conduct of the Study,

(4) to exempt the members of the Japanese study team from income taxes and charges of any kind imposed on or in connection with any emoluments or allowances paid to the members of the Japanese study team for their services in connection with the implementation of the study,

(5) to provide necessary facilities to the Japanese study team for remittance as well as utilization of the funds introduced into Nepal from Japan in connection with the implementation of the Study.

(6) to secure permission for entry into private properties or restricted areas for the implementation of the Study.

(7) to secure permission for the Japanese study team to take all data and documents (including (maps,) photographs) related to the Study out of Nepal to Japan.

(8) to provide medical services as needed. Its expenses will be chargeable on members of the Japanese study team.

2. HMG/N shall bear claims, if any arises, against the members of the Japanese study team resulting from, occurring in the course of, or otherwise connected with, the discharge of their duties in the implementation of the Study, except when such claims arise from gross negligence or willful misconduct on the part of the members of the Japanese study team.

3. The Department of Roads shall act as counterpart agency to the Japanese study team and also as coordinating body in relation with other governmental and non-governmental organizations concerned for the smooth implementation of the Study.

4. HMG/N shall, at its own expense, provide the Japanese study team with the following, in cooperation with other organization concerned;

(1) available data and information related to the Study,

RR

Y.K.

(2) counterpart personnel,

(3) administrative supports for follows:

- helicopter
- radiotelephone
- driver
- guide
- guard

(4) credentials of identification cards.

VIII. UNDERTAKING OF JICA

For the implementation of the Study, JICA shall take the following measures;

1. to dispatch, at its own expense, the study team to Nepal.

2. to pursue technology transfer to the Nepal counterpart personnel in the course of the Study.

IX. OTHERS

JICA and HMG/N shall consult with each other in respect of any matter that may arise from or in connection with the Study.

TENTATIVE STUDY SCHEDULE

MONTH / DESCRIPTION	1	2	3	4	5	6	7
WORK IN NEPAL	▬▬▬	▬▬▬			▬▬		
WORK IN JAPAN	▭		▭▭▭	▭▭▭		▭	
REPORT PRESENTATION	△ IC/R				△ DF/R		△ F/R

Note: IC/R: Inception Report
DF/R: Draft Final Report
F/R: Final Report

MINUTES OF MEETING

ON

SCOPE OF WORK

FOR

AFTERCARE STUDY

FOR

SINDHULI ROAD CONSTRUCTION PROJECT

IN

KINGDOM OF NEPAL

AGREED UPON BETWEEN

HIS MAJESTY'S GOVERNMENT OF NEPAL

AND

JAPAN INTERNATIONAL COOPERATION AGENCY

KATHMANDU
SEPTEMBER 22, 1992

R. B. SHARMA
Director Genaral,
Department of roads
Ministry of Works and Transport
His Majesty's Government of Nepal

Yasuyuki KOGA
Leader,
Preparatory Study Team
Japan International
Cooperation Agency

The Japanese Preparatory Study Team (the Team) organized by the Japan International cooperation Agency (JICA) and headed by Dr. Yasuyuki KOGA, visited Kingdom of Nepal from September 14 to September 25, 1992 for the purpose of formulating the Scope of Work for the Aftercare Study (the Scope of Work) for Sindhuli Road Construction Project in Kingdom of Nepal.

During the stay in Nepal, the Team carried out a field survey and had several meetings with officials of the Department of Roads (the DOR) of Ministry of Works & Transport on the Scope of Work and other related matters.

The main items which were understood by both sides are as follows:

1. The Scope of Work was agreed, as attached.

2. The Study is expected to start as early as possible. The both sides shall make the best effort on whatever possible in the preparation of the study.

3. The Aftercare Study Team will carry out the study of two (2) alternatives (single lane plan and double lanes plan) revising the previous feasibility study for the purpose of reducing the construction cost.

4. The DOR will provide two (2) full-time counterparts (engineers) who will work together with the Aftercare Study Team.

5. The DOR explained, to the Team's request to provide with suitable office space, that this request could not be accepted because of limited space in the DOR office. However, the DOR will assist the Aftercare Study Team to obtain the office space.

RR

Y. K.

Attendant List

Nepal Side

Mr. R. B. SHARMA	----------	Director General of DOR
Mr. B. R. THAPA	----------	Deputy Director General of DOR
Mr. V. P. SHRESTHA	----------	Deputy Director General of DOR
Mr. M. B. PRADAANANG	----------	Divisional Engineer of DOR

Japanese Side

Dr. Yasuyuki KOGA	----------	Leader of the Mission
Mr. Takanori TACHIBANA	----------	Member of Mission
Mr. Takeo KAI	----------	Member of Mission
Mr. Takao INAMI	----------	Member of Mission
Mr. Takeshi KANOME	----------	Member of Mission
Mr. Mikio ISHIWATARI	----------	Second Secretary, Embassy of Japan
Mr. Toshikazu MASAKI	----------	JICA, Nepal Office

RB

Y. K.

APPENDIX - B

MINUTES OF DISCUSSION

MINUTES OF DISCUSSION
ON
INCEPTION REPORT
OF
THE AFTERCARE STUDY
FOR
SINDHULI ROAD CONSTRUCTION PROJECT

BETWEEN
DEPARTMENT OF ROADS
MINISTRY OF WORKS AND TRANSPORT
HIS MAJESTY'S GOVERNMENT OF NEPAL
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

KATHMANDU
JANUARY 28, 1993

V.P. SHRESTHA
DIRECTOR GENERAL
DEPARTMENT OF ROADS
MINISTRY OF WORKS AND TRANSPORT
HIS MAJESTY'S GOVERNMENT OF NEPAL

T. NAKAGAWA
DEPUTY TEAM LEADER OF THE STUDY TEAM
ON BEHALF OF
JAPAN INTERNATIONAL
COOPERATION AGENCY

Yasuyuki Koga

WITNESSED BY
Dr. Yasuyuki KOGA
CHAIRMAN OF THE
ADVISORY COMMITTEE

 Y.K.

MINUTES OF DISCUSSION

THE AFTERCARE STUDY
FOR
SINDHULI ROAD CONSTRUCTION PROJECT
(January 1993 - August 1993)

In accordance with the Scope of Works (hereinafter referred to as "S/W") agreed upon on September 22, 1992 between Japan International Cooperation Agency (hereinafter referred to as "JICA") and the Department of Roads, Ministry of Works and Transport (hereinafter referred to as "DOR"), the Inception Report for the Aftercare Study on Sindhuli Road Construction Project (hereinafter referred to as "the Study") was submitted by the Study Team to the Director General of DOR on January 19, 1993. Mr. H.Shinkai, Team Leader of the Study Team, and members of the Study Team made a briefing on the Inception Report on January 21, 1993.

After a series of discussions among the Study Team, the Advisory Committee, JICA Representatives, (specially constituted for this Aftercare Study) and the officials of DOR, the following subjects have been confirmed by both DOR and the Japanese Side.

1. Acceptance of Inception Report

The Study Team submitted 20 copies of the Inception Report on January 19, 1993 to DOR in accordance with S/W for study and approval. DOR acknowledged receipt of the report and agreed to the contents herein in principle.

2. Road Classification

Nepalese side requested the Japanese side to carry out the review on previous preliminary design prepared in the Feasibility Study dated in 1988 taking into consideration Sindhuli Road as a National Highway in principle connecting North to South of the Nation.

3. Implementation Schedule

Taking into account the importance and priority of the Sindhuli Road, Nepalese side requested the Japanese side to formulate the construction schedule in full consideration so that entire section of the Sindhuli Road connecting Bardibas and Dhulikhel will be opened to the traffic within the earliest possible time.

V.P. SHRESTHA
DIRECTOR GENERAL
DEPARTMENT OF ROADS
MINISTRY OF WORKS AND TRANSPORT
HIS MAJESTY'S GOVERNMENT OF NEPAL

T. NAKAGAWA
DEPUTY TEAM LEADER OF THE STUDY TEAM
ON BEHALF OF
JAPAN INTERNATIONAL
COOPERATION AGENCY

WITNESSED BY
Dr. Yasuyuki KOGA
CHAIRMAN OF THE
ADVISORY COMMITTEE

Appendix-1

List of Participants in the Meeting
for
The Aftercare Study on Sindhuli Road Construction Project

Venue : Conference Room, DOR,
Date : January 21,26 & 28 1993

A. Nepalese Side

(1) Mr. Varun Prasad Shrestha, Director General

(2) Mr. Gopal Shakti Pradhan, Deputy Director General

(3) Mr. Devi Prasad Bastola, Deputy Director General

(4) Mr. Mohan Bahadhur Karki, Deputy Director General

(5) Mr. Pawan Man Shrestha, Divisional Engineer

(6) Mr. Kamal Raj Pande, Divisional Engineer

(7) Mrs. Sushila Dali, Transport Economist

(8) Dr. Shanta Bir Singh Tuladhar, Project Coordinator

(9) Mr. Deepak Man Singh Shrestha, Highway/Traffic Engineer

(10) Mr. Madan Bandhu Regmi, Bridge Engineer

B. Japanese Side

- **Study Team**

(1)	Mr. Hiroki Shinkai	:	Team Leader
(2)	Mr. Tetsu Nakagawa	:	Deputy Team Leader/Road and Bridge Planner
(3)	Mr. Yoshimasa Yamashita	:	Project Execution Planner
(4)	Mr. Katsuyoshi Matsuda	:	Economist

- **Member of Advisory Committee & JICA Representatives**

(1) Dr. Yasuyuki Koga, Chairman of Advisory Committee

(2) Mr. Takanori Tachibana, Member of Advisroy Committee

(3) Mr. Takeshi Kanome, JICA Coordinator

(4) Mr. Toshikazu Masaki, Assistant Resident Representative in Nepal

MINUTES OF DISCUSSION
ON
PROGRESS REPORT
OF
THE AFTERCARE STUDY
FOR
SINDHULI ROAD CONSTRUCTION PROJECT

BETWEEN
DEPARTMENT OF ROADS
MINISTRY OF WORKS AND TRANSPORT
HIS MAJESTY'S GOVERNMENT OF NEPAL
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

KATHMANDU
MARCH 9, 1993

V.P. SHRESTHA
DIRECTOR GENERAL
DEPARTMENT OF ROADS
MINISTRY OF WORKS AND TRANSPORT
HIS MAJESTY'S GOVERNMENT OF NEPAL

T. NAKAGAWA
DEPUTY TEAM LEADER OF THE STUDY TEAM
ON BEHALF OF
JAPAN INTERNATIONAL
COOPERATION AGENCY

MINUTES OF DISCUSSION

THE AFTERCARE STUDY
FOR
SINDHULI ROAD CONSTRUCTION PROJECT
(JANUARY 1993-AUGUST 1993)

In accordance with the schedule stipulated in the Inception Report submitted to Department of Roads (DOR) on January 19, 1993, the Progress Report for the Aftercare Study on Sindhuli Road Construction Project (hereinafter referred to as "the Study") was submitted by the Study Team to DOR on March 3, 1993, and the Study Team made a briefing on the Progress Report on March 5, 1993.

After a series of discussions made between the DOR officials concerned and the Study Team (constituted for this Aftercare Study), the following subjects have been confirmed and agreed upon by both DOR and the Japanese side.

(1) DOR acknowledged the receipt of 30 copies of Progress Report, and the contents of the Report were accepted by DOR in general.

(2) DOR requested the Study Team to take the following issues into account in selecting the optimum development scheme, which will be carried out during the succeeding Phase I (B) period in Japan.

In view of construction of bridges from investment consideration with respect to traffic projection, it is desirable to adopt the bridge development scheme considering the second stage widening which includes construction of full substructure and partial-superstructure having 4.75 m width in the first stage so as to enable the widening to double lane (6.5 m) easily in the future by installation of additional girders or cantilever brackets.

- Taking into account the present inadequate road maintenance budget provisions in DOR, the maintenance equipment and offices for Sindhuli Road should be incorporated in formulating maintenance program in the Study.

- In view of questionable durability of the causeways, it is expected to apply bridges as much as possible.

- Right of way be fixed to 50 m wide.

(3) The Japanese side replied that selection of the optimum development scheme depends on viability of each alternative in general, but the Nepalese side's requests are conveyed to JICA Headquarter for consideration.

(4) Draft Final Report of the Aftercare Study will be forwarded to HMG/N for the official comments tentatively by June 1993.

V.P. SHRESTHA	T. NAKAGAWA
DIRECTOR GENERAL	DEPUTY TEAM LEADER OF THE STUDY TEAM
DEPARTMENT OF ROADS	ON BEHALF OF
MINISTRY OF WORKS AND TRANSPORT	JAPAN INTERNATIONAL
HIS MAJESTY'S GOVERNMENT OF NEPAL	COOPERATION AGENCY

List of Participants in the Meeting & During the Study Period For The Aftercare Study on Sindhuli Road Construction Project

Venue : Conference Room, DOR,
Date : March 5, 1993

A. Nepalese Side

(1) Mr. Varun Prasad Shrestha, Director General
(2) Mr. Gopal Shakti Pradhan, Deputy Director General
(3) Mr. Debi Prasad Bastola, Deputy Director General
(4) Mr. Mohan Bahadhur Karki, Deputy Director General
(5) Mr. Niranjan Chalise, Deputy Director General
(6) Mr. Pawan Man Shrestha, Divisional Engineer
(7) Mr. Kamal Raj Pande, Divisional Engineer
(8) Mrs. Sushila Dali, Transport Economist
(9) Dr. Shanta Bir Singh Tuladhar, Project Coordinator
(10) Mr. Deepak Man Singh Shrestha, Highway/Traffic Engineer
(11) Mr. Madan Bandhu Regmi, Bridge Engineer

B. Japanese Side

(1)	Mr. Tetsu Nakagawa	:	Deputy Team Leader/Road and Bridge Planner
(2)	Mr. Yoshimasa Yamashita	:	Project Execution Planner
(3)	Mr. Toshikazu Masaki	:	JICA Assistant Resident Representative in Nepal.

MINUTES OF DISCUSSION
ON
DRAFT FINAL REPORT
OF
THE AFTERCARE STUDY
FOR
SINDHULI ROAD CONSTRUCTION PROJECT

BETWEEN
DEPARTMENT OF ROADS
MINISTRY OF WORKS AND TRANSPORT
HIS MAJESTY'S GOVERNMENT OF NEPAL
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

KATHMANDU
JUNE 7, 1993

V.P. SHRESTHA
DIRECTOR GENERAL
DEPARTMENT OF ROADS
MINISTRY OF WORKS AND TRANSPORT
HIS MAJESTY'S GOVERNMENT OF NEPAL

H. SHINKAI
TEAM LEADER OF THE STUDY TEAM
ON BEHALF OF
JAPAN INTERNATIONAL
COOPERATION AGENCY

Witnessed By
T.Kai
REPRESENTATIVE OF THE ADVISORY COMMITTEE

MINUTES OF DISCUSSION

THE AFTERCARE STUDY
FOR SINDHULI ROAD CONSTRUCTION PROJECT
(JANUARY 1993 - AUGUST 1993)

In accordance with the Scope of Works (herein after referred to as "S/W") agreed upon on September 22, 1992 between Japan International Cooperation Agency (hereinafter referred to as "JICA") and the Department of Roads, Ministry of Works and Transport (hereinafter referred to as "DOR"), the Draft Final Report for the Aftercare Study on Sindhuli Road Construction Project (hereinafter referred to as "the Study") was submitted by the Study Team to the Director General of DOR on June 2, 1993 and Mr. H.Shinkai, Team Leader of the Study Team, and members of the Study Team made a briefing and discussion on the Draft Final Report from June 3 to June 6, 1993.

After a series of discussion made between the Advisory Team, the Study Team and the officials of DOR and the representatives of other government agencies concerned, the following subjects have been confirmed and agreed upon by both DOR and the Japanese Side.

1. Acceptance of Draft Final Report

DOR acknowledged the receipt of 30 copies of the Report with 4 copies of Drawings and the contents of these were accepted by DOR in principle.

2. Implementation Program of the Sindhuli Road

DOR basically agreed to adopt the development scheme of Alternative - 1 and the implementation program of Case-B as concluded in the Report with the following conditions:

(1) Nepalese side strongly requested the Japanese side to consider application of Alternative -4 with penetration macadam pavement and bridge scheme -B (construction of full width substructure with partial superstructure having 4.75 m width), in stead of Alternative-1, if possible.

(2) DOR agreed to participate the project through the construction of earthwork and causeway in Section-I, provided that the materials and equipment to be used for the work shall be supplied under the program of Sindhuli Road Construction Project.

3. **Strengthening DOR's Maintenance Formation For Sindhuli Road**

DOR recognized necessity of maintaining Sindhuli Road on a force account basis, after handing over the entire sections, and accordingly DOR agreed to establish maintenance unit for Sindhuli Road with financial assistance from a foreign funding agency.

4. **Certainty of Land Acquisition**

DOR understand that special attention shall be paid to land acquisition in order to implement the Project smoothly. Subsequently, DOR expressed that the required land acquisition and fund arrangement will be carried out by DOR with every effort on a timely manner, in case a foreign funding agency commits the project implementation.

5. **Detailed Technical Comments From DOR**

DOR presented the detailed technical comments for Study Team' s review. The study team replied that some of the comments were considered in the Study and the other several comments will be reflected in the further detailed design. DOR's comments and Study Team's replies are enclosed in Appendix-II.

V.P. SHRESTHA
DIRECTOR GENERAL
DEPARTMENT OF ROADS
MINISTRY OF WORKS AND TRANSPORT
HIS MAJESTY'S GOVERNMENT OF NEPAL

H. SHINKAI
TEAM LEADER OF THE STUDY TEAM
JAPAN INTERNATIONAL
COOPERATION AGENCY

Witnessed By
T. Kai
REPRESENTATIVE OF THE ADVISORY COMMITTEE

Appendix-1

List of Participants in the Meeting for The Aftercare Study on Sindhuli Road Construction Project

Venue : Conference Room, DOR,
Date : June, 6 1993

A. Nepalese Side

(1) Mr. Varun Prasad Shrestha, Director General

(2) Mr. Gopal Shakti Pradhan, Deputy Director General

(3) Mr. Debi Prasad Bastola, Deputy Director General

(4) Mr. Mohan Bahadhur Karki, Deputy Director General

(5) Mr. Niranjan Chalise, Deputy Director General

(6) Mr. Hari Lal Pajbahak, Senior Divisional Engineer

(7) Mr. Pawan Man Shrestha, Divisional Engineer

(8) Mr. Kamal Raj Pande, Divisional Engineer

(9) Mrs. Sushila Dali, Transport Economist

(9) Dr. Shanta Bir Singh Tuladhar, Project Coordinator

(10) Mr. Deepak Man Singh Shrestha,Highway/Traffic Engineer

(11) Mr. Madan Bandhu Regmi ,Bridge Engineer

B. Japanese Side

- Study Team

(1) Mr. Hiroki Shinka, Team Leader

(2) Mr. Tetsu Nakagawa, Deputy Team Leader/Road and Bridge Planner

(3) Mr. Yoshimasa Yamashita, Project Execution Planner

- Advisory Committee and JICA Representative

(1) Mr.Takeo Kai, Representative of Advisory Committee

(2) Mr. Takanori Tachibana, Member of Advisory Committee

(3) Mr. Hasegawa,JICA Coordinator

(4) Mr. Mikio Ishiwatari, Second Secretary of EOJ

(5) Mr.Toshikazu Masaki, Assistant Resident Representative in JICA Nepal

DOR' s Technical Comments and The Study Team's Replies

C-1 Suitable widening are required in horizontal curves.

R-1 Widening due to horizontal curves were incorporated in the Study.

C-2 Application of minimum 5.5m wide pavement with 1.5m wide shoulder in flat/rolling terrain, i.e. Application of Double lane road.

R-2 As indicated by IRRs and taking into account indirect benefits and environmental adverse effects, it is concluded that stagewise construction alternatives is superior to the full scale construction, and 3.75m carriageway with 0.5m hard shoulder both sides is suitable in the initial stage.

C-3 Difficulty of the Future Widening.

R-3 The future widening was considered in the alignment design and cross section design. For instance, certain sections totalling about 5 km was proposed to be double lane, even in the first stage taking into account the difficulty. Thus, it is presumed that the future widening can be done with provision of an appropriate traffic control.

C-4 Proposed 2.5% of Cross Slope on asphaltic surface pavement.

R-4 Acceptable and this requirement will be reflected in the detailed design.

C-5 Maximum Superelevation - 10%.

R-5 Superelevation will be reviewed based on DOR's comments and the result will be reflected in the detailed design.

C-6 Higher Design Speed to be applied.

R-6 Design speed to be applied relies on not only the Road Standard but also topographic and geological condition where route passes through. Taking into account very steep slope on the mountain topography and on the fragile geology, the Study Team is confident that proposed design speed in the Report is suitable.

It is noted that sufficient transition length for each curve was considered in the Study.

C-7 Vertical Curves to be considered.

R-7 Vertical curves were considered in the Study.

C-8 Lower Gradient.

R-8 Gradient applied in the Study will be reviewed in the D/D stage and lower gradient will be applied as much as possible within available budget.

C-9 Necessity of Detailed Drainage Design.

R-9 Accepted and the detailed drainage design will be carried out in the D/D Stage.

C-10 Application of Comprehensive Pavement Design.

R-10 In the D/D stage, comprehensive pavement design will be carried out referring to Road Note 31, BCEOM guide or even Indian Standards.

C-11 Elimination of Gunite in Slope Protection.

R-11 Comprehensive slope protection design will be carried out in the D/D stage taking into account maximum usage of local know-how and materials.

C-12 In case of asphaltic pavement, whether shoulders are paved or not ?

R-12 The paved shoulder was considered in the Study.

APPENDIX–C

TRAFFIC SURVEY AND TRAFFIC DEMAND FORECAST

TABLE OF CONTENTS

Appendix - C1 Result of Traffic Counts

Result of Traffic Counts(1)

Station No	Name of the Station		Direction			Day		Weather	
1	Banepa		From Kathmandu to Dhulikhel			Feb.3, 1993		Clear	
Time	Motorcycle	Car,Van, Jeep,Pick-up	Minibus	Bus	Light Truck	Medium, Heavy Truck	Tractor	Others	Total
6:00 - 7:00	0	1	4	4	1	3	1	0	14
7:00 - 8:00	4	7	4	9	1	4	1	0	30
8:00 - 9:00	8	17	9	9	1	6	1	0	51
9:00 - 10:00	15	17	14	13	6	9	2	0	76
10:00 - 11:00	16	11	9	7	3	8	3	1	58
11:00 - 12:00	23	15	8	5	2	9	2	0	64
12:00 - 13:00	19	14	9	6	2	9	1	0	60
13:00 - 14:00	19	14	8	7	3	6	1	0	58
14:00 - 15:00	22	7	11	6	1	6	3	0	56
15:00 - 16:00	17	16	10	7	3	14	2	3	72
16:00 - 17:00	11	5	17	2	5	11	1	1	53
17:00 - 18:00	14	10	10	8	5	9	1	1	58
18:00 - 19:00	19	10	9	2	4	3	1	0	48
19:00 - 20:00	11	8	8	0	0	2	0	0	29
20:00 - 21:00	5	3	2	0	2	1	0	0	13
21:00 - 22:00	2	1	0	0	0	1	0	0	4
22:00 - 23:00	1	1	0	0	0	0	0	0	2
23:00 - 24:00	0	1	0	0	0	1	0	0	2
0:00 - 1:00	0	0	0	0	0	0	0	0	0
1:00 - 2:00	0	0	0	0	0	0	0	0	0
2:00 - 3:00	1	0	0	0	0	0	0	0	1
3:00 - 4:00	0	0	0	0	0	0	0	0	0
4:00 - 5:00	0	0	3	0	0	3	0	0	6
5:00 - 6:00	0	2	1	1	1	0	0	0	5
Total	207	160	136	86	40	105	20	6	760

Result of Traffic Counts(2)

Station No	Name of the Station		Direction			Day		Weather	
1	Banepa		From Dhulikhel to Kathmandu			Feb.3, 1993		Clear	
Time	Motorcycle	Car,Van, Jeep,Pick-up	Minibus	Bus	Light Truck	Medium, Heavy Truck	Tractor	Others	Total
6:00 - 7:00	0	3	6	4	0	0	0	0	13
7:00 - 8:00	2	4	6	5	1	3	1	0	22
8:00 - 9:00	3	3	10	5	2	4	0	0	27
9:00 - 10:00	15	3	14	6	3	10	1	0	52
10:00 - 11:00	8	7	14	10	4	8	2	0	53
11:00 - 12:00	18	4	10	9	2	10	2	1	56
12:00 - 13:00	19	15	7	8	5	4	0	0	58
13:00 - 14:00	16	8	10	7	2	3	0	0	46
14:00 - 15:00	16	21	9	12	6	11	1	0	76
15:00 - 16:00	23	13	14	5	6	9	2	1	73
16:00 - 17:00	35	22	9	7	2	5	3	2	85
17:00 - 18:00	16	19	7	7	3	17	3	0	72
18:00 - 19:00	9	16	6	4	4	2	1	0	42
19:00 - 20:00	4	5	4	3	3	6	1	0	26
20:00 - 21:00	5	2	1	0	1	6	0	0	15
21:00 - 22:00	1	2	0	1	1	2	0	0	7
22:00 - 23:00	2	4	0	0	1	0	0	0	7
23:00 - 24:00	1	1	0	0	3	0	0	0	5
0:00 - 1:00	0	0	0	0	0	0	0	0	0
1:00 - 2:00	0	0	1	0	0	0	0	0	1
2:00 - 3:00	1	0	0	0	0	1	0	0	2
3:00 - 4:00	0	1	0	0	0	1	0	0	2
4:00 - 5:00	1	1	1	0	1	0	0	0	4
5:00 - 6:00	0	1	5	1	0	5	1	0	13
Total	195	155	134	94	50	107	18	4	757

Result of Traffic Counts(3)

Station No	Name of the Station		Direction			Day		Weather	
2	Thankot		From Kathmandu to Naubise			Feb.3, 1993		Clear	
Time	Motorcycle	Car,Van, Jeep,Pick-up	Minibus	Bus	Light Truck	Medium, Heavy Truck	Tractor	Others	Total
6:00 - 7:00	3	7	6	6	5	18	1	0	46
7:00 - 8:00	4	14	9	19	5	28	2	2	83
8:00 - 9:00	10	16	8	14	7	30	1	0	86
9:00 - 10:00	10	14	1	8	1	26	0	0	60
10:00 - 11:00	9	13	2	6	3	23	0	1	57
11:00 - 12:00	10	16	2	5	2	30	0	1	66
12:00 - 13:00	17	15	1	3	0	37	1	1	75
13:00 - 14:00	10	13	1	2	1	47	0	2	76
14:00 - 15:00	4	17	7	3	3	53	0	0	87
15:00 - 16:00	7	12	2	3	3	47	1	2	77
16:00 - 17:00	6	11	2	20	9	38	0	0	86
17:00 - 18:00	6	12	1	26	3	65	0	1	114
18:00 - 19:00	4	2	0	26	2	38	0	0	72
19:00 - 20:00	1	3	0	42	3	48	1	2	100
20:00 - 21:00	0	1	1	34	2	34	1	0	73
21:00 - 22:00	1	1	0	1	0	18	0	0	21
22:00 - 23:00	1	0	0	0	0	2	0	0	3
23:00 - 24:00	0	0	0	0	1	5	0	0	6
0:00 - 1:00	0	0	0	0	0	0	0	0	0
1:00 - 2:00	0	1	0	1	0	3	0	0	5
2:00 - 3:00	0	2	0	0	0	0	0	0	2
3:00 - 4:00	0	0	0	0	0	0	0	0	0
4:00 - 5:00	0	0	0	0	0	7	0	0	7
5:00 - 6:00	0	4	0	3	2	13	0	0	22
Total	103	174	43	222	52	610	8	12	1224

Result of Traffic Counts(4)

Station No	Name of the Station		Direction			Day		Weather	
2	Thankot		From Naubise to Kathmandu			Feb.3, 1993		Clear	
Time	Motorcycle	Car,Van, Jeep,Pick-up	Minibus	Bus	Light Truck	Medium, Heavy Truck	Tractor	Others	Total
6:00 - 7:00	1	3	3	15	5	34	0	0	61
7:00 - 8:00	1	6	1	26	3	51	0	2	90
8:00 - 9:00	6	2	3	14	2	51	0	0	78
9:00 - 10:00	1	6	1	3	3	58	1	1	74
10:00 - 11:00	2	2	2	3	8	64	0	0	81
11:00 - 12:00	4	3	1	3	0	47	0	0	58
12:00 - 13:00	7	9	4	2	3	39	1	0	65
13:00 - 14:00	8	11	4	10	4	33	0	0	70
14:00 - 15:00	9	12	2	8	5	20	0	0	56
15:00 - 16:00	17	11	2	13	2	30	0	2	77
16:00 - 17:00	13	18	3	7	3	30	0	1	75
17:00 - 18:00	14	16	4	5	1	18	0	1	59
18:00 - 19:00	12	13	4	7	1	16	0	0	53
19:00 - 20:00	0	12	1	3	1	19	0	0	36
20:00 - 21:00	6	13	0	1	1	5	0	0	26
21:00 - 22:00	1	11	0	1	2	11	0	0	26
22:00 - 23:00	2	4	0	0	1	3	0	0	10
23:00 - 24:00	0	2	0	0	0	2	0	0	4
0:00 - 1:00	0	3	0	0	1	1	0	0	5
1:00 - 2:00	0	2	0	1	1	4	0	0	8
2:00 - 3:00	0	2	0	0	1	11	0	0	14
3:00 - 4:00	0	2	0	31	0	8	0	0	41
4:00 - 5:00	0	2	1	39	4	23	0	0	69
5:00 - 6:00	0	0	2	21	3	18	0	0	44
Total	104	165	38	213	55	596	2	7	1180

Result of Traffic Counts(5)

Station No	Name of the Station		Direction			Day		Weather	
3	Hetauda		From Kathmandu to Birganj			Feb.3, 1993		Clear	
Time	Motorcycle	Car,Van, Jeep,Pick-up	Minibus	Bus	Light Truck	Medium, Heavy Truck	Tractor	Others	Total
6:00 - 7:00	0	3	0	4	2	39	1	0	49
7:00 - 8:00	1	2	0	4	4	36	0	0	47
8:00 - 9:00	3	7	0	4	5	56	3	0	78
9:00 - 10:00	11	6	3	3	2	36	0	1	62
10:00 - 11:00	8	3	0	3	1	37	0	0	52
11:00 - 12:00	7	6	0	4	1	35	0	0	53
12:00 - 13:00	8	9	2	7	2	38	0	0	66
13:00 - 14:00	12	11	3	7	0	35	2	0	70
14:00 - 15:00	7	13	1	5	0	18	1	2	47
15:00 - 16:00	2	10	0	1	1	20	0	0	34
16:00 - 17:00	2	6	1	3	1	27	0	0	40
17:00 - 18:00	3	8	0	3	0	16	0	0	30
18:00 - 19:00	5	1	0	3	2	31	1	2	45
19:00 - 20:00	2	6	0	2	0	17	1	0	28
20:00 - 21:00	2	4	0	3	0	18	0	0	27
21:00 - 22:00	0	1	0	13	0	12	0	1	27
22:00 - 23:00	0	1	0	5	0	1	0	0	7
23:00 - 24:00	0	1	0	28	1	23	0	0	53
0:00 - 1:00	0	0	0	11	0	5	0	0	16
1:00 - 2:00	0	0	0	33	0	16	0	0	49
2:00 - 3:00	0	0	0	16	0	7	0	0	23
3:00 - 4:00	0	0	0	12	1	1	0	0	14
4:00 - 5:00	0	1	0	12	0	12	0	0	25
5:00 - 6:00	0	1	0	4	0	15	0	0	20
Total	73	100	10	190	23	551	9	6	962

Result of Traffic Counts(6)

Station No	Name of the Station		Direction			Day		Weather	
3	Hetauda		From Birganj to Kathmandu			Feb.3, 1993		Clear	
Time	Motorcycle	Car,Van, Jeep,Pick-up	Minibus	Bus	Light Truck	Medium, Heavy Truck	Tractor	Others	Total
6:00 - 7:00	0	2	0	2	0	12	3	0	19
7:00 - 8:00	1	1	0	4	0	18	1	0	25
8:00 - 9:00	3	3	3	3	0	10	0	0	22
9:00 - 10:00	3	3	1	4	0	22	1	1	35
10:00 - 11:00	3	6	0	4	0	12	0	0	25
11:00 - 12:00	3	4	0	4	0	17	0	0	28
12:00 - 13:00	1	12	0	2	0	26	0	0	41
13:00 - 14:00	4	6	0	4	0	16	0	0	30
14:00 - 15:00	5	10	0	2	1	29	0	1	48
15:00 - 16:00	7	8	0	6	2	31	0	0	54
16:00 - 17:00	6	7	2	4	4	31	0	0	54
17:00 - 18:00	6	7	0	2	5	36	0	0	56
18:00 - 19:00	10	6	1	3	4	34	0	1	59
19:00 - 20:00	7	4	1	0	0	38	1	0	51
20:00 - 21:00	2	1	0	10	0	27	0	0	40
21:00 - 22:00	1	4	1	20	0	43	0	0	69
22:00 - 23:00	0	2	0	18	0	22	0	0	42
23:00 - 24:00	1	3	0	17	0	46	0	2	69
0:00 - 1:00	0	0	0	5	2	14	0	0	21
1:00 - 2:00	0	2	0	27	0	6	0	0	35
2:00 - 3:00	0	0	0	27	0	4	0	0	31
3:00 - 4:00	0	0	0	12	0	6	0	0	18
4:00 - 5:00	0	0	0	6	0	4	0	0	10
5:00 - 6:00	0	1	0	0	0	7	0	0	8
Total	63	92	9	186	18	511	6	5	890

Result of Traffic Counts(7)

Station No	Name of the Station		Direction			Day		Weather	
4	Dhalkebar		From Kathmandu to Biratnagar			Feb.3, 1993		Clear	
Time	Motorcycle	Car,Van, Jeep,Pick-up	Minibus	Bus	Light Truck	Medium, Heavy Truck	Tractor	Others	Total
6:00 - 7:00	0	0	0	2	0	5	0	0	7
7:00 - 8:00	1	0	0	6	0	9	0	0	16
8:00 - 9:00	1	1	0	5	0	11	0	0	18
9:00 - 10:00	2	5	0	6	0	12	0	0	25
10:00 - 11:00	1	1	0	4	0	7	0	0	13
11:00 - 12:00	1	4	1	4	0	8	0	0	18
12:00 - 13:00	5	4	0	1	0	10	0	0	20
13:00 - 14:00	0	4	0	3	0	8	0	0	15
14:00 - 15:00	3	6	0	1	0	13	0	0	23
15:00 - 16:00	4	3	0	7	0	9	0	0	23
16:00 - 17:00	5	7	0	6	0	10	0	0	28
17:00 - 18:00	2	2	0	2	0	11	0	0	17
18:00 - 19:00	1	3	0	2	1	9	2	0	18
19:00 - 20:00	1	2	0	1	1	5	0	0	10
20:00 - 21:00	0	1	0	1	0	9	0	0	11
21:00 - 22:00	0	1	2	2	3	6	0	0	14
22:00 - 23:00	0	2	0	2	0	2	0	0	6
23:00 - 24:00	0	0	0	5	0	11	2	0	18
0:00 - 1:00	0	0	0	10	0	5	0	0	15
1:00 - 2:00	0	0	0	22	0	3	0	0	25
2:00 - 3:00	0	1	0	13	0	6	0	0	20
3:00 - 4:00	0	0	0	10	0	3	0	0	13
4:00 - 5:00	0	0	0	9	0	3	0	0	12
5:00 - 6:00	0	0	0	3	0	5	0	0	8
Total	27	47	3	127	5	180	4	0	393

Result of Traffic Counts(8)

Station No	Name of the Station		Direction			Day		Weather	
4	Dhalkebar		From Biratnagar to Kathmandu			Feb.3, 1993		Clear	
Time	Motorcycle	Car,Van, Jeep,Pick-up	Minibus	Bus	Light Truck	Medium, Heavy Truck	Tractor	Others	Total
6:00 - 7:00	0	1	0	3	0	14	0	0	18
7:00 - 8:00	0	0	0	4	0	9	1	0	14
8:00 - 9:00	0	6	0	4	0	11	0	0	21
9:00 - 10:00	1	7	0	5	0	6	1	0	20
10:00 - 11:00	2	1	2	4	0	10	0	0	19
11:00 - 12:00	1	3	0	4	0	10	0	0	18
12:00 - 13:00	2	4	0	3	0	12	1	0	22
13:00 - 14:00	2	1	1	4	0	10	0	0	18
14:00 - 15:00	2	2	2	5	0	16	2	0	29
15:00 - 16:00	8	6	1	1	0	5	0	0	21
16:00 - 17:00	0	2	0	6	1	12	1	0	22
17:00 - 18:00	1	1	0	4	0	8	2	0	16
18:00 - 19:00	0	0	0	5	0	2	0	0	7
19:00 - 20:00	1	6	0	11	0	7	0	0	25
20:00 - 21:00	0	0	0	5	1	8	0	0	14
21:00 - 22:00	0	0	0	3	1	8	0	0	12
22:00 - 23:00	1	2	0	13	0	2	0	0	18
23:00 - 24:00	0	0	0	17	0	5	0	0	22
0:00 - 1:00	0	0	0	15	0	3	0	0	18
1:00 - 2:00	0	0	0	2	0	3	0	0	5
2:00 - 3:00	0	0	0	2	0	7	0	0	9
3:00 - 4:00	0	1	0	1	0	6	0	0	8
4:00 - 5:00	0	0	0	0	0	2	0	0	2
5:00 - 6:00	0	0	0	1	0	12	0	0	13
Total	21	43	6	122	3	188	8	0	391

Result of Traffic Counts(9)

Station No	Name of the Station		Direction			Day		Weather	
5	Bharatpur		From Kathmandu to Hetauda			Feb.3, 1993		Clear	
Time	Motorcycle	Car,Van, Jeep,Pick-up	Minibus	Bus	Light Truck	Medium, Heavy Truck	Tractor	Others	Total
6:00 - 7:00	1	1	0	1	5	26	0	0	34
7:00 - 8:00	1	0	0	0	6	43	1	1	52
8:00 - 9:00	6	5	0	1	2	23	0	1	38
9:00 - 10:00	4	11	0	3	4	18	1	6	47
10:00 - 11:00	3	18	1	8	2	16	0	3	51
11:00 - 12:00	4	14	7	10	8	21	1	4	69
12:00 - 13:00	6	16	2	7	3	17	0	1	52
13:00 - 14:00	10	11	5	7	4	26	5	3	71
14:00 - 15:00	9	13	1	7	5	18	2	3	58
15:00 - 16:00	5	12	1	6	5	27	0	1	57
16:00 - 17:00	2	10	0	7	1	30	0	0	50
17:00 - 18:00	1	4	3	4	5	28	0	0	45
18:00 - 19:00	2	10	1	5	4	26	0	0	48
19:00 - 20:00	1	4	2	11	5	27	0	0	50
20:00 - 21:00	1	6	1	29	0	28	0	1	66
21:00 - 22:00	0	1	0	20	2	34	0	0	57
22:00 - 23:00	0	3	1	20	1	20	0	0	45
23:00 - 24:00	0	1	0	27	2	11	0	0	41
0:00 - 1:00	0	1	0	15	0	10	0	0	26
1:00 - 2:00	0	0	0	20	0	16	0	0	36
2:00 - 3:00	0	0	0	4	0	11	1	2	18
3:00 - 4:00	0	1	0	0	0	5	0	0	6
4:00 - 5:00	0	0	0	5	1	10	0	0	16
5:00 - 6:00	0	0	0	0	1	12	0	0	13
Total	56	142	25	217	66	503	11	26	1046

Result of Traffic Counts(10)

Station No	Name of the Station		Direction			Day		Weather	
5	Bharatpur		From Hetauda to Kathmandu			Feb.3, 1993		Clear	
Time	Motorcycle	Car,Van, Jeep,Pick-up	Minibus	Bus	Light Truck	Medium, Heavy Truck	Tractor	Others	Total
6:00 - 7:00	0	6	0	3	1	30	0	0	40
7:00 - 8:00	1	1	1	5	5	23	0	0	36
8:00 - 9:00	3	11	3	5	1	15	0	4	42
9:00 - 10:00	3	10	0	8	2	22	1	2	48
10:00 - 11:00	4	10	3	8	0	18	1	2	46
11:00 - 12:00	6	8	3	12	0	15	1	3	48
12:00 - 13:00	10	11	1	9	4	7	0	2	44
13:00 - 14:00	5	23	2	8	3	21	2	4	68
14:00 - 15:00	8	17	0	8	3	16	0	2	54
15:00 - 16:00	1	7	0	4	3	14	0	0	29
16:00 - 17:00	2	11	0	3	1	15	0	0	32
17:00 - 18:00	3	14	0	0	3	16	0	0	36
18:00 - 19:00	1	8	2	1	2	44	1	0	59
19:00 - 20:00	0	5	0	0	5	30	0	0	40
20:00 - 21:00	0	3	0	2	4	39	0	0	48
21:00 - 22:00	1	3	0	3	1	32	0	0	40
22:00 - 23:00	0	1	1	11	2	23	0	0	38
23:00 - 24:00	0	1	0	13	1	19	0	0	34
0:00 - 1:00	0	0	0	39	1	24	0	0	64
1:00 - 2:00	0	0	0	21	0	17	0	0	38
2:00 - 3:00	0	1	0	8	0	18	0	0	27
3:00 - 4:00	0	1	0	25	1	21	0	0	48
4:00 - 5:00	0	1	0	17	1	32	1	0	52
5:00 - 6:00	1	1	0	6	1	15	0	0	24
Total	49	154	16	219	45	526	7	19	1035

Result of Traffic Counts(11)

Station No	Name of the Station		Direction			Day		Weather	
6	Pathlaiya		From Kathmandu to Biratnagar			Feb.3, 1993		Clear	
Time	Motorcycle	Car,Van, Jeep,Pick-up	Minibus	Bus	Light Truck	Medium, Heavy Truck	Tractor	Others	Total
6:00 - 7:00	3	3	0	3	1	20	1	0	31
7:00 - 8:00	1	5	0	4	1	19	1	0	31
8:00 - 9:00	1	3	2	2	0	12	1	1	22
9:00 - 10:00	2	5	1	3	0	10	0	0	21
10:00 - 11:00	1	3	0	1	0	15	3	1	24
11:00 - 12:00	3	4	0	2	1	20	2	0	32
12:00 - 13:00	3	6	0	4	1	11	1	0	26
13:00 - 14:00	2	4	0	5	2	11	1	0	25
14:00 - 15:00	4	3	1	3	1	24	1	0	37
15:00 - 16:00	1	4	0	3	2	13	1	0	24
16:00 - 17:00	2	4	0	5	1	8	0	0	20
17:00 - 18:00	3	7	0	1	2	17	0	0	30
18:00 - 19:00	2	3	0	1	0	11	0	0	17
19:00 - 20:00	1	2	0	1	0	10	0	0	14
20:00 - 21:00	0	1	0	0	0	5	0	0	6
21:00 - 22:00	1	0	0	1	1	2	0	0	5
22:00 - 23:00	0	2	0	9	1	9	0	0	21
23:00 - 24:00	0	0	0	30	0	4	0	0	34
0:00 - 1:00	0	2	0	13	0	2	0	0	17
1:00 - 2:00	0	0	0	15	0	5	0	0	20
2:00 - 3:00	0	0	0	12	0	2	0	0	14
3:00 - 4:00	0	0	0	2	2	1	0	0	5
4:00 - 5:00	0	0	0	4	1	6	0	0	11
5:00 - 6:00	0	0	0	3	1	9	0	0	13
Total	30	61	4	127	18	246	12	2	500

Result of Traffic Counts(12)

Station No	Name of the Station		Direction			Day		Weather	
6	Pathlaiya		From Biratnagar to Kathmandu			Feb.3, 1993		Clear	
Time	Motorcycle	Car,Van, Jeep,Pick-up	Minibus	Bus	Light Truck	Medium, Heavy Truck	Tractor	Others	Total
6:00 - 7:00	1	0	0	1	0	8	0	0	10
7:00 - 8:00	0	1	0	5	1	16	0	2	25
8:00 - 9:00	3	2	0	5	0	24	0	0	34
9:00 - 10:00	1	1	1	5	0	17	0	0	25
10:00 - 11:00	4	4	0	5	1	19	2	0	35
11:00 - 12:00	1	9	1	1	2	23	0	0	37
12:00 - 13:00	1	2	0	3	0	10	0	0	16
13:00 - 14:00	0	6	0	2	0	13	0	1	22
14:00 - 15:00	4	3	0	5	0	15	0	3	30
15:00 - 16:00	1	3	0	0	1	11	3	0	19
16:00 - 17:00	2	3	0	2	1	17	4	3	32
17:00 - 18:00	5	7	1	3	2	19	0	1	38
18:00 - 19:00	0	4	0	1	4	15	1	1	26
19:00 - 20:00	0	1	0	6	2	9	0	0	18
20:00 - 21:00	0	1	0	5	0	9	0	0	15
21:00 - 22:00	0	4	0	12	2	10	0	0	28
22:00 - 23:00	0	0	0	9	0	2	0	0	11
23:00 - 24:00	0	0	0	5	0	12	0	0	17
0:00 - 1:00	0	1	0	14	1	5	0	0	21
1:00 - 2:00	0	0	0	18	0	2	0	0	20
2:00 - 3:00	0	0	0	10	0	3	0	0	13
3:00 - 4:00	0	0	0	2	1	0	0	0	3
4:00 - 5:00	0	0	0	0	0	3	2	0	5
5:00 - 6:00	0	0	0	3	0	4	0	0	7
Total	23	52	3	122	18	266	12	11	507

Result of Traffic Counts(13)

Station No	Name of the Station		Direction			Day		Weather	
7	Bardibas		To Sindhuli Bazar			Feb.3, 1993		Clear	
Time	Motorcycle	Car,Van, Jeep,Pick-up	Minibus	Bus	Light Truck	Medium, Heavy Truck	Tractor	Others	Total
6:00 - 7:00	2	0	0	1	0	0	0	0	3
7:00 - 8:00	0	1	0	1	0	0	0	0	2
8:00 - 9:00	0	0	0	0	0	0	0	0	0
9:00 - 10:00	0	0	0	0	0	1	0	0	1
10:00 - 11:00	0	0	0	0	0	1	0	0	1
11:00 - 12:00	1	0	0	0	0	1	0	0	2
12:00 - 13:00	1	0	0	0	0	1	0	0	2
13:00 - 14:00	1	0	0	1	0	0	0	0	2
14:00 - 15:00	0	0	0	1	0	0	0	0	1
15:00 - 16:00	2	0	0	0	0	2	0	0	4
16:00 - 17:00	0	1	0	0	0	0	0	0	1
17:00 - 18:00	0	0	0	0	0	0	0	0	0
18:00 - 19:00	0	0	0	0	0	1	0	0	1
19:00 - 20:00	0	1	0	0	0	0	0	0	1
20:00 - 21:00	0	0	0	0	0	0	0	0	0
21:00 - 22:00	1	0	0	0	0	0	0	0	1
22:00 - 23:00	0	0	0	0	0	0	0	0	0
23:00 - 24:00	0	0	0	0	0	0	0	0	0
0:00 - 1:00	0	0	0	0	0	0	0	0	0
1:00 - 2:00	0	0	0	0	0	0	0	0	0
2:00 - 3:00	0	0	0	0	0	0	0	0	0
3:00 - 4:00	0	0	0	2	0	0	0	0	2
4:00 - 5:00	0	0	0	1	0	0	0	0	1
5:00 - 6:00	0	0	0	0	0	0	0	0	0
Total	8	3	0	7	0	7	0	0	25

Result of Traffic Counts(14)

Station No	Name of the Station		Direction			Day		Weather	
7	Bardibas		From Sindhuli Bazar			Feb.3, 1993		Clear	
Time	Motorcycle	Car,Van, Jeep,Pick-up	Minibus	Bus	Light Truck	Medium, Heavy Truck	Tractor	Others	Total
6:00 - 7:00	0	1	0	0	0	0	0	0	1
7:00 - 8:00	0	0	0	0	0	0	0	0	0
8:00 - 9:00	0	0	0	1	0	1	0	0	2
9:00 - 10:00	0	0	0	0	0	0	0	0	0
10:00 - 11:00	2	0	0	0	0	1	0	0	3
11:00 - 12:00	1	0	0	0	0	0	0	0	1
12:00 - 13:00	1	0	0	0	0	0	0	0	1
13:00 - 14:00	1	0	0	1	0	1	0	0	3
14:00 - 15:00	1	1	0	0	0	0	0	0	2
15:00 - 16:00	0	0	0	1	0	0	0	0	1
16:00 - 17:00	3	0	0	1	0	0	0	0	4
17:00 - 18:00	0	0	0	2	0	0	0	0	2
18:00 - 19:00	0	0	0	0	0	1	0	0	1
19:00 - 20:00	3	0	0	0	0	0	0	0	3
20:00 - 21:00	0	1	0	0	0	0	0	0	1
21:00 - 22:00	0	0	0	0	0	0	0	0	0
22:00 - 23:00	0	0	0	0	0	0	0	0	0
23:00 - 24:00	0	0	0	0	0	0	0	0	0
0:00 - 1:00	0	0	0	0	0	0	0	0	0
1:00 - 2:00	0	0	0	0	0	0	0	0	0
2:00 - 3:00	0	0	0	0	0	0	0	0	0
3:00 - 4:00	0	0	0	0	0	0	0	0	0
4:00 - 5:00	0	0	0	0	0	0	0	0	0
5:00 - 6:00	0	0	0	0	0	0	0	0	0
Total	12	3	0	6	0	4	0	0	25

Rehabilitation of Highways & Feeder Roads (1993-1998)

Name of Project			Physical Target in km.
EAST-WEST HIGHWAY			
Kakarbhita	-	Kamala	237
Kamala	-	Pathlaiya	163
NORTH-SOUTH HIGHWAY			
Jogbani	-	Dharan & Dhankuta Basantpur	85
Birgunj	-	Hetauda	46
Charali *	-	Ilam (Mechi Highway)	76
MRM *	-	Gaighat (SagarmathaHighway)	7
Godawari *	-	Bhatkande (Dhangadhi Darchula Highway)	101
Bhatkanda**	-	Patan (Dhangadhi - Darchula Highway)	59
Tulsipur **	-	Sallyan (Rapti Highway)	62
MID-HILL EAST-WEST HIGHWAY			
Prithvi Highway ***			30
Bhatkanda *	-	Doti	74
MRM (Lamhi) *	-	Tulsipur	47
Dumre **	-	Besisahar	40
MRM (Bardibas)	-	Sindhuli	37
Lumbini *	-	Taulihawa	22
Nepalgunj *	-	Guleriya	24
		Total	1083

* Rehabilitation including upgrading to black-topping

** Rehabilitation including upgrading to Gravelling

*** Includes only Naubise-Mugling and Mugling-Marsyangdi sectors of Marsyangdi Hydropower and project.

Source : Eighth Plan (NPC)

Periodic Maintenance (1993-1998)

Name of Project			Physical Target in km
HIGHWAY			
Hetauda	-	Narayangadh	78
Tribhuvan Highway (Hetauda-Naubise)			107
Naubise	-	Thankot	17
Thankot	-	Kathmandu	9
Kathmandu	-	Banepa	20
Kathmandu	-	Kodari	94
Mugling	-	Narayangadh	36
East-west Highway (Butwal-Dhanukhula section)			88
Prithivi Highway (Mugling - Pokhara section)			90
Siddhartha Highway (Pokhara-Butwal-Bhairahawa-Sunauli)			180
East-West Highway (Dhanu Khola-Kohalpur section)			151
Nepalgunj	-	Kohalpur	20
FEEDER ROADS			
Dhalkeswor-Janakpur-Birtamod			43
Kathmandu	-	Godawari	8
Kathmandu	-	Dakshinkali	15
Kathmandu	-	Kakani	20
Kakani	-	Trisulhi	48
Trisulhi-Dhunche-Somdang			105
Lamasaangu	-	Jiri	110
Malekhu	-	Dhading	20
MRM (Goru Singh) Paathar Kot - Sindupalchowk			57
Tansen - Ridi - Tamghas *			75
Bhairahawa	-	Parasi *	56
Ring Road (Kathmandu)			27
		Total	1,475

* Periodic maintenance including upgrading based on study.

Source : Eighth Plan (NPC)

Road Flood Rehabilitation Project (1993-1998)

Name of Project	Physical Target in km
Thankot - Naubise (Flood damaged part reconstruction)	22
Arniko Highway (Flood damaged part reconstruction)	26

Source : Eighth Plan (NPC)

Highway Construction (1993-1998)

Name of Project	Total Length	Black top	Gravelling	Earth	Total
EAST-WEST HIGHWAY					
Kohalpur - Mahakali					
Karnali - Mahakali	40	10	-	-	10
Mid-Hill East-West Highway					
Basantpur - Tehrathum	26	-	-	16	16
Pokhara - Baglung	73	38	-	-	38
North-South Highway					
(Mechi Highway)					
Phidim - Taplejung	86	-	35	-	35
(Koshi Highway)					
Hile - Khandbari					
Hile - Khandari - Num					
(Arun Access Road)	149	-	-	149	149
(Sagarmatha Highway)					
Gaighat - Diktel	83	-	-	83	83
(Katari-Okhaldungha-Solu)					
Katari - Okhaldhunga	76	-	-	76	76
(Rapti Highway)					
Sallyan - Musikot	107	-	-	101	101
(Karnali Highway)					
Surkhet - Jumla	215	-	-	60	60
(Dhangadhi - Darchula)					
Patan - Baitadi	36	-	36	-	36
Baitadi - Darchula	121	-	-	81	81
Other Highways					
Sindhuli - Banepa	118	-	78	-	78
Total		48	149	566	763

Source : Eighth Plan (NPC)

Feeder Road Construction (1993-1998)

Name of Project	Total Length	Black top	Gravelling	Earth	Total
Baglung-Beni-Tatopani	23	-	-	20	20
Chinchu-Jajarkot	92	-	-	61	61
Khopde-Bajhang	99	-	-	84	84
Mahendranagar-Budar	66	-	-	60	60
Sahajpur-Diayal	110	-	-	99	99
Prithivi Highway (Galchi - Devighat (Trishuli))	18	-	18	-	18
Baitadi-Jhulaghat	20	-	-	16	16
Dailekh Road *	-	-	-	26	26
Total		-	18	336	354

* Comparative study of Surkhet-Dailekh, Tallo Dungesar-Dailekh shall be conducted and one will be constructed.

Source : Eighth Plan (NPC)

Roads Helping in Development of Important Development Project - Economic Sectors (1993-1998)

Name of Project	Length	Blacktop	Gravelling	Earth	Total
A. Roads Helping Hydro Power Sections					
Khimiti Road	27	-	27	-	27
Kali Gandaki Road	30	-	-	30	30
Bhalubang-Devisthan (Pyuthan)	44	-	37	-	37
Patan - Pancheswor	60	-	-	60	60
West Seti Road	25	-	-	25	25
Total			64	115	179
B. Road Helping Tourism Development					
Panchkhal-Helambu	65	-	-	40	40
C. Other Feeder					
Name of Project	Length	Blacktop	Gravelling	Earth	Total
Bhojpur Road	80	-	-	72	72
Biratnagar-Rangeli -Ratuwa	38	38	-	-	38
Chatra - Chakrakuti-Birpur	51	51	-	-	51
Sindhuli (kharkot) -Manthali (Ramechaap)	18	-	-	18	18
Chhare-Tokha	25	-	20	-	20
Besishar-Chame	75	-	-	10	10
Ghorahi-Holleri (Dang)	28	-	28	-	28
Doti (Silgadhi)	-				
Safaybagar-Manglasen	75	-	75	-	75
Paripatle-Kagate	6	-	-	6	6
Nepalgunj-Baghuda	50	-	-	24	24
Total		89	123	130	342
Total (A+B+C)		89	187	285	461

Source : Eighth Plan (NPC)

Proposed Expenditure

Name of Project	Expense in million NRs.	Total Expense in Percent.
HIGHWAY REHABILITATION, RECONSTRUCTION AND PERIODIC MAINTENANCE		
MAINTENANCE	3,941.0	31.96
Road Rehabilitation	2,325.6	18.86
Periodic maintenance	1,298.5	10.53
Reconstruction of Flood damaged	316.9	2.57
ROAD CONSTRUCTION	6,534.0	53.00
Highway construction	2,596.5	21.06
Feeder construction	2,230.0	18.08
Urban construction	200.0	1.62
Farm to market Road construction	1,507.5	12.23
BRIDGE CONSTRUCTION	476.0	3.86
RURAL TRANSPORTATION DEVELOPMENT	1,058.0	8.58
MISCELLANEOUS	320.0	2.60
Total	12,329.0	100.00

Source : Eighth Plan (NPC)

Present OD Matrix (1993,Vehicle Type-All)

Unit:vpd

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	Total		
*	147						4						4												155	(1)	Mahottari
	*	35			175		57		3			9	17	107	13		2	5				10			580	(2)	Dhanusha
		*					15																		50	(3)	Sindhuli
			*				3																		3	(4)	Ramechhap
				*			38								6										44	(5)	Dolakha
					*		45						96		20			4	7		4				351	(6)	Sarlahi
						*	1104	68	38						9		6		3		16				1244	(7)	Kabhre
							*			292		282	212	472	84	41	96	2	337		154	62	7	60	3367	(8)	Kathmandu
								*					9	4	17				4						102	(9)	Bhaktapur
									*			3	4	13	2		12								75	(10)	Lalitpur
										*															292	(11)	Sindhupalchok
											*														0	(12)	Nuwakot/Rasuwa
												*													294	(13)	Dhading
													*	453		11	22	4						11	843	(14)	Makawanpur
														*	230	26	41	17	122		40	28			1553	(15)	Rauthat/Bara/Parsa
															*	4	28	11							424	(16)	Chitwan
																*					2				84	(17)	Mechi
																	*		12		7	5			231	(18)	Koshi
																		*			9				52	(19)	Sagarmatha
																			*						485	(20)	Gandaki
																				*					0	(21)	Dhawalagiri
																					*				232	(22)	Lumbini
																						*			105	(23)	Mid-west Dev. R.
																							*		7	(24)	Far-west Dev. R.
																								*	71	(25)	India
																									10644	Total	

Trend Type OD Matrix (1999, Vehicle Type - All)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	Total		
*	266	0	0	0	0	0	8	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	281	(1)	Mahottari
	*	59	0	0	317	0	112	0	5	0	0	16	30	199	22	0	3	9	0	0	0	18	0	0	1056	(2)	Dhanusha
		*	0	0	0	0	29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	88	(3)	Sindhuli
			*	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	(4)	Ramechhap
				*	0	0	71	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0	82	(5)	Dolakha
					*	0	88	0	0	0	0	0	176	0	38	0	0	7	13	0	7	0	0	0	646	(6)	Sarlahi
						*	1876	121	63	0	0	0	0	0	16	0	10	0	3	0	27	0	0	0	2116	(7)	Kabhre
							*	0	0	505	0	504	423	934	166	82	173	4	595	0	299	118	12	112	6117	(8)	Kathmandu
								*	0	0	0	0	18	8	35	0	0	0	8	0	0	0	0	0	190	(9)	Bhaktapur
									*	0	0	5	8	25	4	0	23	0	0	0	0	0	0	0	133	(10)	Lalitpur
										*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	505	(11)	Sindhupalchok
											*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	(12)	Nuwakot/Rasuwa
												*	0	0	0	0	0	0	0	0	0	0	0	0	525	(13)	Dhading
													*	801	0	21	40	7	0	0	0	0	0	17	1548	(14)	Makawanpur
														*	438	45	67	30	217	0	72	50	0	0	2886	(15)	Rauthat/Bara/Parsa
															*	8	49	21	0	0	0	0	0	0	808	(16)	Chitwan
																*	0	0	0	0	3	0	0	0	159	(17)	Mechi
																	*	0	20	0	13	9	0	0	407	(18)	Koshi
																		*	0	0	16	0	0	0	94	(19)	Sagarmatha
																			*	0	0	0	0	0	856	(20)	Gandaki
																				*	0	0	0	0	0	(21)	Dhawalagiri
																					*	0	0	0	437	(22)	Lumbini
																						*	0	0	195	(23)	Mid-west Dev. R.
																							*	0	12	(24)	Far-west Dev. R.
																								*	129	(25)	India
																									19276	Total	

Impact Type OD Matrix (1999, Vehicle Type-All)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	Total		
*	289	0	0	0	0	0	16	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	312	(1)	Mahottari
	*	191	0	0	338	0	244	0	11	0	0	18	31	208	23	0	3	10	0	0	0	18	0	0	1384	(2)	Dhanusha
		*	0	0	0	0	112	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	303	(3)	Sindhuli
			*	0	0	0	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	(4)	Ramechhap
				*	0	0	78	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0	89	(5)	Dolakha
					*	0	118	0	0	0	0	0	180	0	39	0	0	7	13	0	7	0	0	0	702	(6)	Sarlahi
						*	2091	135	70	0	0	0	0	0	17	0	18	0	3	0	27	0	0	0	2361	(7)	Kabhre
							*	0	0	558	0	537	445	985	175	130	272	7	595	0	299	118	12	112	6923	(8)	Kathmandu
								*	0	0	0	0	19	8	37	0	0	0	8	0	0	0	0	0	207	(9)	Bhaktapur
									*	0	0	5	8	26	4	0	36	0	0	0	0	0	0	0	160	(10)	Lalitpur
										*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	558	(11)	Sindhupalchok
											*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	(12)	Nuwakot/Rasuwa
												*	0	0	0	0	0	0	0	0	0	0	0	0	560	(13)	Dhading
													*	807	0	22	41	7	0	0	0	0	0	17	1584	(14)	Makawanpur
														*	441	46	69	31	217	0	72	50	0	0	2960	(15)	Rauthat/Bara/Parsa
															*	8	50	22	0	0	0	0	0	0	827	(16)	Chitwan
																*	0	0	0	0	3	0	0	0	209	(17)	Mechi
																	*	0	20	0	13	9	0	0	531	(18)	Koshi
																		*	0	0	16	0	0	0	100	(19)	Sagarmatha
																			*	0	0	0	0	0	856	(20)	Gandaki
																				*	0	0	0	0	0	(21)	Dhawalagiri
																					*	0	0	0	437	(22)	Lumbini
																						*	0	0	195	(23)	Mid-west Dev. R.
																							*	0	12	(24)	Far-west Dev. R.
																								*	129	(25)	India
																									21418	Total	

Trend Type OD Matrix (2010, Vehicle Type-All)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	Total		
*	501	0	0	0	0	0	17	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	532	(1)	Mahottari
	*	95	0	0	590	0	306	0	13	0	0	25	56	388	47	0	3	17	0	0	0	30	0	0	2071	(2)	Dhanusha
		*	0	0	0	0	73	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	168	(3)	Sindhuli
			*	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	(4)	Ramechhap
				*	0	0	126	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	146	(5)	Dolakha
					*	0	195	0	0	0	0	0	332	0	73	0	0	13	23	0	13	0	0	0	1239	(6)	Sarlahi
						*	3431	234	124	0	0	0	0	0	27	0	16	0	3	0	42	0	0	0	3877	(7)	Kabhre
							*	0	0	864	0	909	1105	2193	421	188	430	12	1184	0	662	268	24	226	12645	(8)	Kathmandu
								*	0	0	0	0	44	17	87	0	0	0	18	0	0	0	0	0	400	(9)	Bhaktapur
									*	0	0	7	19	53	9	0	49	0	0	0	0	0	0	0	274	(10)	Lalitpur
										*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	864	(11)	Sindhupalchok
											*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	(12)	Nuwakot/Rasuwa
												*	0	0	0	0	0	0	0	0	0	0	0	0	941	(13)	Dhading
													*	1403	0	39	72	15	0	0	0	0	0	28	3127	(14)	Makawanpur
														*	898	67	116	57	343	0	122	77	0	0	5734	(15)	Rauthat/Bara/Parsa
															*	15	96	44	0	0	0	0	0	0	1737	(16)	Chitwan
																*	0	0	0	0	6	0	0	0	315	(17)	Mechi
																	*	0	33	0	24	16	0	0	855	(18)	Koshi
																		*	0	0	29	0	0	0	187	(19)	Sagarmatha
																			*	0	0	0	0	0	1604	(20)	Gandaki
																				*	0	0	0	0	0	(21)	Dhawalagiri
																					*	0	0	0	898	(22)	Lumbini
																						*	0	0	391	(23)	Mid-west Dev. R.
																							*	0	24	(24)	Far-west Dev. R.
																								*	254	(25)	India
																									38294	Total	

Impact Type OD Matrix (2010, Vehicle Type-All)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	Total		
*	544	0	0	0	0	0	34	0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0	0	593	(1)	Mahottari
	*	308	0	0	630	0	668	0	28	0	0	29	58	406	49	0	3	18	0	0	0	30	0	0	2771	(2)	Dhanusha
		*	0	0	0	0	283	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	591	(3)	Sindhuli
			*	0	0	0	35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	(4)	Ramechhap
				*	0	0	137	0	0	0	0	0	0	0	21	0	0	0	0	0	0	0	0	0	158	(5)	Dolakha
					*	0	264	0	0	0	0	0	340	0	75	0	0	14	23	0	13	0	0	0	1359	(6)	Sarlahi
						*	3824	263	138	0	0	0	0	0	29	0	29	0	3	0	42	0	0	0	4328	(7)	Kabhre
							*	0	0	955	0	967	1163	2310	443	298	676	22	1184	0	662	268	24	226	14443	(8)	Kathmandu
								*	0	0	0	0	47	18	92	0	0	0	18	0	0	0	0	0	438	(9)	Bhaktapur
									*	0	0	7	20	56	9	0	77	0	0	0	0	0	0	0	335	(10)	Lalitpur
										*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	955	(11)	Sindhupalchok
											*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	(12)	Nuwakot/Rasuwa
												*	0	0	0	0	0	0	0	0	0	0	0	0	1003	(13)	Dhading
													*	1414	0	40	74	16	0	0	0	0	28	3215	(14)	Makawanpur
														*	905	69	120	60	343	0	122	77	0	0	5900	(15)	Rauthat/Bara/Parsa
															*	15	99	46	0	0	0	0	0	0	1783	(16)	Chitwan
																*	0	0	0	0	6	0	0	0	428	(17)	Mechi
																	*	0	33	0	24	16	0	0	1151	(18)	Koshi
																		*	0	0	29	0	0	0	205	(19)	Sagarmatha
																			*	0	0	0	0	0	1604	(20)	Gandaki
																				*	0	0	0	0	0	(21)	Dhawalagiri
																					*	0	0	0	898	(22)	Lumbini
																						*	0	0	391	(23)	Mid-west Dev. R.
																							*	0	24	(24)	Far-west Dev. R.
																								*	254	(25)	India
																									42862	Total	

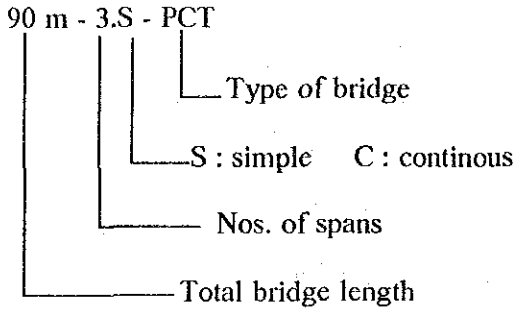
APPENDIX - D

FIELD RECONNAISSANCES AND FINDINGS

Appendix - D1 Alteration of Bridges

LEGEND

1. Original Design in F/S



Type of bridge

PCT	:	prestressed concrete T shaped beam.
PCB	:	prestressed concrete box girder.
RCT	:	reinforced concrete T shaped beam.
RCS	:	reinforced concrete slab.
RCA	:	reinforced concrete arch.
StG	:	steel plate girder.
StH	:	steel H shaped beam.
Trs	:	steel truss.

2. Proposed Alternative

S/C	:	slab culvert
P/C	:	pipe culvert
C/Wb	:	bed level causeway
C/Wv	:	Vented causeway
S/B	:	submersible bridge

the type of bridges are as in 1.

3. Reasons of alteration

R-1 : The flood volume of crossing river is relative by a little and dry season there is scarcely flow or only a little stream. So the causeways can be applied.

R-2 : The flood volume is a little more than R-1, therefore in rainy season it often probably occurs to be unable to cross the river for to a few days only by setting bed level causeway.

R-3 : Because the crossing valley is relatively small and shallow by arranging the alignment it is possible to minimize the scale of the bridge.

R-4 : The superstructure is not erected by the all staging method as PC and then it is possible to work even in rainy season and to reduce the total construction period.

R-5 : It is necessary to transfer the proposed bridge alignment in order to avoid existing obstacles - ex. power transmission towers.

R-6 : It is possible to make the construction work easier by changing the skew angle of the bridge to right angle.

R-7 : It is possible to shorter the bridge length by making the formation heights down.

R-8 : It is possible to shorter the construction period by changing the bridge type.

R-9 : It is possible to reduce the construction cost by changing the bridge type.

4. Advantage/Disadvantage

A1/D1 : economical /costly
A2/D2 : speedy construction is possible/impossible
A3/D3 : workable without big and/or special machine/unworkable
A4/D4 : workable without skilled labour/unworkable
A5/D5 : usable local materials/unusable
A6/D6 : maintenance work is easy/not always
A7/D7 : road condition is stable/not always

5. **Remarks**

Ca	:	change alignment
Cf	:	change formation height
Ct	:	change the location of the bridge
Cb	:	change bridge scale and type
Cs	:	change bridge to another structures

Section I

Category	Station	Original Design in F/S	Proposed Alternative	Reasons of Alternation	Advantage/ Disadvantage	Remarks
Bridge	77 + 90	90m-3S-PCT	75m-35-PCT	R-7	A1	(BHOGATE) Cf, Cb
	82 + 05	50m-2S-PCT	no alteration	-	A1	(KAREKARE) Cf
	82 + 90	20m-1S-PCT	no alteration	-	A1	Cf
	125 + 25	175m-7S-PCT	no alteration	R-5	-	(RATU) Cf
	172 + 40	25m-1S-PCT	C/Wb (l=80m)	R-1	A1-A5 D6	Cs
	201 + 00	20m-1S-PCT	C/Wv (l=40m)	R-1	A1-A5 D6	Cs
	211 + 90	15m-1S-RCT	C/Wv (l=30m)	R-1	A1-A5 D6	Cs
	217 + 64	30m-1S-PCT	C/Wb (l=60m)	R-1	1-A5 D6	Cs
	237 + 00	25m-1S-PCT	C/Wv (l=140m)	R-1	A1-A5 D6	Cs
	242 + 25	15m-1S-RCT	C/Wv (l=20m)	R-1	A1-A5 D6	Cs
	282 + 10	60m-2S-PCT	C/Wv (l=70m)	R-1	A1-A5 D6	(SINDHUSE) Cs
	289 + 60	165m-3C-PCB	120m-4S-PCT	R-5, R-7	A1, A6, D4	(KAMALA) Ca, Cb
	323 + 65	60m-2S-PCT	no alteration	R-6	A1, A2, A6 D4	(PHITTANG) Cf
	344 + 40	60m-2S-PCT	50m-2S-PCT	R-7	A1, A6 D4	(BUKA) Ca
	352 + 60	60m-2S-PCT	no alteration	-	-	(GADEULI)

Section II-1

Category	Station	Original Design in F/S	Proposed Alternative	Reasons of Alternation	Advantage/ Disadvantage	Remarks
Bridge	22 + 45	15m-1S-RCT	S/C (1=5m)	R-3	A1, A3-A6 D7	Cs
	26 + 95	15m-1S-RCT	S/C (1=5m)	R-3	A1, A3-A6 D7	Cs
	44 + 10	15m-S-RCT	S/C (1=5m)	R-3	A1, A3 - A6 D7	Completed Cs
	59+00	20m-S-RCT	S/C (1=10m)	R-3	A1, A3 - A6 D7	Cs
	66 + 20	15m-1S-RCT	S/C (1=5m)	R-3		Cs
	75 + 55	15m-1S-RCT	S/C (1=5m)	R-3		Cs
	79 + 55	70m-2S-StG	40m-2S-StH	R-7	A1-A2	(GWANGU) Cb
	81 + 90	60m-2S-StG	40m-2S-StH	R-7	A1-A2	(SIURANI) Cs
	90 + 00	35m-1S-StG	no alteratiion	-	-	-
	118 + 50	30m-1S-StG	S/C (l=10m)	R-3	A1,A3-A6 D6	Ca, Cs
	151 + 60	30m-1S-StG	P/C	R-3	"	Ca, Cs
	257 + 70	35m-1S-StG	S/C (1=10m)	R-3	"	Ca, Cs
	260 + 15	20m-1S-StH	P/C	R-3	"	Ca, Cs
	267 + 00	25m-1S-StG	P/C	R-3	"	Cs
	290 + 50	40m-1S-StG	P/C	R-3	"	Cs
	296 + 35	30m-1S-StG	P/C	R-3	"	Cs
	346 + 25	35m-1S-StG	P/C	R-3	A1, A3-A6	Ca, Cs
	376 + 90	15m-1S-StG	S/C (1=10mx2)	R-3	"	Cs
	387 + 00	20m-1S-StH	S/C (l=10m)	R-3	"	Ca, Cs
	390 + 60	35M-1S-StG	S/C(1=10m)	R-3	"	Ca, Cs
	491 + 70	120m-4S-StG	C/Wb(1=120m) S/B(1=40m)	R-1, R-2	A1 - A5 D6	(ARDLERI) Ca, Cf, Cs
	405 + 70	25m-1S-StG	S/Wb(1=20)	R-1	"	Ca, Cf, Cs
	408 + 00	40m-1S-StG	CWb(1=40m)	R-1	"	Ca, Cf, Cs

Section II-2

Category	Station	Original Design in F/S	Proposed Alternative	Reasons of Alternation	Advantage/ Disadvantage	Remarks
	3 + 75	40m-1S-StG	C/Wb (l=140m)	R-1	A1- A5 D6	Ca, Cf, Cs
	14 + 25	30m-1S-StG	S/C (l=10m)	R-3	SA1, A3-A6 D7	Ca, Cf, Cs
	18 + 05	20m-1S-StH	C/Wb (l=70m)	R-1	A1-A5 D6	Ca,Cf, Cs
	22 + 80	20m-1S-StH	C/Wb (l=20m)	R-1	A1- A5 D6	Cf, Cs
	43 + 80	140m-4S-StG	C/Wb (l=160m) S/B (l=30m)	R-1, R-2	A1-A5 D6	(NIGAULI) Ca, Cf, Cs
	93 + 80	105m-3S-StG	C/Wb (l=80m)	R-1	A1-A5 D6	(ARUBOTE) Ca, Cf, Cs
	106 + 95	50m-2S-StG	C/Wb(l=90m)	R-1	A1-A5 D5	(KHAHARE) Ca, Cf, Cs
	128 + 45	20m-1S-StH	S/C (l=50m)	R-3	A1,A3-A6 D7	Ca, Cs
	153 + 25	70m-2S-StG	C/Wb(l=50m) S/B (l=40m)	R-1, R-2	A1-A5 D6	(BHOTE) Ca, Cf, Cs
	183 + 85	60m-2S-StG	S/B (l=30) C/Wb (l=50m)	R-1, R-2	A1,A3-A6 D6	(GANGATE) Ca, Cf, Cs
	185 + 35	40m-1S-StG	C/Wb (l=60m)	R-1	A1, A3-A6 D7	(GANGATE) Ca, Cf, Cs
	188 + 30	20m-1S-StH	P/C	R-3	A1, A3-A6 D7	Ca, Cf, Cs
	191 + 45	15m-1S-StH	S/C (l=10m)	R-3	A1, A3-A6 D7	Ca, Cf, Cs
	192 + 60	20m-1S-StG	S/C (l=10m)	R-3	A1, A3-A6 D7	Cs
	202 + 05	70m-2S-StG	C/Wb(l=20m) C/Wb(l=30m)	R-1	A1- 5 D6	(DHAMILE) Ca, Cf, Cs
	230 + 50	80m-2S-StG	C/Wb (l=100m)	R-1	A1-A5 D6	(SANDI) Ca, Cf, Cs
	239 + 30	85m-1S-RCA	(EARTH - WORK)	(R-3)	A1-A6	(St 240 BR) Ca, Cs
	267 + 20	15m-1S-StH	S/C (l=10m)	R-3	A1, A3-A6 D6	Ca, Cf, Cs
	269 + 55	20m-1S-StH	S/C (l=10m)	R-3	"	Ca, Cf, Cs
	270 + 05	20m-1S-StH	S/C(1-10m)	R-3	"	Ca, Cf, Cs
	273 + 05	15m-45-StH	S/C(l=10m)	R-3	"	Ca, Cf, Cs
	274 + 30	25m-1S-StG	S/C(l=10)	R-3	"	Ca, Cf, Cs
	277 + 95	30m-1S-StG	S/C (l=10m x 2)	R-3	"	Ca, Cf, Cs
	249 + 35	30m-1S-Trs	30m-2S-StH			

Section II-3

Category	Station	Original Design in F/S	Proposed Alternative	Reasons of Alternation	Advantage/ Disadvantage	Remarks
Bridge	12 + 20	275m-7S-PCT	C/Wb(l=260m) S/B(l=70	R-1, R-2	A1-A5 D6	(GHAMPE) Ca, Cf, Cs
	31 +10	25m-1S-StG	20m-1S-StH	R-7	A1, A6 D4	Ca, Cb
	44 + 80	120m-4S-PCT	S/Wb (l=30m) S/Wv(l=30m) S/B (l=30m)	R-1, R-2	A1-A5 D6	(MAMTI) Ca, Cf, Cs
	100 + 80	120m-4S-PCT	C/Wb (L=140m)	R-1	"	(BHYAKUREE) Ca, Cf, Cs
	105 + 10	40m-1S-StG	C/Wb(l=50m)	R-1	"	Ca, Cf,Cs
	115 + 80	45m-1S-StG	C/Wb (l=30m) C/Wv (l=40m)	R-1	"	Ca, Cf, Cs
	116 + 75	45m-1S-StG	C/Wb (l=70m) C/Wv (l=40m)	R-1	"	Ca, Cf, Cs
	127 + 75	15m-1S-StH	S/C (l=10m)	R-3	A1, A3-A6 D7	Ca, Cs
	135 + 85	50m-1S-RCA	50m-1S-Trs	R-4	A2 D1, D3, D5	(DAUNE) Cb
	155 + 05	20m-1S-StH	S/C (l=5m)	R-3	A1,A3-A6 D7	Ca, Cs
	159 + 50	70m-1S-RCA	60m-1S-Trs	R-4	A2 D1, D3, D5	(NARKE) Cb
	162 + 15	15m-1S-StH	S/C (l=10m)	R-3	A1, A3-A6 D7	Ca, Cs
	192 + 20	25m-1S-StG	C/Wb(l=30m)	R-1	A1-A5 D6	Ca, Cs
	206 + 95	10m-1S-RCS	C/S(l=10m)	R-3	A1,A3-A6 D7	Cs
	213 + 15	75m-1S-Trs	65m-1S-Trs	R-7	A1,A6 D4	(ROSI) Cb
	249 + 35	30m-1S-StG	30m-2S-Trs	R-8	A2, A4 D3, D5	Cb
	274 + 85	20m-1S-StH	S/C (l=5m)	R-3	A1, A3-A6 D7	Ca, Cs
	285 + 55	20m-1S-StH	25m-1S-PCT	R-9	A1, A5,A6 D2	Cb
	319 + 50	20m-1S-StH	S/C (l=10m)	R-3	A1, A3-A6	Cs
	430 + 55	45m-1S-StG	S/C (l=10m)	R-3	"	Ca, Cs
	437 + 65	35m-1S-StG	S/C (l=10m)	R-3	"	Ca, Cs
	444 + 00	20m-1S-StH	S/C (l=10m)	R-3	"	Ca, Cs
	447 + 80	45m-1S-StG	S/C (l=10m)	R-3	"	Ca, Cs
	460 + 25	20m-1S-StG	S/C (l=10m)	R-3	"	Ca, Cs
	470 + 25	35m-1S-StG	S/C (l=10m)	R-3	"	Ca, Cs

Appendix - D2 Alteration of Road Alignment

1. Section where both horizontal and Vertical re-alignment are required.

SECTION - I

No.	Station	length (m)	Remarks
1	17.1 - 17.4	300	Bridge to causeway
2	20.0 - 20.2	200	- do -
3	21.1 - 21.3	200	- do-
4	21.6 - 23.6	2,000	Changed to be along existing road
5	23.8 - 24.2	400	- do -
6	24.2 - 24.3	100	Bridge to causeway
7	26.5 - 26.7	200	- do -
8	29.2 - 27.3	100	- do -
9	28.0 - 28.5	500	
Section I Total		4,000	

SECTION II - 1

No.	Station	Length (m)	Remarks
1	39.0 - 41.8	2.800	Bridge to causeway
Section II-1 Total		2,800	

SECTION II - 2

No.	Station	Length (m)	Remarks
1	0 - 1.0	1,000	Bridge to causeway
2	1.7 - 1.9	200	- do -
3	2.2 - 2.4	200	- do -
4	4.2 - 4.9	700	- do -
5	8.8 - 9.7	900	- do -
6	10.2 - 11.2	1,000	- do -
7	15.1 - 16.1	1,000	- do -
8	18.2 - 18.8	600	- do -
9	19.4 - 21.1	1,700	- do -
10	22.7 - 23.5	800	- do -
Section II-2 Total		8,100	

SECTION II-3

No.	Station	Length (m)	Remarks
1	6 - 2.0	1,400	Bridge to causeway
2	3.1 - 5.2	1,500	- do -
3	9.8 - 10.8	1,000	- do -
4	11.4 - 11.9	500	- do -
5	19.17 - 19.27	100	- do -
Section II-3 Total		4,500	

2. **Section where both horizontal re-alignment in required**

SECTION I

No.	Station	Length (m)	Remarks
1	12.2 - 13.2	1,000	
2	28.9 - 29.2	300	
Section I Total		1,300	

SECTION II-1

No.	Station	Length (m)	Remarks
1	11.84 - 11.94	100	
2	15.14 - 15.24	100	
3	25.75 - 25.85	100	
Section II-1 Total		300	

SECTION II-2

No.	Station	Length (m)	Remarks
1	1.3 - 1.6	300	
2	12.8 - 12.9	100	
3	19.1 - 19.2	100	
4	26.93 - 27.03	100	
5	27.4 - 27.5	100	
6	27.74 - 27.84	100	
Section II-2 Total		800	

SECTION II-3

No.	Station	Length (m)	Remarks
1	15.46 - 15.56	100	
2	16.16 - 16.26	100	
3	31.9 - 32.0	100	
4	43.0 - 43.1	100	
5	43.73 - 43.83	100	
6	44.36 - 44.46	100	
7	44.75 - 44.85	100	
8	46.0 - 46.1	100	
9	47.0 - 47.1	100	
Section II-3 Total		900	

APPENDIX - E

INSTITUTIONAL DATA AND INFORMATION FOR LAMOSANGU - JIRI ROAD PROJECT AND DHARAN - DHANKUTTA ROAD PROJECT

Lamosangu-Jiri Road Project

I General

This is the 110 km hill road which starts at the km 78, Lamosangu, Kodari road and joins Jiri. This project was formulated to develop the inner hilly region of the central part of Nepal.

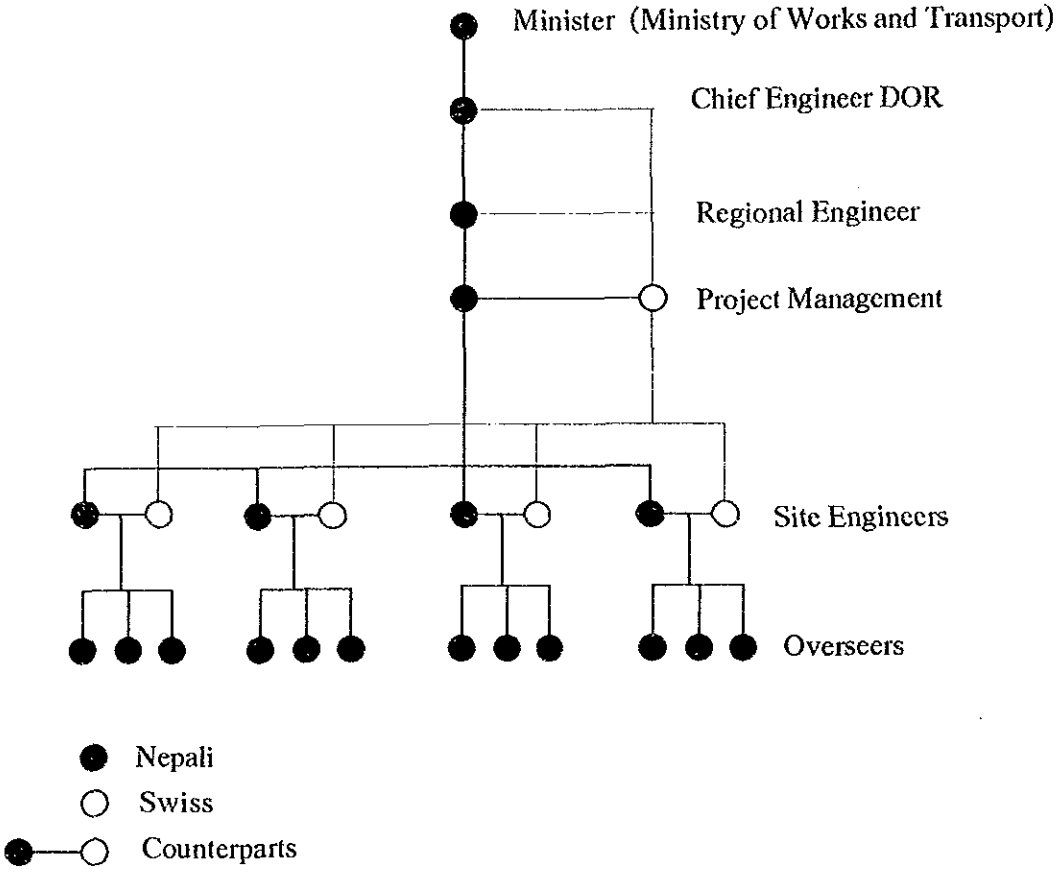
The feasibility study was conducted on 1971 and found positive results. The detail survey design and construction program were started on 1975 with completion target at 1981. Actually the project was completed on 1985 due to some additional work and delays.

Basically the project was under taken by HMG and Swiss Government (SG) on force account basis applying all the rules and regulation of HMG. For active participation of HMG on the survey, detail design, construction and maintenance phase the two government decided on the already known concept of partnership i.e., counterpart system. This concept is based on the existing rules and regulation of HMG and joint decision making process at all levels especially in project management and site engineers.

Contracting parties : HMG, Ministry of Finance and Department of Foreign Affairs, SG.

Executing Agency : DOR, Ministry of Work & Transport & SATA for Directorate of Development Co-operation for SG.

Counterpart System (joint decision making)



II Main Objectives

Apart from the technical considerations for the betterment of road and road users the other main objectives were.

1. Application of labour intensive construction method was foreseen to create the employment opportunity to local peoples. Only hand tools were used in earthworks except in blasting purposes.

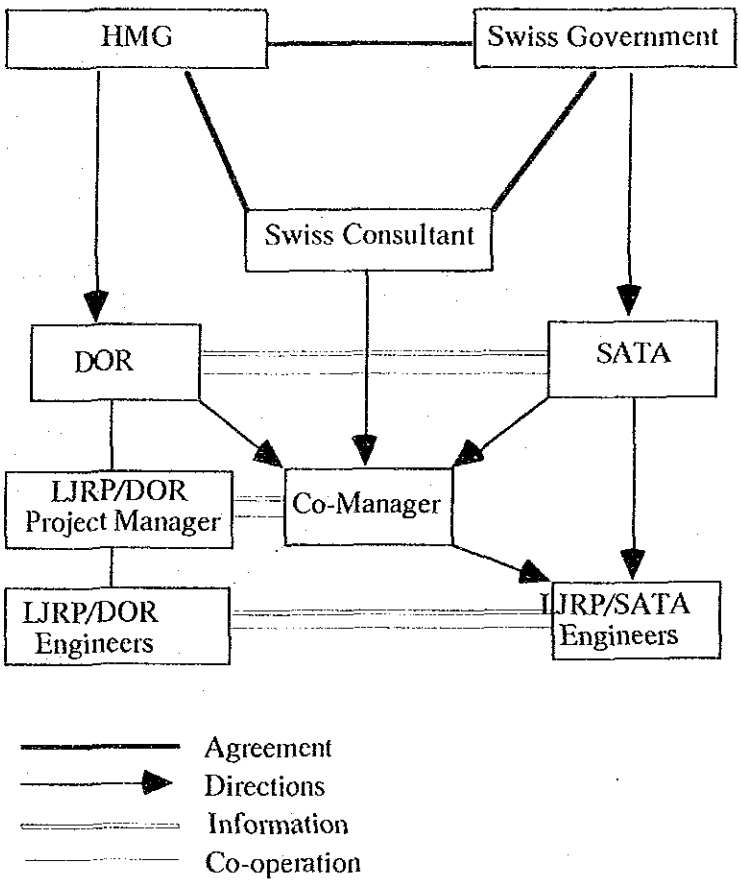
2. Land compensation were provided to the owners as the farmers should not loose their livelihood.

3. Application of bitumen emulsion as binder for black topping to save the natural surrounding and avoid the use of large amount of firewood.

III Project Organization

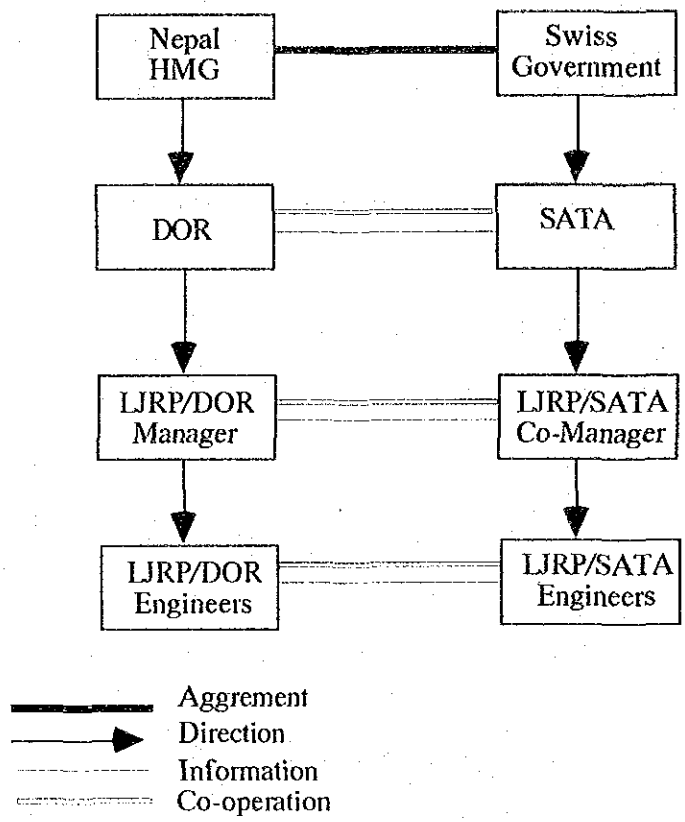
During the 1st phase of project i.e.; survey, design and construction works both the governments decided to appoint Swiss Consulting firm for the project realization. But by time this triangular relationship was found to be not the best solution. The project organization chart during 1st phase was as ;

Organizational Set up during Phase I



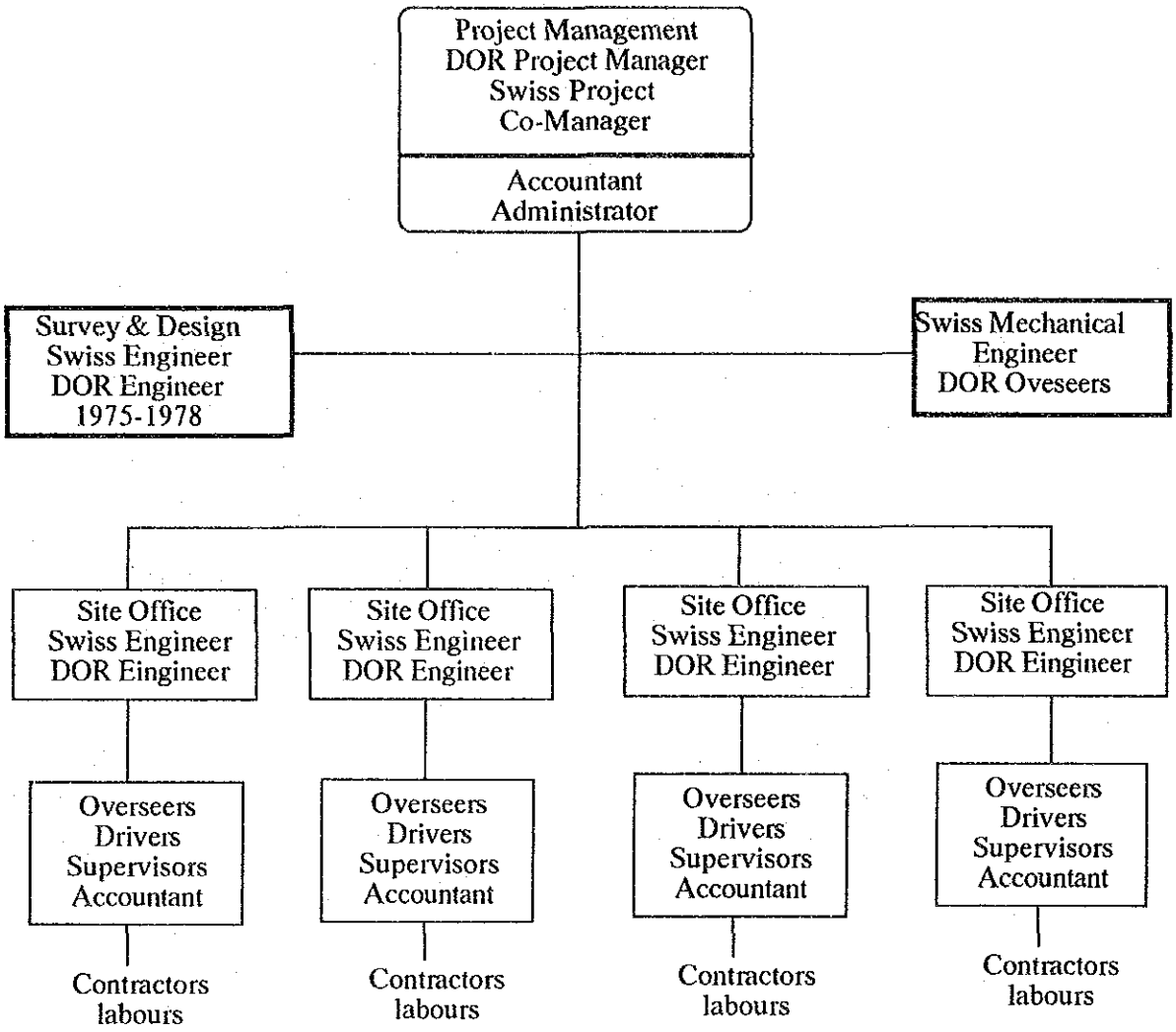
To over come the deficiency of the project organization of phase 1 the organization set up was slightly changed by eliminating the consultant. Thus the modified organizational set up was as: This organizational set up lasted till the end of construction phase.

Organizational Set up during Phase 2



Apart from the project organizational set up the project implementation has been carried out with the following basic diagrams.

Project Implementation Diagram For Construction



Note: Site office were established as per the requirement for execution and supervision purpose.

IV Engineering Standards

1. Design speed 30 km/hour
2. Formation width 5.70 to 6.10 m
3. Pavement width 2.90 m in straight portion and widening in bends
4. Bridge width 3.5 m
5. Gradient

Longitudinal Gradient Maximum	12%
Longitudinal Gradient Average	7%
Longitudinal Gradient Minimum	1%
Cross fall Gradient	4% always towards mountain side

6.	Minimum Radius in normal curves	10 m
7.	Minimum Radius in hairpin bends	8.5 m
8.	Slope inclination	
	Normal (m s)	1:1
	Maximum (m s)	4:1
	Embankments (v s)	2:3
	Maximum (v s)	4:5
9.	Load capacity of bridges	HS 20-44

V Materials/Equipments

A. Materials Used

		Quantity
1.	Explosives for rock excavation	100 MT
2.	Galvanized, mild steel wire for Gabions	2200 MT
3.	Cement for Cement masonry and concrete works	4000 MT
4.	Concrete pipe for pipe Culvert	
5.	Bitumen emulsion (60%) for blacktop	3700 MT
6.	Gravel (Stone soling, Layer work, Black top)	190,000 MT

B. Construction Equipment

1. Rock drill and compressors
2. Stone crusher
3. Concrete equipment like mixer, vibrators
4. Light and heavy rollers for compaction
5. Trucks and tractors for transport purpose.

VI Project Cost

The total project cost of the LJRP is NC Rs. 250 Million (1984)

(Amount does not include the expenses for the foreign expitrates)

A. Project cost borne by

Country	Percentage	In million NRs
Switzerland	88%	220
Nepal	9.5%	24
WFP	2.5%	6

B. Project Cost as per Construction Activities

Description of work	Percentage	Total cost in million NRs
Earth Work	30%	75.9
Water Management and Erosion Control	17%	42.90
Layer Work	12%	29.70
Black Top	26%	64.10
Bridges/Buildings/Equipment's/ Maintenance/Administration	15%	37.40
Total	100%	250

C. Project Cost as per Labour, Material and Supervision

Description of Work	Percentage	Total Cost in million NRs
Construction Execution	60%	150.20
Construction Material	19%	46.70
Equipment's	3%	7.40
Spare parts	2%	5.60
Engineering	2%	4.60
Administration	14%	35.50
Total	100%	250

VIII. Special Aspects

A. Equipments and Material Procurement

HMG rules and regulation were applied which led to some delays in the construction programme due to no timely decisions. So it was agreed that SATA (SG) will procure through SATA for all materials and equipment from abroad.

B. Construction Contract Awards

HMG rules and regulation were applied which led to delays up to 1 full years (in exceptional cases) and loss of money due to inflation.

C. Land Compensation

The Land compensation is paid by HMG up to first 4 km only. Later SG agreed to pay all the remaining land from 4 km to 110 km.

D. WFP Support

The road support facilities provided by the WFP for the labours was interest among the labours. HMG was responsible to transport and distribution of WFP Foods.

IX. LJRP Maintenance

After the completion of the road construction (May 1985) the project started road maintenance phase. This phase was again implemented under the Nepal Swiss Co-operation for Eight years (1985-92)

The main purpose were:

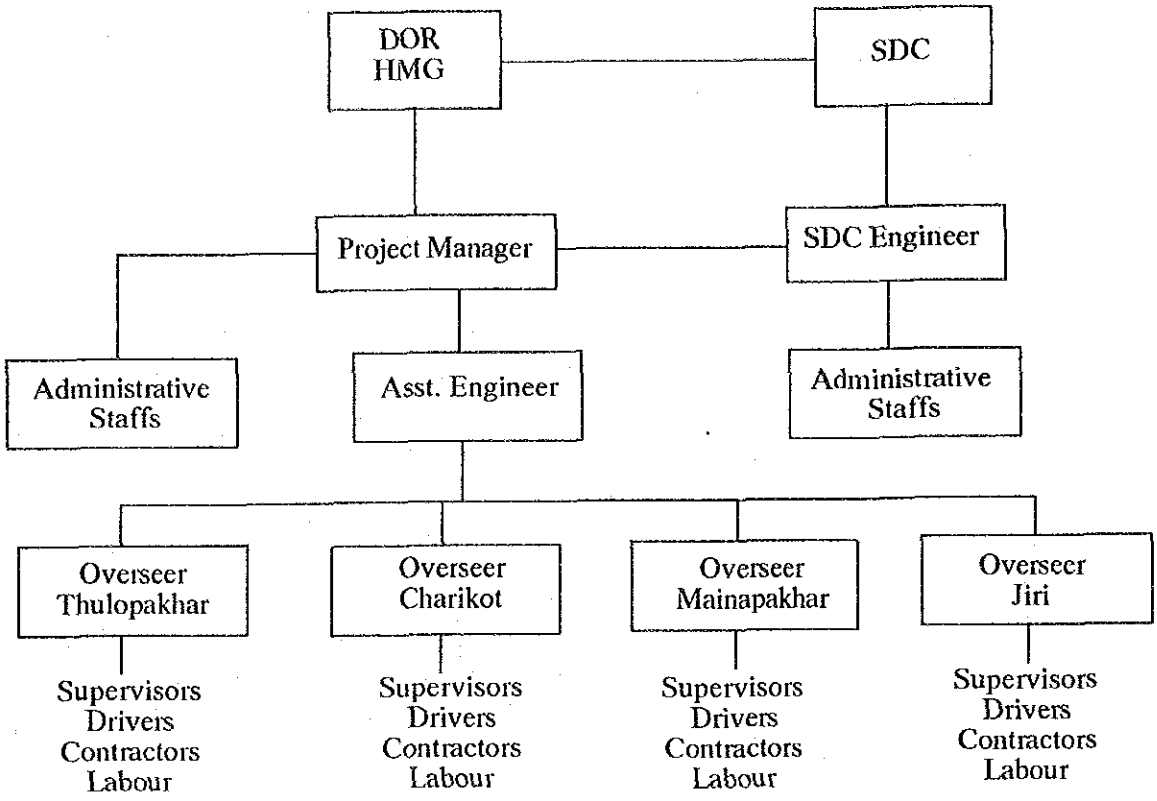
1. To build up the efficient maintenance system to secure the construction investment.
2. To reduce the maintenance cost by giving emphasis to preventive maintenance methods.
3. Execution of work based on labour intensive technique to generate the income for local people.
4. Maintenance using bitumen emulsion as binder to support the balance of environment.
5. Establishing a monitoring system to determine the technical, financial and socio-economic impact of the road.

A. Organizational Setup

The Maintenance work was implemented with the project office at Kathmandu after which the maintenance was decentralized to Charikot.

Charikot (54 km from Lamosangu) is considered to be the headquarter of Maintenance Division besides 4 other Maintenance Sub division mainly Thulopakhar (18 km), Charikot (54 km), Maina Pokhari (87 km) and Jiri (107 km). The maintenance Organizational set up is as:

The maintenance Organizational set up is



B. LJRP Maintenance Trend in Last Five Years (in million NRs)

Year	Total	HMG	SDC	
1992/93	22.166	14.191	7.975	Materials like Diesel, Petrol, Cement, GI wire, Emulsion etc.
1991/92	25.684	16.034	7.4	Cash
			2.25	
			Material	
			Total 9.65	
1990/91	43.483	11.083	32.40	Materials, CHRP
1989/90	49.237	6.247	42.99	Materials, CHRP
1988/89	26.982	7.0	19.982	Materials, CHRP

CHRP is the maintenance project in 45 km mainly.

Bridge Construction

River training work

Landslide Stabilization and Road Reconstruction.

Dharan Dhankutta Road

I. General

This road is part of the North-South highway which joins the Dharan and Dhankutta. The road starts right at the foot hills and passes through various critical steep slopes. The total Road length is 50 km.

The feasibility study of this road was carried out in 1974-75 and the construction was started from 1976. This project was completed in 1982 July.

This road construction was executed by HMG and UK.

II. Engineering Standards

Formation width	6.5 m
Carriageway width	6.5 m
Surface Double Coat Surface dressing (DBST)	
Radius of curvature minimum	10 m
Longitudinal gradient Average	9%
Longitudinal gradient Maximum	10%

III. Present Maintenance Management in DD Road.

The maintenance of the Dharan-Dhankutta Road has been mainly divided in the following categories

1.	Routine/Recurrent Maintenance	:	Masonry/Gabions repair, Slip/Culvert clearing, Pavement repair, Bridge maintenance etc.
2.	Periodic Maintenance	:	Road marking, Confidence Block painting, Steel Bridge Repainting, Road Regravelling, Bleeding rectification etc.
3.	Preventive Maintenance	:	Sub soil drain construction, Rock armoring etc.
4.	Emergency Maintenance	:	Usually 1st July to 15 Oct. for incidents like slips and road blockage, fallen trees etc.
5.	Monsoon damage repair works	:	Gabion walls, Masonry walls, Gully Protection, Miscellaneous Drainage etc.

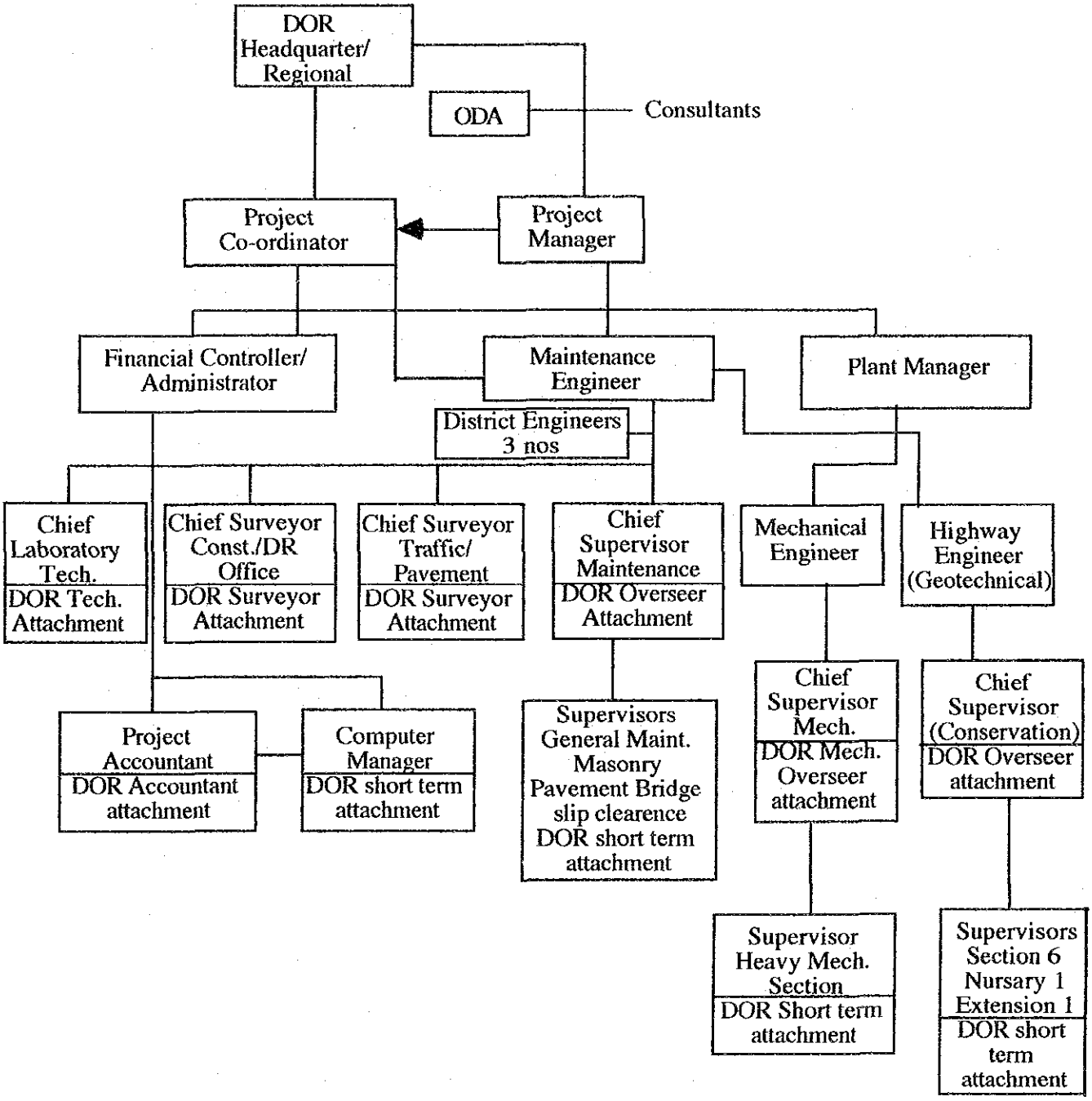
6. Traffic and Pavement Monitoring : Traffic count, Pavement deflection, Axel load Survey, Surface roughness etc.

7. Bridge Inception Program

A. Central Maintenance Unit Structure :

The present central maintenance unit structure for the maintenance of Dharan Dhankutta Road is presented as :

Central Maintenance Unit Structure



B. The Maintenance and Rehabilitation Budget Over Last 5 years is presented as. (in million NRs)

Year	Total	HMG	UK
1992/93	50	-	50
1991/92	40	-	40
1990/91	26.6	0.2	26.4
1989/90	40.243	0.243	40
1988/89	33.518	0.276	33.242

APPENDIX - F

SUPPORTING DATA OF PRELIMINARY DESIGN

APPENDIX - F-1

PAVEMENT CALCULATION

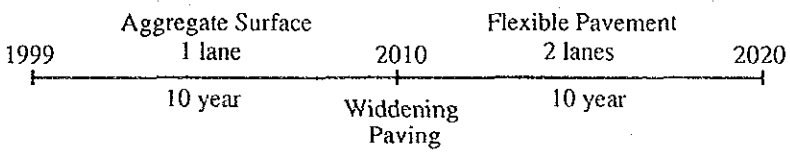
Pavement Structural Design for Implementation Alternatives

1. General

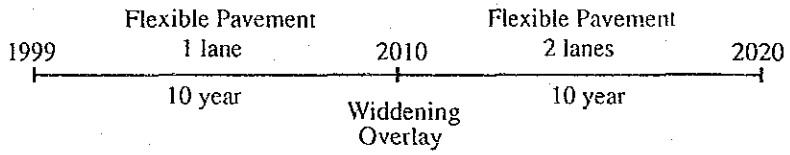
Pavement structural design were carried out in accordance with the methodology as described in "AASHTO GUIDE FOR DESIGN OF PAVEMENT STRUCTURES 1986" basically.

2. Implementation Alternatives and Analysis Period

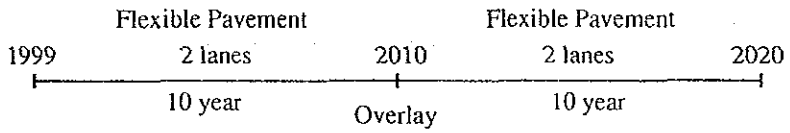
Case-1 Alternative-1,2



Case-2 Alternative 3,4



Case-3 Alternative-5



Case-4 Second stage construction for alternative-1,2,3 and 4

10 years

3. Specific Conditions

(1) The estimated future traffic, W18,for the performance period

Case-1	Section-I	1,550,000
	Section-II	1,468,000
Case-2	Section-I	1,550,000
	Section-II	1,468,000
Case-3	Section-I	1,299,000
	Section-II	1,229,000
Case-4	Section-I	2,964,000
	Section-II	2,975,000

(2) The reliability,R

R = 80 %

(3) The overall standard deviation,So

So = 0.45

(4) The effective resilient modules of roadbed material,MR

MR = 10,600 Section-I (CBR15)

MR = 7,300 Section-II (CBR8)

(5) The design serviceability loss

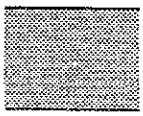
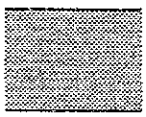
d.PSI = 4.5(Po) - 2.0(Pt) = 2.5

4. Required Structural Number (SN)

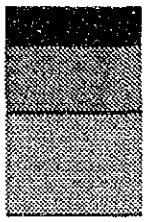
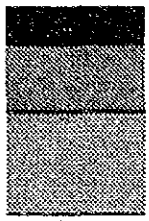
Case-1	Section-I	-
	Section-II	-
Case-2	Section-I	3.0
	Section-II	3.3
Case-3	Section-I	2.9
	Section-II	3.2
Case-4	Section-I	3.2
	Section-II	3.6

5. Pavement Structure

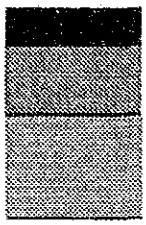
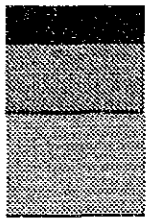
CASE -1

	Section - I Thickness (cm)		Section - II Thickness (cm)	
	30		30	Sub-base course (CBR30)
Total =	30		30	

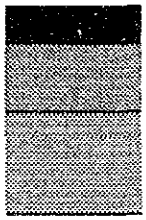
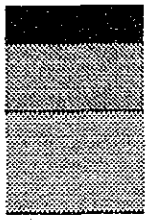
CASE -2

	Section - I Thickness (cm)		Section - II Thickness (cm)	
	5		5	Surface course (Road mix)
	21		18	Base-course (CBR80)
	35		45	Sub-base course (CBR30)
Total =	61		68	

CASE -3

	Section - I Thickness (cm)		Section - II Thickness (cm)	
	5		5	Surface course (Road mix)
	19		17	Base-course (CBR80)
	35		45	Sub-base course (CBR30)
Total =	59		67	

CASE -4

	Section - I Thickness (cm)		Section - II Thickness (cm)	
	5		5	Surface course (Road mix)
	25		24	Base-course (CBR80)
	35		45	Sub-base course (CBR30)
Total =	65		74	