

INTRODUCTION

1.1 Background

Ministry of Road Transport and Highways (Govt. of India) has embarked upon massive up gradation of its road network through National Highway Infrastructure Development Corporation Ltd (NHIDCL) with the purpose of development of highways and any structures thereon and other infrastructure projects entrusted to it. As part of this endeavor, the NHIDCL has been mandated to undertake improvement and up-gradation of various National, State Highways and Major District Roads at different locations in Arunachal Pradesh.

In view of the above work NHIDCL has entrusted **K& J Projects Pvt. Ltd. and Alliance Engineers & Consultants (JV)** to carry out Consultancy Services for preparation of Project Report for 2- laning of Joram-Koloriang Road from km.70/000 to 138/000 (Length :68 km) in the state of Arunachal Pradesh under SARDP-NE on EPC Mode.

The LOA for consultancy services is issued by the authorities vide letter No. NHIDCL/Ar.Pr/Joram-Koloriang/2015/01 dt. 12.08.2015.

The Agreement between authority and consultant was signed on dt. 12.08.2015 and effective commencement date of services is considered as 17.08.2015. The project preparation studies are proposed to carry out accordingly.

The project preparation and investigation studies are proposed to carry out accordingly.

1.2 Project Appreciation

The project road is located in the State of Arunachal Pradesh. Arunachal Pradesh is located in North-East Part of India and is surrounded by Assam, Nagaland and Bhutan, Myanmar and China other countries. Most of the traffic on the project road is moving from North Lakhimpur of Assam, Itanagar capital of Arunachal and district headquarters of Ziro, Daporijo etc. The project road gives connectivity to the thickly populated area of Palin, Sangram Kolloriang etc. to the Trans Arunachal Highway. The Project Stretch starts at km.70/000 (New Palin River) and ends at km.138/000. The total length of Project Road under study is 68.00km. There is no existing bypass to any town in entire length of Project Road. Project corridor under study is a part of National Highway No. 713 from Joram to Koloriang, China border



is about 20 km from Koloriang. The entire Project Road passes through Hilly terrain. At very many locations exposed Hard Rock strata is found and in the other portions the road passes through Ordinary rock or Soil Strata.

The existing features of the project road is listed below in

Sr. No.	Item	Description
1	Terminal Points	Start Point : km 70.000 (New Palin) End Point : km 138.000(at Dangba village)
2	Connectivity	Through start point :Ziro, Potin Through end point :Koloriang, Sarli.
3	Important Settlements	New Palin, Old Palin,LungbaVillage,PaguVillage,Meer Village,Poungung Village, Zero Point Village,SangramVillage,Gante Village ,YarteVillage,Tagum village ,Lil Village and Dangba Village.
4	Terrain	The entire Project Road passes through Hilly terrain in general with some stretch passing through rolling terrain.
5	Land use pattern	In general, Barren Hill/ Agriculture or a mixture of agricultural, open land use pattern is observed. Built-up areas with Residential/Commercial activities are seen near the villages.
6	Horizontal Geometry	Poor in general with many sharp curve locations where geometric improvement is required.
7	Vertical Geometry	Good in general at few locations but steep gradient is observed along with roller coaster profile in the project stretches.
8	Pavement Condition	The pavement in the whole road is in deteriorated condition and requires reconstruction.
9	Existing Carriageway	Surface Type: Bituminous; Width: 3.00m to 4.10m.
10	Existing Shoulder	Type: Earthen; Width: 0.5m-1.5m (Both side)
11	Existing ROW	ROW observed on the Project road varies from 6.0m to 7.0m in the village portions and from 7.00m to 8.0m on open stretches.
12	Bridges	5 nos.



Sr. No.	Item	Description
13	Culverts	271 nos.
14	ROB	Nil
15	Existing Bypass	Nil
16	Submergence Stretch	Nil
17	Major Intersections	Nil
18	Minor intersections	18 nos.
19	Existing Utilities	HT line, Electric poles, Transformer, OFC and Water Pipe Lines etc.



DESIGN – ROADWORKS

2 Traffic Survey

2.1 General

Traffic surveys have been carried out on the project road in order to identify present and likely future traffic scenarios so as to propose suitable measures and to evolve appropriate design methods. The primary objectives of these traffic surveys are to establish and assess the characteristics of traffic movement on the project road, pavement design, junction improvement etc.

2.2 Traffic Study

2.2.1 Objectives of Traffic Study

The objective of traffic study is to provide basic input for the following part of the Study:

- Finding out the present level of traffic flow and its various characteristics (through Classified Traffic Volume Count)
- Capacity assessment based on demand forecasting for next 20 years
- Pavement design.
- Environmental Impact Assessment and deciding mitigation measures

2.2.2 Methodology

7 days Classified Traffic Volume Counts (CVC's) were conducted at three locations to understand traffic intensity of the project road. Origin and Destination (OD) Surveys and Commodity movement characteristics were not required to be conducted as there is no bypassable traffic and the traffic intensity is very low. As there is no major intersection in the road Intersection volume count surveys were not required to be conducted. Pedestrian/ animal cross count surveys were conducted at major habitations namely Old Palin, Meer , Zero Point Village , Sangram Village. The details of survey locations are as follows:

- 7-days classified traffic volume count surveys at three locations on the project road at KM 70 (Near Palin), KM 95 (Near Meer) and KM 118 (Near Sangram Village).
- Pedestrian/Animal Crossing Survey at four locations namely Old Palin (KM 75) , Meer (KM 95) , Zero Point Village(108KM), Sangram Village(KM 118) on the project road.



Traffic survey stations were selected by the Consultant on the basis of understanding of the road network as well as consideration of the following aspects:

- to be outside urban and local influence area
- to be located at a level with good visibility

Brief description and analysis of each of the above surveys are presented in the following sections. Based on the detailed reconnaissance of the project road, major traffic generators and travel pattern, Classified Volume Count (CVC) locations were identified. The schedule of all traffic surveys are presented in

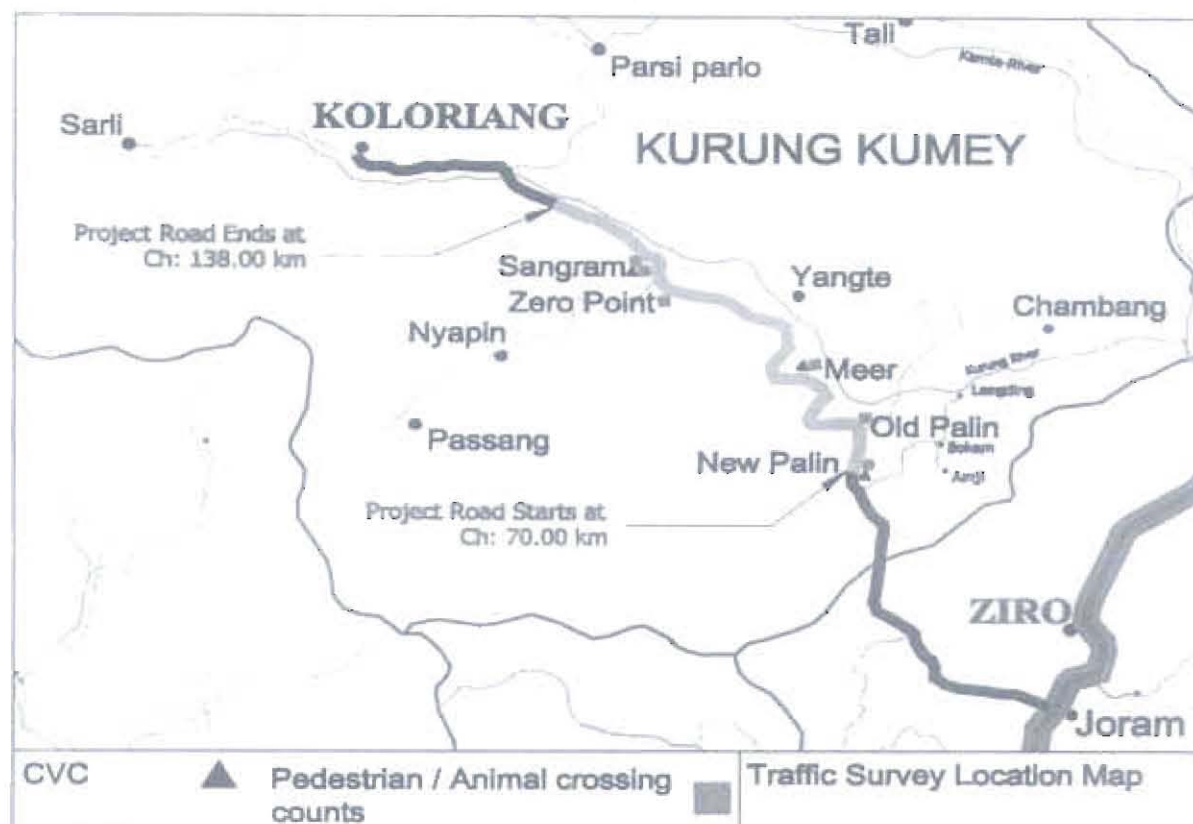
Schedule of Traffic Surveys

Type of Survey	Survey Location	Chain age	Duration	Survey Dates
7 Days CVC	Near Palin	70 km	7 days , 24 Hours	18/08/2015 - 24/08/2015
7 Days CVC	Near Meer	95 km	7 days , 24Hours	18/08/2015 - 24/08/2015
7 Days CVC	Near Sangram	118 km	7 days , 24 Hours	16/06/2015 - 24/08/2015
Pedestrian/ Animal Crossing Counts	Old Palin	75 KM	8 A.M. to 8 P.M	17/08/2015
	Meer	95 KM	8 A.M. to 8 P.M	17/08/2015
	Zero Point	108 KM	8 A.M. to 8 P.M	17/08/2015
	Sangram	118 KM	8 A.M. to 8 P.M	17/08/2015

The survey locations are depicted in below



Traffic Survey Locations



Location of Survey Stations

2.2.3 Traffic Intensity

Classified Traffic Volume Counts

For carrying out the traffic survey, vehicle classifications, as given in below Table, were adopted. The vehicle classification used is based on IRC: SP: 19-2001.

Vehicle Classification System

FAST MOVING VEHICLES	SLOW MOVING VEHICLES		Others (Pl. Specify) Drawn
2 wheelers	Cycle		
Three Wheeler/ Auto Rickshaw	Cycle Rickshaw		
Car/ Jeep/ Van/ Taxi	Animal Drawn	Bullock Cart	



			Horse	
Bus	Mini Bus			
	Full Bus			
LCV				
Truck	2 – Axle			
	Multi Axle			
	Arctic/ Semi Arctic			
Agri. Tractor	With Traller			
	Without Trailer			

Specially trained enumerators were deployed for counting traffic under the supervision of experienced Traffic Engineers. For the purpose of counts, a day was divided into two shifts of 12 hours each and different groups of enumerators with a supervisor were assigned for each shift. The count data was recorded at 15-minute intervals for each vehicle group for each direction of travel separately. Trained enumerators were deployed for counting and recording by making tally marks in the five-dash system.

The various vehicle types having different sizes and characteristics were converted into equivalent passenger car unit. Passenger Car Unit (PCU) values are adopted from Indian Road Congress publication on "Capacity of Roads in Rural areas", IRC-64-1990 Table 1 and presented in below table.

Vehicle Classification and PCU Factors Used in the Study (As Per IRC 64:1990)

Vehicle Type	PCU Factor
<i>Fast Moving Vehicles</i>	
Motor cycle or scooter	0.50



Vehicle Type	PCU Factor
Passenger car, pick-up van or Auto-rickshaw	1.00
Agricultural Tractor, Light Commercial Vehicle	1.50
Truck or Bus (2-axle and 3-axle)	3.00
4-6 axle truck	4.50
Truck- Trailer, Agricultural Tractor-Trailer	4.50
<i>Slow Moving Vehicles</i>	
Cycle	0.50
Cycle-rickshaw	2.00
Hand Cart	3.00
Horse-drawn vehicle	4.00
Bullock Cart	8.00

The directional classified traffic volume counts, observed at the count stations, are analyzed to obtain:

- Average Daily Traffic (ADT)
- Daily variation of ADT
- Hourly variation and Peak Hour Factor (PHF)
- Directional distribution

Average Daily Traffic

The summary of ADT, in terms of each class, vehicles and PCUs at the three count stations on the project road are given in the following tables ADT (PCU) is 636 at Km 70 (Palin) , 521 at 95 KM (Meer) and 402 at 118 KM (Sangram) on the project road. The ADT is more in 70 KM (Palin) and gradually decreases towards Koloriang. CVC was conducted for 24 hour traffic from morning 8:00 am to evening 8:00 pm when the traffic is significant. Because of the remoteness of the location, negligible traffic of has been observed at night.



Annual Average Daily Traffic:

Traffic intensity along a project stretch varies during different period of time. Information on this aspect is necessary to estimate the AADT. For deriving seasonal variation and correction factors, petrol and diesel sales data have been collected from petrol pumps for different years which are along the project corridor. There is no petrol pump along the project corridor. Only one petrol pump is found near the beginning of the project road. Therefore SCF is worked out from the fuel sale data of that petrol pump only. The following tables show the calculation of AADT.

ADT observed at count locations (Without Seasonal Corrections)

Survey Location	70 Km		95 km		118 Km	
Vehicle Category	ADT Vehicles	ADT (PCU)	ADT Vehicles	ADT (PCU)	ADT Vehicles	ADT (PCU)
Two Wheeler	206	103	198	99	136	68
Car/jeep/van/Taxi	287	287	245	245	196	196
FULL BUS	1	3	1	3	1	3
LCV	68	102	36	54	24	36
2 axle Truck	47	141	40	120	33	99
Total	609	636	520	521	390	402



Daily Fuel Sales and Seasonal Correction Factor (SCF) for calculating AADT

Month	Daily Diesel Consumption (Liters)	Daily Petrol Consumption (Liters)	SCF (Diesel)	SCF (Petrol)
August	290	155	1.21	1.09
September	342	163	1.02	1.04
October	355	170	0.99	0.99
November	402	188	0.87	0.9
December	452	208	0.77	0.81
January	405	197	0.86	0.86
February	395	191	0.89	0.88
March	370	175	0.95	0.97
April	325	157	1.08	1.08
May	310	146	1.13	1.16
June	282	141	1.24	1.2
July	273	137	1.28	1.23
Average	350	169	1.02	1.02

AADT obtained after applying Seasonal Correction Factors

Survey Location	70 Km		95 km		118 Km	
Vehicle Category	AADT Vehicles	AADT (PCU)	AADT Vehicles	AADT (PCU)	AADT Vehicles	AADT (PCU)
Two Wheeler	210	105	202	101	139	69



Survey Location	70 Km		95 km		118 Km	
Vehicle Category	AADT Vehicles	AADT (PCU)	AADT Vehicles	AADT (PCU)	AADT Vehicles	AADT (PCU)
Car/jeep/van/Taxi	293	293	250	250	200	200
FULL BUS	1	3	1	3	1	3
LCV	69	104	37	55	24	37
2 axle Truck	48	144	41	122	34	101
Total	621	649	530	531	398	410

2.3 Traffic Projection

To establish the traffic characteristics along the project road, Consultants have carried out 7 days Classified Traffic Volume Counts, Pedestrian/ animal cross count survey etc.

The Average Annual Daily Traffic (AADT) in the base year 2015 on the three (3) locations is presented in below table

The AADT in the Year 2015

Homogeneous Traffic Section	AADT (Nos)	AADT (PCU)
At 70 th Km	621	649
At 95 th Km	530	531



Homogeneous Traffic Section	AADT (Nos)	AADT (PCU)
At 118 th Km	398	410

The traffic growth rates are considered as 5% as per Clause 4.2.2 of IRC:37-2012

The projected traffic considering the above growth rate are given in below table

Projected Traffic

Year	At Km 70 (New Palin)		At Km 95 (Meer)		At Km 118 (Sangram)	
	Nos.	PCU	Nos.	PCU	Nos.	PCU
2015	621	649	530	531	398	410
2016	652	681	557	558	418	431
2017	685	716	584	585	439	452
2018	719	751	614	615	461	475
2019	755	789	644	645	484	498
2020	793	828	676	678	508	523
2021	832	870	710	712	533	549
2022	874	913	746	747	560	577
2023	917	959	783	785	588	606
2024	963	1007	822	824	617	636
2025	1012	1057	863	865	648	668
2026	1062	1110	906	908	681	701
2027	1115	1166	952	954	715	736
2028	1171	1224	999	1001	750	773
2029	1230	1285	1049	1051	788	812
2030	1291	1349	1102	1104	827	852
2031	1356	1417	1157	1159	869	895
2032	1423	1488	1215	1217	912	940
2033	1495	1562	1276	1278	958	987
2034	1569	1640	1339	1342	1006	1036
2035	1648	1722	1406	1409	1056	1088

2.4 Pedestrian/ Cattle Movement Survey

Objective of the Study

Pedestrian/ Cattle movements were observed all along the project road where it passes through villages, built-up areas, schools, colleges and religious



places. The predominant flows were observed at the following village locations tabulated in.

Pedestrian/ Cattle Movement Location

Sl. No.	Location	Chainage	Total Count (in 12 Hrs.)
1	Old Palin	75 KM	179
2	Meer	95 KM	126
3	Zero Point	108 KM	92
4	Sangram	118 KM	195

The pedestrian/ cattle movement surveys were carried out at 4 locations and these pedestrian/ cattle flows present a potential problem for the free flow of traffic. The pedestrian/ cattle flows are an important element in the design of intersections also in the vicinity of these areas. The pedestrian counts give justification for planning pedestrian facilities such as subway or signals for pedestrians crossing. The cattle counts give justification for planning of cattle facilities such as CUP.

Methodology

The pedestrian/ cattle movement surveys were conducted at selected locations from morning 8:00 AM to evening 8:00 PM for total 12 hours period. The pedestrian flows were recorded for each 15 minutes interval by counting pedestrian and animals crossing/ parallel the road.

Following tablesError! Reference source not found. gives the peak hours of pedestrian flows and peak volumes of pedestrian crossings of Project Road.

Summary table for the Pedestrian/ Cattle Movement

Sl.No	Location	Chainage (km)	Peak hours	Time		Total Count
1	Old Palin	75 KM	Morning peak	08:00 AM	09:00 AM	40



Sl.No	Location	Chainage (km)	Peak hours	Time		Total Count
			Evening Peak	04:00 PM	05:00 PM	27
2	Meer	95 KM	Morning peak	08:00 AM	09:00 AM	30
			Evening Peak	04:00 PM	05:00 PM	19
3	Zero Point	108 KM	Morning peak	08:00 AM	09:00 AM	21
			Evening Peak	04:00 PM	05:00 PM	15
4	Sangram	118 KM	Morning peak	09:00 AM	10:00 AM	45
			Evening Peak	05:00 PM	06:00 PM	33

The pedestrian vehicular conflict index, which is the product of number of pedestrians crossing the road and square of number of motorized vehicles on the road, which is based on IRC: 103-1988 "Guidelines for Pedestrian Facilities". The code suggests controlled crossing measures for pedestrians, if PV^2 value is more than 1×10^8 for undivided roads and 2×10^8 for divided roads. It is observed that no pedestrian control crossing measures is required presently. Considering safety of pedestrians and animals some basic controlling measures are suggested such as pedestrian marking & speed breaker on approach.

The maximum number of pedestrians crossing the project road, and corresponding average hourly motorized traffic and the estimated pedestrian vehicular conflict for the same period are presented in below.



Pedestrian Facilities

Locations	Peak hour Volume of Pedestrians (P)	Peak hour Volume of Vehicles (V)	PV^2	Need Controlled Crossing for Pedestrians If $PV^2 > 1 \times 10^8$
Old Palin	40	140	0.784×10^6	Only Speed Breakers required controlling the speed.
Meer	30	136	0.555×10^6	
Zero Point	21	85	0.145×10^6	
Sangram	45	81	0.295×10^6	



3 PAVEMENT DESIGN REPORT

3.1 Introduction

Pavement design basically aims at determining the total thickness of the pavement structure as well as the thickness of the individual structural components for carrying the estimated traffic loading throughout design life under the prevailing environmental condition and adopted maintenance strategy with satisfactory performance of the pavement which shall result in higher savings in terms of Vehicle operating costs and travel time. Many design methods, from purely empirical to rigorous analytical ones are available, and these are practiced in different parts of the world. In our country, the generally adopted method of design of flexible pavement is the one recommended in IRC: 37-2012, Guidelines for the Design of Flexible Pavements.

The existing road is of Single Lane configurations. Hence for improvement to 2 Lane with Paved Shoulder, Flexible pavement is proposed.

3.2 Parameters for Design of Pavement.

1. The detailed design of pavement involve the following:
 - i. *design of the new pavement*
 - ii. *design of shoulders.*
2. The design of pavement will primarily based on IRC publications.
3. Pavement is designed shall be for a minimum design period of 15 years. Stage construction is not permissible
4. For the design of pavement, each set of design input has been decided on the basis of rigorous testing and evaluation of its suitability and relevance in respect of in-service performance of the pavement. The design methodology accompany the design proposals and clearly bring out the basic assumptions, values of the various design inputs, rationale behind the selection of the design inputs and the criteria for checking and control during the implementation of works. Design of pavement structure would take due account of the type, characteristics of materials used in the respective courses, variability of their properties and also the reliability of traffic predictions. The methodology adopted for the design of pavement has been in complete with flow charts indicating the various steps in the design process,



their interaction with one another and the input parameter required at each step.

5. The paved shoulders have been designed as integral part of the pavement for the main carriageway. The design requirements for the carriageway pavement have been applicable for the design of shoulder pavements. The design of granular shoulder has been taken into account the drainage considerations besides the structural requirements.
6. The strength of sub-grade in terms of California Bearing Ratio (CBR) is required for the design of new flexible pavement as per IRC: 37-2012. Soil sample was collected throughout the project road so as to determine the CBR value.
7. Base year traffic (vehicle category-wise & in terms of AADT), traffic growth rates, design life (in terms of number of years) and vehicle damage factors are used to estimate the design traffic in terms of equivalent standard axes.

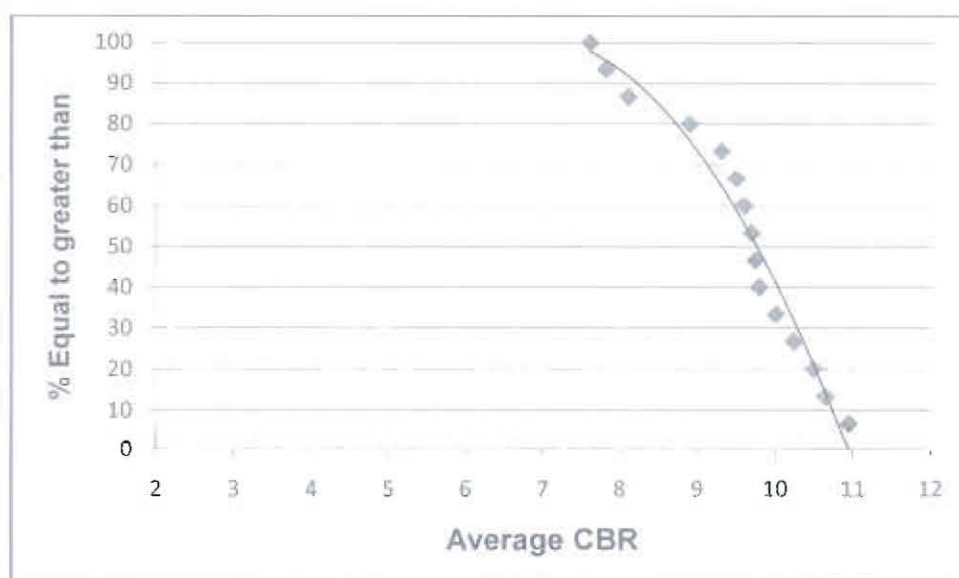
3.3 Strength of Sub grade

The strength of sub-grade in terms of California Bearing Ratio (CBR) is required for the design of new flexible pavement as per IRC: 37-2012. The minimum value of CBR as per Cl. 5.1 of IRC: 37-2012 is 8%. 15 different soil samples were collected from the subgrade and their CBR values were calculated. The CBR values are presented in the table below.

Sl. No.	Sample No.	Chainage (KM)	MDD (gm/cc)	OMC (%)	CBR (%)
1	1	70	1.773	10.536	9.31
2	2	75	1.821	10.109	9.50
3	3	80	1.904	10.872	10.01
4	4	85	1.915	10.510	9.60
5	5	90	1.765	10.870	8.90
6	6	95	1.828	10.777	9.70
7	7	100	1.821	10.817	9.75
8	8	105	1.862	10.168	9.80
9	9	110	1.877	10.046	8.11
10	10	115	1.862	10.590	10.24
11	11	120	1.823	10.896	10.95
12	12	125	1.792	10.671	10.50
13	13	130	1.809	10.217	7.62
14	14	135	1.805	10.556	7.82
15	15	138	1.822	10.046	10.65



The CBR values of a highway vary along a highway alignment. Therefore as per Cl. 5.1.1.2 and Annexure IV of IRC: 37-2012, 90th percentile CBR is recommended as design CBR. Therefore a graph between percentages of values greater than or equal the CBR value versus the CBR values is plotted.



From the Fig above, the design CBR for pavement design is found to be 8.2, which satisfies Cl. 5.1 of IRC: 37-2012.

3.4 Computation of Design Traffic

3.4.1 Evaluation of Design Traffic (MSA) for Pavement Design

Base year traffic (vehicle category-wise & in terms of AADT), traffic growth rates, design life (in terms of number of years) and vehicle damage factors are required to estimate the design traffic in terms of equivalent standard axles. The following data have been considered to arrive at the design traffic (MSA).

The msa calculated is found to be 4.44msa. But as per Cl. 5.4.1 of IRC: 73-2015 a minimum of 20 msa has to be considered for design of pavement.

3.4.2 Initial traffic after construction in terms of no. of commercial vehicles per day

According to clause 4.6.1 of IRC: 37-2012, the design traffic is considered in terms of the cumulative number of standard axles (in the lane carrying maximum traffic) to be carried out during the design life of the road.

$$N = \{365 * [(1 + r)^n - 1] * A * D * F\} / r$$



Where

N = the cumulative number of standard axles to be catered for in the
design in terms of msa (Million standard axle)

A = Initial Traffic, in the year of completion of construction, in terms of
the number of commercial vehicles per day

r = Annual growth rate of commercial vehicles

D = Lane Distribution Factor

n = Design life in year

F = Vehicle damage factor

The construction period of 3 years has been assumed for proposed road and will
be opened to traffic in 2019. Therefore the traffic in the year of completion is
estimated using the formula given in clause 4.6.1 of IRC: 37-2012.

$$A = P \times (1 + r)^x$$

P = Number of commercial vehicles as per last count

x = Number of years between the last count and the year of completion
of construction

x = 2016-2019 = 3 years

The details of MSA calculations are given below

DATA



$$\begin{aligned}
 r &= 0.050 && \text{(clause No.4.2.2) of IRC-37} \\
 x &= 3 && \text{(Years of completion of construction of project)} \\
 P &= 650 && \text{CVPD (from traffic data of the year)} \\
 A &= 650 \times (1 + 0.050)^3 = 752 \\
 D &= 0.5 && \text{(For Two Lane single carriageway vide para 4.5.1 (ii))} \\
 F &= 1.5 && \text{[For traffic volume 150- 1500 CVPD on rolling/ plain area, vide clause 4.4.6 (Table-4.2) of IRC:37]} \\
 n &= 15 && \text{years (as per Clause 4.3.2 of IRC:37)} \\
 N &= \frac{365 \times \left\{ \frac{(1 + 0.050)^{15} - 1}{0.050} \right\} \times 752 \times 1.5 \times 0.5}{0.050} \\
 &= 4.44 \text{ msa}
 \end{aligned}$$

A minimum value of 20 MSA is to be considered as per IRC 73: 2015 for pavement design.

3.5 Proposed Pavement

3.5.1 Pavement Composition

Minimum pavement composition adopted for new pavement/reconstruction of road as below:-

Km 70/000 to km 132/990, Length = 62.99 km

Sl. No.	Description	Minimum Crust Composition of Flexible Pavement for Pavement
1	BC	40 mm
2	DBM	85 mm
3	WMM	250 mm
4	GSB	200 mm
	Total	575 mm

3.5.2 Pavement Components and materials

- The pavement construction materials for sub-base and bituminous surfacing shall conform to the requirements prescribed herein and the MOSRTH/IRC Specifications, unless specified otherwise.
- Since several materials have been adequately serve as component within the pavement structure, such as a sub-base or a base course. Therefore it is kept in view that good engineering practice and product quality



requirements are not set-aside for the sake of effecting cost reductions.

3. Improvement Proposal



3.1 Improvement Scheme

Improvement Scheme of the project road are:

- i) Horizontal sharp curves and bends are duly modified by adopting the radius of curvature as per IRC Specifications. The road is designed for a speed of 40kmph. At obligatory sharp horizontal curves, the design speed has to be restricted to 30 kmph making the radius of curvature as 30m.
- ii) The width of the carriageway is widened to 7.0m throughout the entire length with 1.50m paved shoulder on both sides in open country locations and 1.0 m earthen shoulder on valley side where retaining wall is not provided. In built-up zones the 7.0m carriageway is provided with 1.5 m raised footpath on both the sides.
- iii) Road side CC drains are provided on the hill sides of the alignment.
- iv) At steep hill cutting locations, catch water drains were provided to arrest the rainwaterdestabilising the hill slopes.
- v) 7 Minor Bridges are proposed to be constructed.
- vi) 270 Nos. of Box Culverts are proposed to be constructed.
- vii) The entire road is designed as Flexible Pavement.
- viii) 22 minor junctions are proposed to be developed.
- ix) Retaining Wall, PCC/Stone crated Breast wall are provided for a length of 2004 m and 51286 m.
- x) Road furniture like Road Signs, Markings, Metal Beam Crash Barrier, Guard posts, KM Stones, Hectometre and 5th KM stones etc. are proposed for the road stretch.
- xi) Rumble strips are proposed to be provided before and on valley side of sharp curves.
- xii) The provisions of vetiver grass in the hill slopes for stabilisation are also provided.
- xiii) Pick-up Bus stop are provided at 7 locations (Both Sides)

3.2 Widening of Existing Highway

TheProjectHighwayis design to follow the existing alignment wherever possible.Geometricdeficiencies intheexisting horizontal and vertical profiles has beencorrected as per the



prescribed standards for mountainous/steep terrain.

3.3 Length of Project

Project Corridor under study is a part of National Highway No.713 This NH is from Joram to Koloriang & about 158 km of length. Study stretch starts from km. 70 to km. 138 of NH-713: The start point of the project road is at New Palin after crossing the Palin River Bridge at Existing Km 70+000. The end point of study corridor is located at Dangba Village (Existing Km 138+000). Existing length of the project stretch is about 68km. The design length of the project stretch is 62.990 Km.

3.4 Width of Carriageway

Two- Laning with Hard shoulders with GSB materials shall be undertaken. The paved carriageway shall be 7 (seven) m wide in accordance with the typical cross sections drawings in the Manual.

3.5 Junctions

The project road does not have any major Junctions. 22 No. of minor Junctions are required to be developed. The Details of the Junctions are as below:

Sl.No.	Chainage	Type	Side	Location	Remarks
1	71.100	T	RHS	New Palin	-
2	71.970	T	LHS	New Palin	
3	72.480	Y	RHS	New Palin	
4	73.010	T	RHS	New Palin	
5	73.300	T	RHS	New Palin	
6	76.000	Y	RHS	Old Palin	
7	76.800	Y	RHS	Old Palin	
8	77.280	Y	RHS	Old Palin	
9	77.375	T	LHS	Old Palin	
10	77.525	Y	LHS	Old Palin	
11	86.600	Y	LHS	Meer	
12	91.940	Y	RHS	Meer	



Sl.No.	Chainage	Type	Side	Location	Remarks
13	92.800	Y	LHS	Meer	
14	93.630	Y	LHS	Meer	
15	100.600	Y	RHS	Poungong	
16	107.950	Y	RHS	Zero Point	
17	108.500	Y	LHS	Zero Point	
18	110.000	Y	RHS	Zero Point	
19	111.560	Y	RHS	Sangram	
20	114.300	T	LHS	Sangram	
21	115.780	Y	RHS	Sangram	
22	127.400	Y	LHS	Tagum Village	

3.6 Road Side Furniture:

Road side Furniture are proposed to be provided as follows: -

1. Traffic Signs and Pavement Markings: Traffic signs and pavement markings includes road side signs, overhead signs, curve mounted signs and road marking along the project highway.
2. Concrete Crash Barrier, Metal beam crash barrier, Separators (MS railings)
3. The minimum length of 1.10 km Metal beam crash barrier, and minimum length of 13.115 km Separator (M.S. railings) all along built up area is proposed for safety of traffic & users.
4. Boundary Stones are proposed throughout the project road on both sides Hectometer / Kilometer Stones.
5. Traffic solar blinker signals (L.E.D) are proposed at all intersections in consultation with Authority's Engineer.
6. Advertisement and Hoardings: No advertisements / hoardings are allowed to be erected on Project Highway.

3.7 Pedestrian Facilities

The additional pedestrians' facilities in the form of guard rails, footpath, lighting etc. are proposed in built-up area and high embankment of structures.



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3.8 Landscaping and Tree Plantation

Landscaping of the highway is proposed.

3.9 Bus- Bays and Bus Shelter

The bus bays and bus shelters shall be provided at following locations of proposed road of the hilly terrain, where there is a general constraint on space, the layout indicated in Fig: 12.3 of the manual may be adopted.

Sl. No.	CHAINAGE		SIDE	LOCATION
	START	END		
1	72111	72170	LHS	Palin
2	72173	72232	RHS	Palin
3	76125	76184	LHS	Old Palin
4	76230	76289	RHS	Old Palin
5	93465	93524	RHS	Meer
6	93568	93627	LHS	Meer
7	108372	108431	LHS	Zero Point
8	108452	108511	RHS	Zero Point
9	115200	115259	RHS	Sangram
10	115258	115317	LHS	Sangram
11	121700	121759	RHS	Gante
12	121760	121819	LHS	Gante
13	129522	129581	LHS	Lill
14	129619	129678	LHS	Lill

3.10 Others

1. Slope protection

For hill slope protection, PCC and Stone crated breast walls are proposed. Vetiver plantations are proposed above the breast walls where the height of slope is more than 10 m.

3.11 Land Acquisition (in Hect.):

Land acquisition is required as the project road cannot be suitably developed within available existing land width.

